Consumers' Willingness to Pay for Reprocessed Fried Chicken: A Way of Reducing Uneaten Food

Abstract

Substantial food loss and waste occur worldwide; approximately one third of produced food is lost or wasted annually, which worsens problems such as starvation and environmental degradation. This study examines the possibility of selling reprocessed meat products made from raw meat near its sell-by date, using Japanese fried chicken as an example. If reprocessed products are accepted by consumers, this will significantly contribute to reducing food waste in grocery stores. Because reprocessing does not require a reduction in current meat consumption, selling reprocessed foods is a more feasible and realistic way to reduce food waste compared to other initiatives, such as "Meat Free Monday." We use a choice experiment to elicit consumer preference for reprocessed fried chicken. Our results show that the willingness to pay for reprocessed fried chicken is above 90% of that of regular chicken, which implies a high feasibility of selling such products.

Keywords

Reprocessed food; food waste; food loss; choice experiment; fried chicken; eco-labeling

1. Introduction

As a large amount of uneaten food is discarded worldwide (Stancu, Haugaard, & Lähteenmäki, 2016), Gustavsson, Cederberg, Sonesson, Van Otterdijk, and Meybeck (2011) point out that approximately 1.3 billion tons of food (i.e., one-third of the current global production) is lost or wasted annually at some stage between farm and table. The main reasons for food loss and waste differ by country. In developing countries, where people tend to suffer from food shortages, large amounts of food are not consumed due to loss during post-harvest storage and use of poor means of transportation (e.g., worm infestation and insufficient air conditioning), as well as loss during processing (Food and Agriculture Organization of the United Nations (FAO), 2007; Parfitt, Barthel, & Macnaughton, 2010). On the other hand, in developed countries, where people have more than enough food, one of the main reasons for discarding food is an excess provision, and substantial food loss or waste occur in the distribution and consumption stages (Kummu et al., 2012). For example, the amount of food discarded in the US and EU was 188 kg (in 2008) and 179 kg (in 2006) per capita per year, respectively (Buzby & Hyman, 2012; Monier, Escalon, & O'Connor, 2011). In fact, Kreutzberger and Thurn (2011) show that almost half of all food is wasted in developed countries.

Japan is no exception. The amount of general food waste from food-related business activities

was 150 kg per capita per year (including edible parts at 26 kg per capita per year) in 2012 (Ministry of Agriculture, Forestry and Fisheries of Japan (MAFF), 2015a). When comparing food supply with the intake, protein loss amounted to 15% in 2012 (Liu et al., 2016). What makes the Japanese situation worse is an unfavorable business practice called the “one-third rule,” which is often observed in food distribution industries. This practice consists of the following two parts: 1) grocery stores do not accept processed food products if the remaining period until their use-by date[1] is less than “two-thirds” of the period between production and this use-by date, and 2) grocery stores return products when the rest of the period is “one-third” of the period between production and the use-by date. Under this unfavorable societal rule, Japanese manufacturers discard large amounts of returned food that is still edible. Such activities have diminished recently under governmental incentives, but continue to be observed because the most important information for Japanese consumers is the use-by date, and the application of the one-third rule is in line with such consumer attitudes (Matsumoto, 2004; Schroeder, Tonsor, Mintert, & Pennings, 2007). Although the one-third rule is applied only to

[1] Either the “best-before date” or “use-by date” is shown on most products sold in Japan, based on relevant laws and supplementary guidelines. Here, the best-before date indicates the period during which product quality is maintained when preserved accordingly, and is applied to products with a longer shelf life, such as canned and snack foods. The use-by date indicates the period during which food product safety is maintained when preserved accordingly, and is applied to products that spoil easily, such as boxed lunches and delicatessen foods.

51 processed food products, other foods, including raw ones, are treated similarly.

52

53 When considering issues related to discarded food, such as starvation (Godfray et al., 2010;
54 Kummu et al., 2012), as well as the environmental and economic impacts in the associated food
55 chain (FAO, 2013; Perry, James, & LeRoux, 2015), the reduction of discarded food could be a
56 key solution for global food security (Kummu et al., 2012; Mena, Adenso-Diaz, & Yurt, 2011;
57 Stancu et al., 2016). One promising solution currently applied is recycling food waste and food
58 near its sell-by date. However, recycling is an inferior solution compared with direct human
59 consumption. As such, we should prioritize the reprocessing of food waste for human use
60 (European Commission, 2008a; Papargyropoulou, Lozano, Steinberger, Wright, & Ujang, 2014).
61 To do so, we need to stop applying the one-third rule and similar customs to processed food and
62 other foods products, and utilize food near its sell-by date in a more efficient manner.

63

64 In this study, we focus on raw chicken near its sell-by date in grocery stores because, among
65 discarded foods, reducing the loss and waste of meat could have one of the largest impacts,
66 since grain equaling several times the weight of the animal is used in the fattening processes
67 (Smil, 2002). We normally observe that Japanese grocery stores sell fried chicken, called
68 *Kara-age*, a ready-to-eat food. It is often the case that unsold raw meat is discarded at grocery

stores when the sell-by date draws near or is reached. Thus, we assume that some grocery stores start selling *Kara-age* made from raw chicken near its sell-by date. By doing this, they can reduce food waste and even increase revenue under certain conditions (see Section 3.4). We use a choice experiment (CE) to elicit consumer preferences for reprocessed *Kara-age*, assuming that Japanese consumers will value reprocessed foods if they are sold in grocery stores. Our assumption is based on the fact that Japanese consumers are somewhat skeptical about food quality, since a series of food poisoning and food fraud incidents has been revealed, especially after the 2000s (Finkelstein, 2005; Hall, 2010; Tanimura & Okamoto, 2013).

When we ask about consumers' willingness to pay (WTP) for reprocessed *Kara-age*, we show a label to subjects indicating that products are reprocessed (for further details, see Section 3.1 and Figure 2). This label can be classified as a variant of an eco-label, because reprocessed food reduces the amount of food waste. However, our label differs from regular eco-labels in that it may reduce the value of products, while products with eco-labels normally enjoy price premiums. Therefore, a label on reprocessed *Kara-age* can be seen as a "negative" eco-label. From this perspective, the aim of this study can be rephrased as follows: we verify whether reprocessed products with "negative" eco-labels retain enough value for sale.

2. Background and Literature Review

2.1. Background

Fried chicken is one of the most popular meat-based products worldwide. Recently, the Japanese equivalent (*Kara-age*) has been introduced onto Western markets (Leroy & Degreef, 2015). Mostly bite-sized pieces of fresh raw chicken thigh are processed into *Kara-age*, which is floured prior to deep-frying (Barbut, 2012; Nam, Jo, & Lee, 2010). It is generally believed that processors, including grocery stores, use fresh raw chicken to make *Kara-age*. On the other hand, we assume that some grocery stores start selling *Kara-age* made from raw chicken near its sell-by date, which has been on store shelves for some time, thus reducing food waste. Currently, to the best of our knowledge, there is no official statement from Japanese food companies or official documents from (local) governments with real life examples of utilizing unsold raw meat near its sell-by date as material for *Kara-age*. Although Japanese examples are limited, the reprocessing of raw chicken is not an unlikely notion; in Japan, it is not prohibited, according to relevant laws, to sell *Kara-age* from reprocessed raw chicken that has been on a store shelf and is near its use-by date (this was confirmed via personal communication with an expert of the Hokkaido government's division of health and welfare, and applies throughout Japan). Therefore, grocery stores can start selling reprocessed *Kara-age* without requiring any changes in the current, relevant Japanese laws.

A grocery store sets both the sell-by and use-by dates for fresh, packed meat (Figure 1). Before starting the production of reprocessed *Kara-age*, packed raw meat is discounted when the sell-by date draws near, and the unsold meat is discarded once the sell-by date arrives. After starting the production of reprocessed *Kara-age*, the store produces reprocessed *Kara-age* from unsold raw poultry. Then, the sell-by and use-by dates of reprocessed *Kara-age* are newly set. According to the law, these dates can be the same as those for regular *Kara-age*.

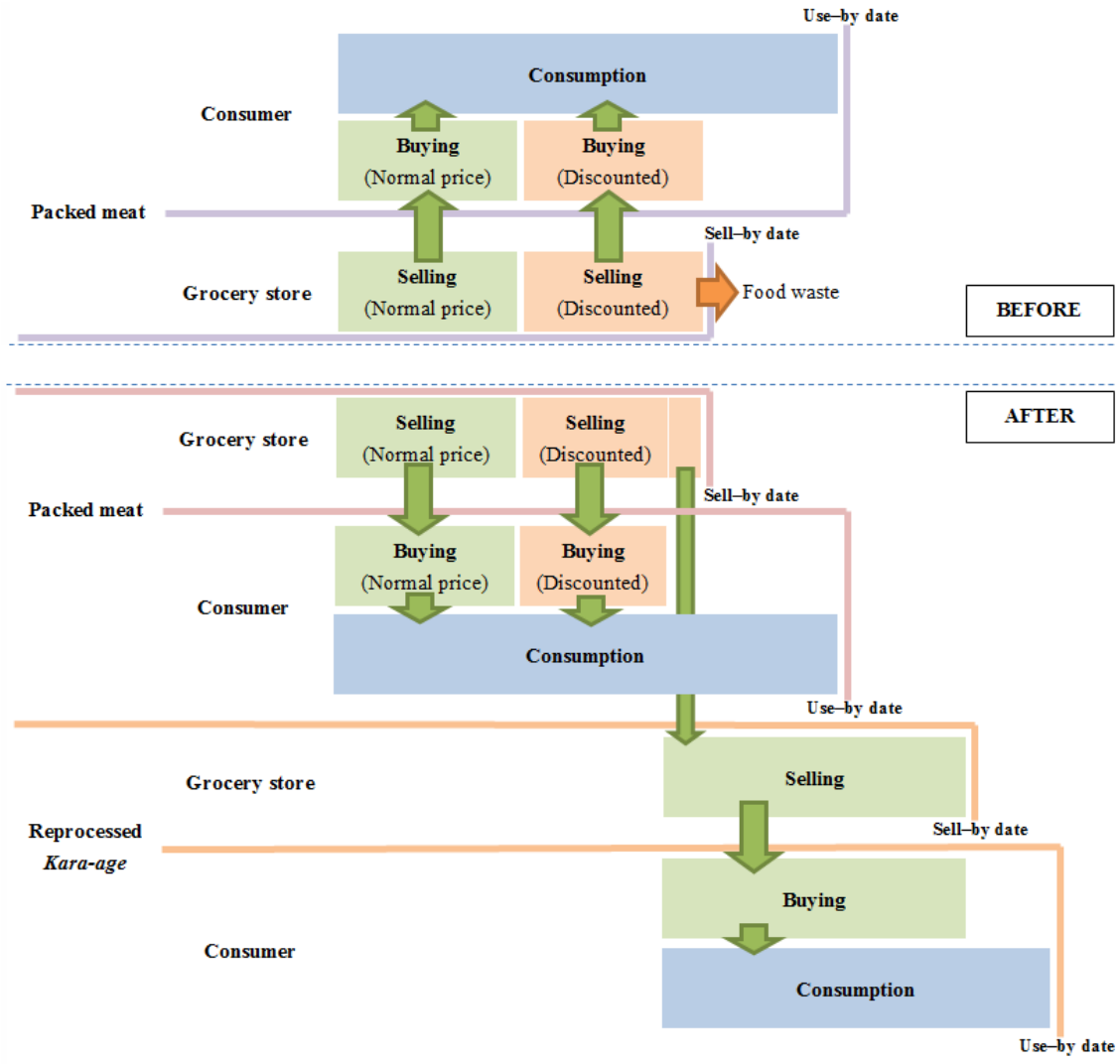

Figure 1. Graphic representation of current status and hypothetical installation

Notes: Before our proposed system for reprocessing on-shelf packed meat, unsold packed meat was discarded at the sell-by date. After introducing the proposed system, unsold packed chicken is processed into *Kara-age* and sold at grocery stores. Both the sell-by and use-by dates of reprocessed *Kara-age* are newly set.

2.2. Related previous studies and superiority of reprocessed foods

The so-called 3Rs (reduce, reuse, and recycle) are applicable to food waste management. The EU Waste Framework Directive (European Commission, 2008b) proposed a food waste

hierarchy that ranks “prevention” (reduce) as the favored method, followed by “reuse” and “recycle” to prevent food waste/loss. Although prevention is the most favorable of the 3Rs, occasionally, it is not economically or technologically feasible, and it is often used last in practice (Mourad, 2016; Vandermeersch, Alvarenga, Ragaert, & Dewulf, 2014). On the other hand, although recycling is the least favored among these three choices, it is often the most applicable and promoted (Mourad, 2016). In fact, food waste recycling is hitherto a dominant research topic (Bernstad, La Cour Jansen, & Aspegren, 2013; Huang, Wang, Dai, Li, & Harder, 2014; Karousakis & Birol, 2008; zu Ermgassen, Phalan, Green, & Balmford, 2016). As such, the Japanese government has been promoting the utilization of food waste as “eco-feed” for domestic animals (Liu et al., 2016; Takata et al., 2012). However, when considering the food waste hierarchy, reusing food near its sell-by date should be emphasized, including the reprocessing of raw chicken examined in this study. Existing studies treat the reuse of food in different stages of the food supply chain. For example, Ceppa and Marino (2012) examine the reuse of pre-production waste in other industries, while Baglioni, Pieri, and Tallarico (2016) analyze the role of non-profit organizations involved in surplus food recovery. Nonetheless, the number of studies dealing with reuse for human consumption is still limited. The current discussion on how to promote the reuse of food near its sell-by date for human consumption deals with the use of surplus foods through food banks and other means (e.g., Mourad, 2016).

142 Liu et al. (2016) examine food waste in Japan and reveal there is room for improvement, but
143 they do not target reprocessed and reworked food. Note that, in this study, we distinguish
144 between “reprocessed” and “reworked” foods, as “those produced from products once put on a
145 shelf” and “those produced from an unused portion of contents during processing,” respectively.
146
147 As demonstrated in this section, reprocessed foods, as one promising new category of reuse
148 activities, should be emphasized because other approaches, such as food provision for hungry
149 people, are less versatile. The number of studies treating reprocessed or reworked food is still
150 limited. Those concerning the reworking of raw scrap materials (unused portions) include
151 Dušková et al. (2015), who examine contamination issues, and Taylor et al. (2006), who review
152 rework practices related to allergens. A limited number of studies consider reprocessed meat
153 products. For instance, Daskalov, Momfre, and Sofos (2006) provide an example from the US
154 by examining *L. monocytogenes* in sausages made from “sausages not sold before the expiration
155 date, or sausages with some defects” (p. 982). Compared with the abovementioned studies, the
156 present study is unique in the following aspects. First, Taylor et al. (2006) and Dušková et al.
157 (2015) deal with raw scrap materials (reworked foods), while our study deals with raw materials
158 on store shelves near their sell-by date. Second, these three previous studies concern hygiene
159 issues, such as bacterial contaminations, which is less severe for the products covered in our

160 study, because raw chicken is deep-fried in the production process of *Kara-age*. In other words,
161 previous studies focus on the hygiene of reworked or reprocessed materials, while we concern
162 the acceptance of reprocessed products, which may incur a negative image for consumers
163 because such raw materials are on store shelves until near their sell-by dates.
164
165 **3. Materials and Methods**
166 **3.1. Choice experimental design**
167 We obtained data for our investigation using a questionnaire, in which we explained there is no
168 Japanese law restricting the reprocessing of raw meat for sale on a shelf into processed goods.
169 We assume a typical grocery store (hereafter, “Grocery Store A”) starts selling reprocessed
170 *Kara-age*. Whereas before unsold raw chicken was discarded when the sell-by date drew closer,
171 now, Grocery Store A decides to reprocess raw chicken into fried chicken or *Kara-age* for sale.
172 To distinguish reprocessed from regular *Kara-age*, we assume that Grocery Store A places a
173 label (a hexagonal-shaped blue label as per Figure 2) on reprocessed *Kara-age* packages. Finally,
174 we assume that both the appearance and taste of reprocessed and regular *Kara-age* are
175 indistinguishable.
176

	Regular *Kara-age*	Reprocessed *Kara-age*	No buy
Price per 100 g	JPY 158	JPY 126	
Ingredients	Fresh raw chicken	Unsold raw chicken near sell-by date 	
Country of origin	Domestic	Foreign (US)	
Processing date and time	6 o'clock this morning	12 o'clock this morning	
Use-by date and time	6 o'clock tomorrow morning (15 hours left)	12 o'clock tomorrow morning (21 hours left)	

Figure 2. Example of choice set for choice experiment

Notes: Each subject is asked to select one of three alternatives ("regular *Kara-age*," "reprocessed *Kara-age*," or "no buy") by consulting five attributes ("price per 100 g," "ingredients," "country of origin," "processing date and time," and "use-by date and time"). The Chinese characters inside the blue label mean "reprocessed products." We set a "use-by date and time" of 24 hours after the "processing date and time" (i.e., the time within which unsold raw chicken is processed into *Kara-age*). We ask subjects to assume that the current time (i.e., when they actually answer the question) is 3 pm.

In our CE, there are three alternatives, called "profiles," in the choice set (Figure 2). We adopt a "labeled type" choice set (Hensher, Rose, & Green 2005), which means that we fix the first, second, and third alternatives as "regular *Kara-age*" (i.e., made from fresh raw chicken), "reprocessed *Kara-age*" (i.e., made from unsold raw chicken near its sell-by date), and "no buy." Subjects are asked to select one. We include the no-buy alternative because previous studies suggest that its absence may lead to biased results (Dhar & Simonson, 2003).

194 There are five attributes for the first and second alternatives, as shown in Figure 2. However,
195 there are only three effective attributes: “price per 100 g,” “country of origin,” and “processing
196 date and time” (Table 1; for details, see Appendix A). In grocery stores, both domestic and
197 foreign chicken is processed into *Kara-age* and sold. Therefore, in our experiment, we clearly
198 state the country of origin (domestic or foreign (US)). Finally, we provide the processing date
199 and time, and ask subjects to assume that the current time (i.e., when respondents actually
200 answer the question) is 3 pm. There are 48 profiles for the first and second alternatives. We
201 develop 24 choice sets based on the orthogonal array design. These 24 choice sets are divided
202 into six groups with four choice sets in each group. Therefore, each respondent replies to four
203 choice sets (see Appendix A).

204

205 **Table 1. Attributes and levels used in the choice experiment**

Attribute	Level
Price per 100 g	Regular *Kara-age*: JPY 78, 98, 128, 158, 198, and 228 per 100 g Reprocessed *Kara-age*: JPY 62, 78, 102, 126, 158, and 182 per 100 g
Country of origin	Domestic or foreign (US)
Processing date and time	6 am, 8 am, 10 am, or 12 pm on the purchasing day

206 Note: We set different price levels for regular and reprocessed *Kara-age*, while those for
207 country of origin and processing date and time are common for both types of *Kara-age*. JPY 1 =
208 USD 0.009 (2014 exchange rate).

209

210 **3.2. Data**

We select citizens throughout Japan as our population. Moreover, we use a professional web research company for gathering data, and those registered as monitors at this company are randomly selected as subjects, with a total of 44,000 candidates from the entire Japan at the date of our questionnaire. The sample sizes for the pre-survey and main survey were 96 and 900, respectively. Because subjects are asked to answer each question completely before proceeding to the next one, there are no invalid answers. The pre-survey and main survey were conducted in February and March 2014, respectively. We use data from both surveys because the pre-survey is conducted successfully, and we did not modify questions for the main survey. Therefore, the sample size is 996. Because each subject repeats the choice tasks four times, the number of observations in the choice experiment is 3,984. Table 2 shows the descriptive statistics for all subjects.

Table 2. Descriptive statistics of subjects

Variable		**Frequency**	**Percentage (%)**
Age			
	20–24	19	1.9
	25–29	61	6.1
	30–34	97	9.7
	35–39	140	14.1
	40–44	163	16.4
	45–49	134	13.5
	50–54	123	12.3
	55–59	93	9.3
	60+	166	16.7

Gender		
Male	626	62.9
Female	370	37.1
Household annual income		
< JPY 2,000,000	89	8.9
JPY 2,000,000–3,990,000	243	24.4
JPY 4,000,000–5,990,000	259	26.0
JPY 6,000,000–7,990,000	176	17.7
JPY 8,000,000–9,990,000	114	11.4
JPY 10,000,000–11,990,000	45	4.5
JPY 12,000,000–13,990,000	26	2.6
> JPY 14,000,000	44	4.4
Marital status		
Married	648	65.1
Single	348	34.9
Sample size	996	

3.3. Econometric model

We analyze the collected data using a random parameter logit model (Revelt & Train, 1998). We develop two models: the main effect model (excluding variables concerning subjects' individual characteristics) and a model with interactions (including variables concerning subjects' individual characteristics). In the main text, we refer only to the former model (see Appendices B.1 and B.2. for details on the latter). The explanatory variables are presented in Table 3. $PRICE$ is the unit price of *Kara-age*, $DOMESTIC$ a dummy variable indicating the country of origin, and $TIME$ the period elapsing between the processing and current times. $ASC(N)$ and $ASC(R)$ are dummy variables that capture all other effects not captured by the other three

explanatory variables described above.

Table 3. Estimation variables

Variable	Definition
$PRICE$	unit price for *Kara-age*
$DOMESTIC$	1 if domestic raw chicken is used for *Kara-age*, and 0 otherwise
$TIME$	period elapsed between processing time and current time (3 pm)
$ASC(N)$	1 if the option is regular *Kara-age*, and 0 otherwise
$ASC(R)$	1 if the option is reprocessed *Kara-age*, and 0 otherwise

By calculating $-\frac{coefficient\ of\ ASC(N)}{coefficient\ of\ PRICE}$, we obtain the WTP for regular *Kara-age* made from foreign (US) raw chicken. Similarly, by calculating $-\frac{coefficient\ of\ ASC(N)}{coefficient\ of\ PRICE} - \frac{coefficient\ of\ DOMESTIC}{coefficient\ of\ PRICE}$, we obtain the WTP for regular *Kara-age* made from domestic raw chicken. For details, see Appendix B.3.

3.4. Conditions for shelf packed meat to be profitable

Here, we identify the conditions for unsold shelf packed meat to be profitable when sold as reprocessed *Kara-age*. For simplicity, we assume processing costs for both regular and reprocessed *Kara-age* to be JPY *c*, regardless of the origin of the chicken (domestic or foreign). We denote the unit retail price of packed meat (100 g) as JPY x^i (i = domestic, foreign). Moreover, we assume that the prevailing price of regular *Kara-age* is the same as its

corresponding WTP, denoted as WTP^{iN}. We also assume that the following equation holds: $WTP^{iN} = c + x^i$. Let the unit retail price of packed meat near its sell-by date be denoted as JPY n % x^i ($0 < n < 100$). Finally, we denote the WTP for reprocessed *Kara-age* as WTP^{iR}.

Then, we obtain the following two conditions.

Condition 1 (packed meat near its sell-by date):

Sales of the reprocessed *Kara-age* are profitable if $WTP^{iR} - \{WTP^{iN} - x^i\} > n\ \% \ x^i$.

Condition 2 (unsold packed meat):

If processors use unsold packed meat for reprocessed *Kara-age*, because the opportunity cost is 0 ($n\ \% \ x^i = 0$), sales of reprocessed *Kara-age* would be profitable as long as $WTP^{iR} - \{WTP^{iN} - x^i\} > 0$.

4. Results

4.1. Estimation results

The results of the main effect model are shown in Table 4 (see Appendix C for the results and a brief discussion of the model with interactions). The p-values of all coefficients of means and standard deviations are statistically significant, except for the mean of $TIME$. All significant

variables satisfy the expected sign conditions. The signs of the coefficients of $ASC(N)$ and $ASC(R)$ are positive, indicating that consumers evaluate positively both regular and reprocessed *Kara-age* made from foreign raw chicken. Additionally, the sign of the coefficient of $PRICE$ is negative, implying that the law of demand is satisfied. Further, the sign of the coefficient of $DOMESTIC$ is positive, suggesting that domestic raw chicken is preferred to foreign. Because, in 2014, the retail price of domestic packed meat was around JPY 132–133 per 100 g (Ministry of Internal Affairs and Communications (MIC), 2015) and that of foreign packed chicken was estimated as JPY 94 (see Appendix D), our result reflects the real situation appropriately.

Table 4. Results of main effect model

Variable	Mean (Median)	p-value	Std. dev.	p-value
$ASC(N)$	4.223	0.000	2.943	0.000
$ASC(R)$	3.871	0.000	3.031	0.000
$PRICE$	-0.022	0.000		
$DOMESTIC$	0.672	0.000	1.750	0.000
$TIME$	0.019	0.468	0.519	0.000
Log-likelihood	-3008.6			
AIC	6,035.2			

Notes: AIC = Akaike's information criterion. The variable definitions are as per Table 3. We assume ASCs, $DOMESTIC$, and $TIME$ to be random parameters, whereas $PRICE$ is a fixed parameter. We specify random parameters as normally distributed in the estimation. We apply simulated likelihood estimation to obtain parameter estimates (Probst, Houedjofonon, Ayerakwa, & Haas, 2012; Train, 2009). The coefficients of means (medians) are reported for all parameters and are statistically significant, except for the mean of $TIME$, while the coefficients of standard deviations are reported for random parameters and are all statistically significant.

285

286 The WTP estimation results are tabulated in Table 5 and are valid because of the following
287 reasons. First, the WTP is higher than the market prices of *Kara-age* and retail raw meat. The
288 WTP for regular domestic *Kara-age* is above the average price of *Kara-age* in big cities (JPY
289 175 per 100 g in 2014; cities with prefectural governments and cities with populations of
290 150,000 or more; MIC, 2015). The WTP for regular foreign (US) *Kara-age* is substantially
291 higher than the estimated retail price of US packed chicken (JPY 94 per 100 g; see Appendix D).
292 Second, the WTP for regular *Kara-age* is higher than that for reprocessed *Kara-age*, as
293 expected.

294

295 **Table 5. Estimated WTP for *Kara-age* (main effect model; units = JPY/100 g)**

	Regular foreign	**Reprocessed foreign**	**Regular domestic**	**Reprocessed domestic**
Mean (Median)	185	170	215	199

296 Note: WTP is calculated based on the procedure explained in Section 3.3 (see also Equations (4)
297 and (5) in Appendix B).

298

299 **4.2. Profitability of unsold packed meat**

300 First, Condition 2 in Section 3.4 is satisfied in the case of domestic raw chicken. As the retail
301 price of domestic packed meat in 2014 was around JPY 132–133 per 100 g (MIC, 2015), 199
302 (WTP for reprocessed domestic) - (215 (WTP for regular domestic) - 132) = JPY 116 (> 0),
303 which makes *Kara-age* made from unsold packed profitable.

304

305 Next, let us examine if Condition 1 is satisfied in the case of domestic raw chicken. If the retail
306 price of packed meat is discounted and decreases below JPY 116, it is profitable to sell
307 reprocessed *Kara-age* rather than discounted packed meat. If we apply a discount rate of more
308 than 20%, which is often observed in reality, the introduction of reprocessed *Kara-age* would
309 increase the revenue of grocery stores. Similar calculations also hold for foreign raw chicken.
310 As the retail price of foreign packed chicken in 2014 is estimated as JPY 94 per 100 g (see
311 Appendix D), 170 (WTP for reprocessed foreign) - (185 (WTP for regular foreign) - 94) = JPY
312 79 (> 0), which makes reprocessed *Kara-age* from packed foreign meat also profitable.

313

314 **5. Discussion and Conclusion**

315 In this study, we examined the possibility of selling reprocessed *Kara-age* as one promising
316 method for reducing food waste in Japan. We suspect that Japanese consumers resist
317 reprocessed products because, particularly in recent years, they have repeatedly faced food
318 poisoning and food fraud incidents (Finkelstein, 2005; Hall, 2010; Tanimura & Okamoto, 2013).
319 However, our results show that the WTP for reprocessed domestic and foreign *Kara-age* is
320 92.8% and 91.7% of the prices of regular *Kara-age*, respectively, and, thus, we may state that
321 selling reprocessed *Kara-age* is feasible. As pointed out in the Introduction, the label placed on

322 a package of reprocessed *Kara-age* can be regarded as a variant of an eco-label. Our label is the
323 same as a regular one, in that it implies a product is more environmentally friendly, but different,
324 in that it would incur negative consumer acceptance, which might result from consumer
325 concerns about food safety. Our results provide evidence to confirm this assertion because the
326 WTP for reprocessed is less than that of regular *Kara-age*. At the same time, our "negative"
327 eco-label is still economically sound because reprocessed *Kara-age* enjoys more than 90% of
328 the WTP of regular *Kara-age*, which makes it profitable. We can also assert reprocessed
329 *Kara-age* is profitable because the conditions provided in Section 4.2 are satisfied. Overall,
330 reprocessed *Kara-age* is a realistic and promising initiative for reducing food waste.
331
332 Next, we examine the reasons why respondents showed relatively high WTP for reprocessed
333 *Kara-age*. First, we consider respondents' expected percentage of reprocessed products among
334 prepared foods, which amounts to 28.8% (Table B.1. in Appendix B). Although, to the best of
335 our knowledge, reprocessed products, including *Kara-age*, are not currently prevalent on the
336 Japanese market, our results suggest that consumers suspect the existence of reprocessed
337 products, and some would accept such products if producers proclaim them as such. It would be
338 better for consumers to be informed the products they are about to buy are reprocessed and they
339 can purchase them at discounted prices (e.g., a 10% discount), rather than purchasing them at

regular prices without knowing they are reprocessed. Therefore, it is reasonable for consumers to reveal relatively high WTP for reprocessed *Kara-age*. Second, respondents showed relatively high WTP for reprocessed *Kara-age* because it is legal, and the sell-by and use-by dates could be the same as those for regular *Kara-age* (see Section 2.1), with the only factor diminishing the price of reprocessed *Kara-age* being its acceptance (negative image). In the questionnaire, we provided no information that implies reprocessed *Kara-age* is less valuable than regular *Kara-age*. Rather, we clearly stated, for example, that both the appearance and taste of reprocessed and regular *Kara-age* are indistinguishable. Therefore, if some consumers willing to buy reprocessed *Kara-age* find it important to buy such products to reduce food waste, they would reveal a relatively high WTP. In other words, they would evaluate our label positively, similarly to a regular eco-label, probably because any negative image is canceled out or exceeded by a positive image, such as the environmental friendliness of reprocessed *Kara-age*. In fact, existing studies show consumers pay price premiums for labels concerning environmentally friendliness (Lombardi, Berni, & Rocchi, 2017; Salladarré, Brécard, Lucas, & Ollivier, 2016; Schmit, Rikard, & Taber, 2013). Third, although this is seemingly contradictory behavior, once reprocessed products are sold in grocery stores, Japanese consumers would believe that such products are safe because they are on sale, meaning they comply with related laws and regulations for food safety (Jin & Zhou, 2014; Mangen, De Wit, & Havelaar, 2007).

358 Our estimation results may support such an assertion, since the coefficient of the $TIME$
359 variable is not statistically significant, which suggests that consumers pay little attention to the
360 period elapsed between processing and purchasing times, probably because since products are
361 sold, safety is confirmed under related laws and regulations.
362
363 There are some advantages of the proposed system compared to existing initiatives because it
364 includes a frying process. First, associated hygiene issues are less severe compared to reworked
365 or reprocessed products treated in previous studies such as Daskalov et al. (2006) and Dušková
366 et al. (2015), as mentioned in Section 2.2. Second, our proposal is more attractive than simply
367 discounting unsold chicken, because discounts may not guarantee the sale of the chicken, while
368 our initiative can reset the sell-by and/or use-by dates, which extends the consumption period
369 and provides more opportunity for human consumption (see Figure 1). In addition to these
370 advantages, we point out the following policy implications. For the successful implementation
371 of food waste reduction, the feasibility of the method is an important factor. Compared with
372 activities such as “Meat Free Monday,” an initiative to reduce carbon dioxide emissions through
373 the reduction of current meat consumption, we propose a method that does not require any
374 reduction of current meat consumption and would attain greater feasibility. Moreover, the
375 circulation of reprocessed *Kara-age* may improve consumers’ awareness toward food loss/waste

issues and evolve into a significant force to change notorious practices, such as the one-third rule.

The application of our initiative is not limited to the Japanese market. Given the spread of home-meal replacements worldwide, a variety of unsold foods, not limited to meat and poultry, could be reprocessed (e.g., seafood for frying). Moreover, as long as the conditions specified in Section 3.4 are satisfied, our proposal is applicable to overseas grocery stores. Because fried chicken is one of the most popular products worldwide and our proposed system is applicable to a variety of fried foods, we believe similar activities are feasible in numerous other countries. In countries in which food banks and second harvests are popular activities, individuals would more willingly accept reprocessed foods. However, there are cases where our initiative is not feasible. If individuals are skeptical about the safety of reprocessed products and/or such products are not legal, our proposed system is not applicable. If food regulations are less strict and/or individuals suffer more often from food fraud incidents, the WTP for reprocessed fried products may be too low to warrant their circulation.

In conclusion, by applying the choice experiment, we showed reprocessed *Kara-age* is currently a feasible initiative in Japan. We hope that the increased use of reprocessed foods will be a

394 significant facilitator of food waste reduction, and will contribute to improving both food safety
395 and security worldwide.
396
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403
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