Who Benefits from Details? The Effects of Green Tea Packaging Information Design on Perceived Quality and the Moderating Roles of Subjective Knowledge and QR Code Usage

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Abstract

This study investigates how information design on green tea leaf packaging affects consumers' perceived quality, focusing on the moderating roles of subjective knowledge (SK) and QR code use. In Japan, the shift from specialty stores to supermarkets has reduced opportunities for consumer education, making packaging a critical information source. Using conjoint analysis with 600 consumers, we tested four attributes (aroma, brewing instructions, award, and authenticity) across nine orthogonal profiles. Illustrations of aroma increased perceived quality, while QR codes with detailed aroma or brewing instructions reduced it compared with on-package information. Award information consistently enhanced perceived quality, whereas authenticity cues showed limited influence. Higher SK lessened the negative

impact of QR codes, allowing knowledgeable consumers to interpret detailed cues more positively. QR codes raised perceived quality only among consumers who scanned them, though fewer than 35% did so. The findings highlight how packaging can balance clarity and depth, offering guidance for agrifood marketing

Keywords: package design; green tea; perceived quality; conjoint analysis

1. Introduction

This study aims to examine the relationship between information design on packaging and consumers' perceived quality of green tea leaves, with particular attention to the moderating roles of consumers' subjective knowledge (SK) and QR code use. Green tea leaves require consumers to possess product knowledge to achieve a richer consumption experience, similar to other knowledge-intensive products such as wine, cheese, and olive oil.

Tea is one of the most popular beverages worldwide, and green tea is widely consumed in Asia, particularly in Japan (Shinozaki & Harada, 2014). In the Japanese green tea market, substantial changes have taken place in consumer behavior and distribution channels. The green tea market can be broadly categorized into pot-brewed green tea and bottled green tea. In 2004, annual household spending on tea beverages overtook that of green tea leaves (Ministry of Internal Affairs and Communications Statistics Bureau of Japan, 2009), marking a dramatic structural shift. The transition from pot-brewed to bottled green tea is closely tied to a transformation in retail channels, particularly the decline in tea specialty stores. The number of tea specialty stores peaked at 15,069 in 1982 and subsequently declined, reaching 6,381 in 2014 (Ministry of Economy, Trade and Industry, 2009; 2016). As of 2020, 76.1% of regular tea leaf purchases were made at supermarkets, followed by 24.6% at tea specialty stores (Ministry of Agriculture, Forestry and Fisheries, 2021). Tea specialty stores not only distribute tea products from farmers to consumers but also transfer knowledge about tea (e.g., what constitutes valuable tea leaves). Changes in the status and connections of production units (e.g., tea farmers, tea specialty stores, and consumers) affect the creation, maintenance, and transfer of knowledge (Argote et al., 2003; Cattani et al., 2013). While specialty stores provide professional staff who educate consumers about tea leaves and assist in their purchases, consumers are less likely to accumulate knowledge about green tea through their purchasing experiences in supermarkets, where packaging becomes a vital source of information. Because consumers vary in their level of product knowledge, similar packaging information may be interpreted differently depending on their subjective knowledge.

Since its invention by Denso in 1994, QR codes have been widely used in consumer communication (Denso Wave, n.d.), enabling consumers to quickly access supplementary information such as website content (Albăstroiu & Felea, 2015; Dou & Li, 2008). However, not all consumers necessarily scan QR codes (Li & Messer, 2019; Rotsios et al., 2022). Given that only a portion of consumers actively scan QR codes, the effectiveness of QR-based information may depend on whether consumers actually engage with the technology. Packaging information can also create confusion by presenting excessive information (Silayoi & Speece, 2004). Moreover, because pot-brewed green tea involves multiple information cues, it remains unclear which types of information are most important to consumers.

Consequently, this study addresses the following research questions:

RQ1. Does the presentation of information on product packaging influence consumers' perceived quality?

RQ2. Does consumers' SK of green tea moderate the effect of packaging information on perceived quality?

RQ3. Does consumers' QR code usage moderate the effect of packaging information on perceived quality?

To address these research questions, we employed conjoint analysis, following previous studies (e.g. Wang et al., 2022). The conjoint analysis included four attributes: (1) Aroma, describing the tea's characteristics such as aroma, taste, liquor color, and appearance; (2) Brew, providing information on how to brew tea using a teapot; (3) Award, indicating the

official evaluation of tea leaves, such as special selection or recognition in national competitions; and (4) Authenticity, referring to information on the product's authenticity, such as production region, manufacturer, or tea cultivar.

2. Literature review

Consumers' product knowledge

Consumers' product knowledge significantly influences purchasing and consumption behavior (Flores et al., 2021; Quevedo-Silva et al., 2024; Raju et al., 1995). Knowledge of a product's information cues and its perceived meaning can change why a product is purchased, when it is consumed, and how it is experienced (Ellis & Caruana, 2018). Pot-brewed green tea consists of various information cues, including culture and customs (Xia & Donzé, 2023), flavor (Lee et al., 2010; Lee et al., 2014), tea ware (Li et al., 2020), and health benefits (Khan & Mukhtar, 2018). Successful purchase and consumption of pot-brewed green tea require substantial knowledge owing to these diverse information cues. Consumer knowledge can be conceptualized and measured in three aspects: SK (i.e., what consumers think they know), objective knowledge (i.e., what consumers actually know), and past product experiences, which determine both objective and SK (Brucks, 1985). Considering the importance of subjective rather than objective knowledge (Flynn & Goldsmith, 1999), this study focuses on consumers' SK.

Packaging and QR codes

For in-store purchase decisions, packaging conveys product information to consumers and assists them in making choices (Deliya & Parmar, 2012; Fernqvist et al., 2015; Silayoi & Speece, 2007). Packaging influences perceived product quality (Ahmad et al., 2012; S.T. Wang, 2013), is closely linked to marketing strategy, and contributes to value creation (Konstantoglou et al., 2021; Rundh, 2016). However, packaging information can also create confusion by conveying excessive information (Silayoi & Speece, 2004). Moreover, because pot-brewed green tea involves multiple information cues, it remains unclear which types of information are most important to consumers.

Previous research has examined the use of QR codes on packaging and their impact. For example, QR codes positively affect both information search and purchase decisions, as the information obtained through scanning influences consumers' choices (Meydanoğlu et al., 2015). The major advantage of QR codes is that they provide information in a personalized and interactive manner without temporal or spatial constraints (Smutkupt et al., 2010). However, not all consumers necessarily scan QR codes (Li & Messer, 2019; Rotsios et al., 2022). Prior research has shown that consumers' responses to additional information are similar regardless of how the information is delivered (Li & Messer, 2019). Nevertheless, in the case of products such as green tea, which require consumers to possess product knowledge in order to achieve a richer consumption experience, it is necessary to clarify whether QR code usage moderates the impact of information provided on packaging.

3. Research design

Conjoint analysis was conducted through an online survey administered by MyVoice Communications, Inc., to assess how four attributes, namely Aroma, Brew, Award, and

Authenticity, influence consumers' perceived quality of tea leaves. The sample comprised 600 men and women in Japan, aged 20-69 years, with equal distributions across sex and age groups (Table 1). The survey was conducted in February 2025. No personally identifiable information was collected; therefore, this study was exempt from ethical review under the institutional regulations. Participants proceeded with the survey only after providing consent for academic use of their responses.

The conjoint experiment used nine cards based on the four attributes, each with three levels (Table 2). These attributes are important for describing the quality of pot-brewed green tea (Japan Tea Central Public Interest Incorporated Association & Nihoncha Instructor Association, 2017; Ohmori, 2017). Levels were defined as follows: (1) Aroma, described through text, illustration, or detailed QR-linked information; (2) Brew, brewing instructions presented in text, as an image accessed via QR code, or as a QR-linked instructional video; (3) Award, special selection, Minister of Agriculture Award, or top prize at a national tea fair; and (4) Authenticity, information on production region, manufacturer, or tea cultivar. The descriptions of each level were based on reference materials on Japanese tea (Japan Tea Central Public Interest Incorporated Association & Nihoncha Instructor Association, 2017; Ohmori, 2017). The four attributes with three levels each yielded 81 possible packaging profiles. To reduce respondent burden and ensure efficient estimation of the main effects, nine profiles were selected using an L9 orthogonal array (Table 3, Figure 1).

Participants were first asked to indicate how they typically interact with QR codes in a retail setting by selecting one of four options: Does not scan any QR code, Scans only the QR code with aroma and flavor information, Scans only the QR code with brewing instructions, or Scans both QR codes (Table 2). Participants viewed additional information only if they selected a scanning option. For each of the nine profiles, participants evaluated perceived quality using two items (Sugitani, 2017), rated on a six-point Likert scale (1 = Completely disagree; 6 = Completely agree). As outlined in RQ2, SK of pot-brewed green tea was measured using five items adapted from Flynn and Goldsmith (1999), also on a six-point response format. Responses for perceived quality and SK were averaged to form composite variables, which were then used for analysis. As the respondents were Japanese, the questionnaire was professionally translated into Japanese.

Analysis proceeded in three stages. Model 1 tested the main effects of the four packaging attributes on perceived quality. Model 2 examined interaction effects between packaging attributes and SK. Model 3 tested interaction effects between packaging attributes and participants' QR code usage behavior.

4. Results

The results of the analysis are summarized in Table 4. In Model 1 (main effects only), Aroma 2 (illustration) had a positive and significant effect on perceived quality ($B = 0.095$, $p = 0.006$), whereas Aroma 3 (QR code with detailed aroma information) had a negative and significant effect ($B = -0.241$, $p < 0.001$). Compared with a text description of aroma, an illustration increased perceived quality, whereas a QR code decreased it. Brew 2 (QR code with an image-based explanation) and Brew 3 (QR code with a video-based explanation) had negative and significant effects ($B = -0.195$, $p < 0.001$; $B = -0.177$, $p < 0.001$), suggesting that explaining the brewing method via a QR code reduced perceived quality compared with an explanation presented directly on the package. Award 2 (Minister of Agriculture Award) and Award 3 (top prize at a national tea fair) had positive and significant effects ($B = 0.072$, $p = 0.037$; $B = 0.093$, $p = 0.007$), showing that displaying the Minister of Agriculture Award or the top prize at a national tea fair increased perceived quality compared with displaying

"special selection."

Model 2 included interaction terms with SK. The interaction between Aroma 3 and SK was positive and significant (B = 0.066, p = 0.037), indicating that higher SK attenuates the negative effect of a QR code with detailed aroma information on perceived quality. The interaction between Authenticity 2 (manufacturer) and SK was negative and significant (B = −0.065, p = 0.040). Although the main effect of the authenticity explanation regarding the manufacturer on perceived quality was not significant, the interaction effect indicated that higher SK lowers perceived quality when the authenticity explanation pertains to the manufacturer. The interaction between Brew 2 and SK was marginally significant and positive (B = 0.054, p = 0.087), suggesting that higher SK attenuates the negative effect of a QR code with an image-based brewing instruction on perceived quality.

Model 3 incorporated interaction terms with QR code scanning choices. Several interaction effects were significant. For Aroma 3 × QR 2 (B = 0.521, p < 0.001), respondents who indicated they would scan only the QR code containing aroma and flavor information (Aroma 3) rated perceived quality higher when the aroma was described via QR code than when it was described in text on the package. For Aroma 3 × QR 3 (B = 0.273, p = 0.006), among respondents who chose to scan only the QR code with brewing instructions (Brew 2 or Brew 3), using the QR code for the aroma description led to higher perceived quality than providing the description in text on the package. For Aroma 3 × QR 4 (B = 0.725, p < 0.001), among respondents who scanned both QR codes (Aroma 3 and Brew 2/3), providing the aroma description via QR code resulted in higher perceived quality compared with a text description. Similarly, Brew 2 × QR 3 (B = 0.347, p < 0.001), Brew 2 × QR 4 (B = 0.437, p < 0.001), Brew 3 × QR 3 (B = 0.290, p = 0.003), and Brew 3 × QR 4 (B = 0.435, p < 0.001) indicated that, among respondents who indicated they would scan only the QR code with brewing instructions (Brew 2 or Brew 3) or both QR codes (Aroma 3 and Brew 2/3), explaining the brewing method via QR code increased perceived quality compared with providing the explanation directly on the package. The adjusted R^2 values were 0.025, 0.026, and 0.098 for Models 1 through 3, respectively.

5. Discussion

Model 1, which addressed RQ1, examined whether the four types of packaging information influenced consumers' perceived quality. The results showed that, for the aroma attribute, using illustrations on the package increased perceived quality, whereas using a QR code with detailed information led to lower perceived quality, both relative to a text description on the package. For brewing instructions, providing concise explanations directly on the package resulted in higher perceived quality than offering detailed explanations via a QR code containing images or a video. Providing such detailed explanations through a QR code may actually reinforce negative impressions, such as that the product is difficult to prepare or time-consuming. Regarding award information, the Minister of Agriculture Award and the top prize at a national tea fair were associated with higher perceived quality compared with the vague label "special selection," for which the selection criteria and authority were unclear. Finally, information about authenticity did not significantly influence perceived quality.

Model 2 (RQ2) examined whether the effect of package information on perceived quality varies depending on consumers' level of SK about green tea. The results indicated that Aroma 3 (QR code with detailed aroma information) decreased perceived quality compared with Aroma 1 (text description), but this negative effect was attenuated among consumers with higher SK. In other words, consumers with higher SK may be better able to

comprehend the detailed aroma and flavor information provided via QR code and, consequently, evaluate the tea leaves as being of higher quality. Similarly, the main effect of Brew 2 (QR code with image-based explanation) lowered perceived quality compared with Brew 1 (on the package), and this negative effect was attenuated among consumers with higher SK, although the attenuation effect for higher SK did not reach conventional levels of statistical significance. This suggests that consumers with higher SK may better understand detailed brewing instructions provided via QR code and therefore evaluate the tea leaves more positively. Finally, higher SK exacerbated the negative association of manufacturer-related authenticity information with perceived quality compared with information about the production region. This may be because the production-region information referred to an actual location, whereas the manufacturer information necessarily used a fictitious company name; consumers with higher SK may have recognized the fictitious nature of the company name, leading to lower perceived quality.

Model 3 (RQ3) examined whether the effect of package information on perceived quality varies depending on whether consumers choose to scan QR codes. The results showed that, for both aroma/flavor and brewing instructions, among respondents who chose to scan the QR code to obtain detailed information, the QR code information was associated with higher perceived quality. However, the number of consumers who chose to view the QR codes was relatively small.

6. Conclusions

As follow, this study extends prior research on packaging by demonstrating that the effectiveness of QR codes is contingent upon both consumer knowledge and scanning behavior. First, this study clarified the effect of using QR codes as a means of providing more detailed package information on perceived quality. According to the results of Model 1, the use of QR codes may in fact reduce perceived quality. However, as indicated by the results of Model 3, among respondents who chose to scan QR codes, the perceived quality of packages with QR codes increased, highlighting the importance of encouraging more consumers to actually scan them. Previous research noted that only a limited proportion of consumers scan QR codes at the time of purchase (Li & Messer, 2019), and in the present study, only 34.17% of respondents chose to scan any QR code. Future research should therefore examine strategies to encourage consumers to scan.

Second, this study clarified how SK influences the effect of information design on packages. The results indicate that higher SK reduces the negative impact of both a QR code with detailed aroma information and a QR code with an image-based brewing instruction on perceived quality. These findings suggest that even when detailed information is provided through QR codes, it contributes to higher perceived quality only if consumers have sufficient product knowledge to interpret it.

From a managerial perspective, this study demonstrates how product-related information should be presented on packages to enhance consumers' perceived quality, particularly in contexts such as supermarkets or online sales where products are purchased without sales staff explanations. Given that QR codes can sometimes reduce perceived quality and that providing detailed information through QR codes does not improve perceived quality when consumers have low SK, it may be more effective to focus on delivering information directly on the package itself or through point-of-purchase displays.

This study has certain limitations that warrant further investigation. First, it relied on a hypothetical scenario and self-reported data from an online survey, which may not fully capture actual purchasing behavior. Second, to reduce respondent burden, the survey

examined only four factors: Aroma, Brew, Award, and Authenticity. Future research should conduct experiments using real products in actual shelf-space settings and examine additional factors.

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Table 1. Demographic characteristics of survey respondents (N = 600)

Type	Category	N	%
Gender	Male	300	50.00%
	Female	300	50.00%
Age	20 – 29	120	20.00%
	30 – 39	120	20.00%
	40 – 49	120	20.00%
	50 – 59	120	20.00%
	60 – 69	120	20.00%
Education	High school or less	165	27.50%
	Some college or vocational training	119	19.83%
	Bachelor's degree	281	46.83%
	Graduate degree	35	5.83%
Household income	< ¥3 million	119	19.83%
	¥3 million – < ¥6 million	212	35.33%
	¥6 million – < ¥9 million	151	25.17%
	≥ ¥9 million	118	19.67%
QR code	QR 1	395	65.83%
	QR 2	42	7.00%
	QR 3	66	11.00%
	QR 4	97	16.17%

Table 2. Levels and descriptions of variables used in the conjoint analysis

Level	Description	Level	Description
Aroma 1	Text description	QR 1	Does not scan any QR code
Aroma 2	Illustration	QR 2	Scans only the QR code with aroma and flavor information (Aroma 3)
Aroma 3	QR code with detailed aroma information	QR 3	Scans only the QR code with brewing instructions (Brew 2 or Brew 3)
Brew 1	On the package	QR 4	Scans both QR codes (Aroma 3 and Brew 2/3)
Brew 2	QR code with image-based explanation		
Brew 3	QR code with video-based explanation		
Award 1	Special selection		
Award 2	Minister of Agriculture Award		
Award 3	Top prize at national tea fair		
Authenticity 1	Production region		
Authenticity 2	Manufacturer		
Authenticity 3	Tea cultivar		

Note: The first level of each factor was used as the reference in dummy coding.

Table 3. Orthogonal arrays (L9) for conjoint analysis

	Aroma	Brew	Award	Authenticity
Card 1	Text description	On the package	Special selection	Production region
Card 2	Text description	QR code: image-based explanation	Minister of Agriculture Award	Manufacturer
Card 3	Text description	QR code: video-based explanation	Top prize at national tea fair	Tea cultivar
Card 4	Illustration	On the package	Minister of Agriculture Award	Tea cultivar
Card 5	Illustration	QR code: image-based explanation	Top prize at national tea fair	Production region
Card 6	Illustration	QR code: video-based explanation	Special selection	Manufacturer
Card 7	QR code with detailed aroma information	On the package	Top prize at national tea fair	Manufacturer
Card 8	QR code with detailed aroma information	QR code: image-based explanation	Special selection	Tea cultivar
Card 9	QR code with detailed aroma information	QR code: video-based explanation	Minister of Agriculture Award	Production region

Table 4. Estimation results

	Model 1			Model 2			Model 3		
	B	p-value	95% CI	B	p-value	95% CI	B	p-value	95% CI
Aroma 2	0.095	0.006	[0.028, 0.163]	0.095	0.006	[0.028, 0.163]	0.071	0.074	[-0.007, 0.149]
Aroma 3	-0.241	< 0.001	[-0.308, -0.173]	-0.241	< 0.001	[-0.308, -0.173]	-0.424	< 0.001	[-0.502, -0.346]
Brew 2	-0.195	< 0.001	[-0.263, -0.128]	-0.195	< 0.001	[-0.263, -0.128]	-0.320	< 0.001	[-0.398, -0.242]
Brew 3	-0.177	< 0.001	[-0.244, -0.109]	-0.177	< 0.001	[-0.244, -0.109]	-0.285	< 0.001	[-0.363, -0.208]
Award 2	0.072	0.037	[0.005, 0.140]	0.072	0.036	[0.005, 0.140]	0.077	0.052	[Negligible, 0.155]
Award 3	0.093	0.007	[0.026, 0.161]	0.093	0.007	[0.026, 0.161]	0.082	0.039	[0.004, 0.160]
Authenticity 2	0.016	0.652	[-0.052, 0.083]	0.016	0.652	[-0.052, 0.083]	Negligible	0.996	[-0.078, 0.078]
Authenticity 3	0.007	0.828	[-0.06, 0.075]	0.008	0.828	[-0.060, 0.075]	-0.012	0.754	[-0.090, 0.065]
Aroma 2 × SK				-0.015	0.644	[-0.076, 0.047]			
Aroma 3 × SK				0.066	0.037	[0.004, 0.127]			
Brew 2 × SK				0.054	0.087	[-0.008, 0.116]			
Brew 3 × SK				0.040	0.208	[-0.022, 0.101]			
Award 2 × SK				-0.016	0.616	[-0.078, 0.046]			
Award 3 × SK				-0.030	0.337	[-0.092, 0.032]			
Authenticity 2 × SK				-0.065	0.040	[-0.126, -0.003]			
Authenticity 3 × SK				-0.035	0.261	[-0.097, 0.026]			
Aroma 2 × QR 2							0.113	0.348	[-0.123, 0.349]
Aroma 2 × QR 3							-0.076	0.440	[-0.270, 0.117]
Aroma 2 × QR 4							0.153	0.070	[-0.012, 0.318]

Aroma 3 × QR 2			0.521	< 0.001	[0.285, 0.757]
Aroma 3 × QR 3			0.273	0.006	[0.079, 0.466]
Aroma 3 × QR 4			0.725	< 0.001	[0.560, 0.890]
Brew 2 × QR 2			0.222	0.066	[-0.014, 0.458]
Brew 2 × QR 3			0.347	< 0.001	[0.154, 0.541]
Brew 2 × QR 4			0.437	< 0.001	[0.272, 0.602]
Brew 3 × QR 2			0.093	0.442	[-0.144, 0.329]
Brew 3 × QR 3			0.290	0.003	[0.097, 0.484]
Brew 3 × QR 4			0.435	< 0.001	[0.270, 0.600]
Award 2 × QR 2			Negligible	0.997	[-0.237, 0.236]
Award 2 × QR 3			-0.037	0.707	[-0.231, 0.156]
Award 2 × QR 4			-0.007	0.937	[-0.172, 0.158]
Award 3 × QR 2			0.003	0.981	[-0.233, 0.239]
Award 3 × QR 3			0.062	0.532	[-0.132, 0.255]
Award 3 × QR 4			0.027	0.753	[-0.138, 0.192]
Authenticity 2 × QR 2			-0.081	0.499	[-0.318, 0.155]
Authenticity 2 × QR 3			0.023	0.818	[-0.171, 0.216]
Authenticity 2 × QR 4			0.117	0.163	[-0.048, 0.282]
Authenticity 3 × QR 2			0.066	0.586	[-0.171, 0.302]
Authenticity 3 × QR 3			-0.023	0.815	[-0.217, 0.171]
Authenticity 3 × QR 4			0.111	0.188	[-0.054, 0.276]
Adj. R^2	0.025	0.026	0.098		

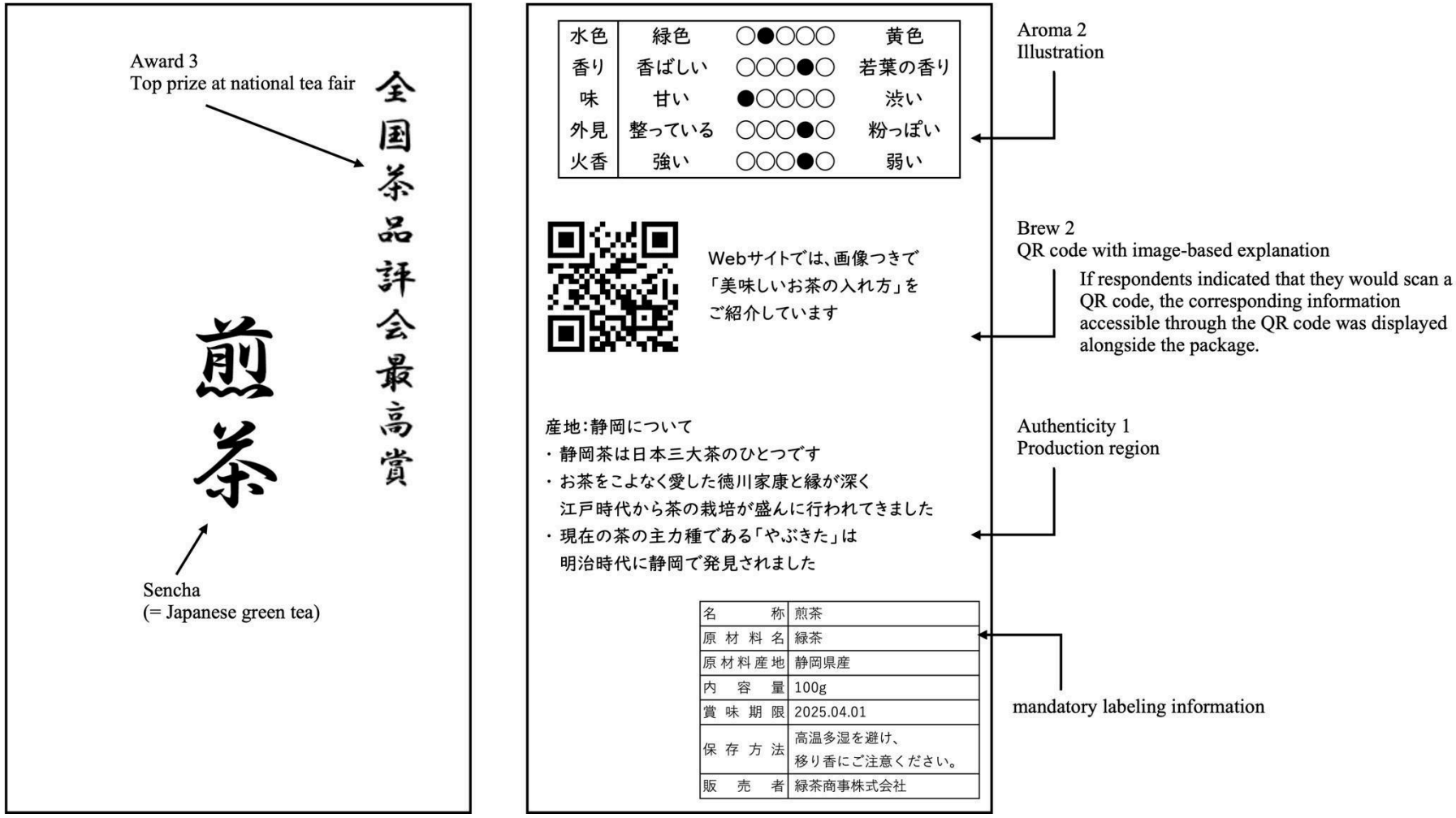

Figure 1. Example of package (Card 5)