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ORIGINAL ARTICLE

Consumer Perception Survey for Labeling of Functional Tomato Juice: Use of Choice Architect to Recognize Functional Information in Japan

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Abstract: This study investigates the impact of information on consumers' perceptions of functional foods, such as *lycopene* and *Gamma Amino Butyric Acid*, and their health awareness when purchasing them. The results show that most participants have limited knowledge of functional foods, and a high percentage of males expect "enhancing efficacy" and females expect "reducing bad effects on the body." The study suggests designing an environment where information is provided not only to consumers with limited knowledge but also on demand. This could involve creating a functional food sales special floor as a choice architect for beginner-level knowledge acquirers, making it easier to access and understand functional foods.

Keywords: *Functional foods, Consumer perceptions, Choice architect, Behavioral economics, Limited knowledge*

1. INTRODUCTION

How they people actually do behave to have various kinds of "cognitive biases"? According to the University of Chicago, Introduce Behavioral Economics by Thaler's position, "Behavioral economics examines the differences between what people "should" do and what they actually do and the consequences of those actions." The differences are often owing to "Bounded rationality." Also, it is explained "Bounded rationality refers to the fact that people have limited cognitive ability, information and time, and do not always make the "correct" choice from an economist's point of view, even if information is available that would point them toward a particular course of action" [9].

One of the famous ways to correct choice cognitive biases is Nudges. Nudges is an example of the Choice Architects as you know, a method of behavioral economics. Choice architects use behavioral science to design environments that guide people's behavior in the desired direction. It is a design based on the concept of libertarian paternalism. Libertarian paternalism is a new idea that policy-makers have the possibility of stepping in at the level where individual freedom of choice is not being interfered with, when intervention is required. Instead of forbidding individual freedom of choice or drastically changing people's behavior with economic incentives such as rewards and fines, we encourage voluntary decision-making by "designing" the structure of facilities and the way information is displayed.

What is an available choice architects for consumers? In this study, we report consumer responses about the taste and functionality of the *Shonan Pomoron* tomato—a food with a functional claim of being rich in lycopene. Moreover, we discuss the consumer recognition of the display of functionality information on the label, regarding the effect of *lycopene* on cholesterol, and *GABA*; *Gamma Amino Butyric Acid*. we would propose decision-making by "designing" the structure of facilities and the way information is displayed as choice Architects.

2. PREVIOUS STUDIES

The EU Regulation 1169/11 already provides consumers with all the information they need to make informed decisions when comparing food. However, in reality, it is nearly impossible for consumers who have various kinds of "cognitive biases" to fully understand this vast amount of information. Hence, the EU has been authorized to simplify information for ingredients, for instance Nutri-score, "as the harmonized mandatory nutrition label for Europe" [12]. Ben-Shahar and Schneider (2014) noted regarding mandatory disclosure that "simplification is a complex business, not readily mastered. And simplification is in tension with the full disclosure principle" [10].

In Japan, the Consumer Affairs Agency of Japan (2021) investigated consumers' understanding of the food labeling system and analyzed the results to understand the status of relevant laws and guidelines, such as the Food Labeling Law and Consumption Act [2]. Their purpose was to understand the needs of consumers for food labeling and help them review the food labeling system.

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Yamashige et al. (2015) researched how "health" can be improved by examining ideal methods of "food labeling," considering willingness to pay [11].

Fujimori and Kogomori (2021) examined the results of a questionnaire survey on the reading of nutritional labels conducted by the Consumer Affairs Agency, to establish the status of the law and the extent to which consumers place importance on the nutrition labeling information [8]. The results show that the correct answer rate for questions related to reading the labels was generally low—regardless of gender, age, and educational background.

According to the report of The Consumer Affairs Agency of Japan [1], the reason provided for ingesting "Foods with Functional Claims" is that "We expect the labeled functions (functionality)." This was the highest reason provided at 65.0%, followed by "because safety is guaranteed" at 19.3%, and "displayed function" (functionality). Regardless of the fact, 17.7% answered that they liked the product itself, and 65% of the respondents answered that they expected the displayed function (functionality). Approximately 60.6%, (68.6% for women), indicated that they are highly interested in foods with functional claims.

3. PURPOSE, MEANING, AND METHOD

3.1 Purpose and meaning

This study is an attempt to show the importance of designing the way information such as *lycopene* or *GABA* on consumers' perceptions with limited knowledge of functional foods and their health awareness when purchasing functional foods, and consumers to assess their evaluation of taste and functionality. By the survey of consumers to assess their evaluation of taste and functionality, we propose the use of a choice architect policy that incorporates the viewpoint of behavioral economics.

In Japan, there are systems for food labelling with function claims and for special uses. We compare *Labeling foods with functional claims* (*kinou sei hyoji shokuhin*) to *foods for specific health uses* (*Tokuho*) to investigate consumer perceptions of functional claims [7]. In Japan, Labeling foods with functional claims is described as "the responsibility of the manufacturer; they are labeled with the functionality based on scientific evidence" [1]. Food has three basic functions. The first is basic nutritional function (primary function), the second is sensory and taste function (secondary function), and the third is bioregulatory function (tertiary function) involved in maintaining and improving health [2].

The *Shonan Pomoron* tomato which had been working on breeding first-generation tomato hybrids (F1) since 1995, focusing on the characteristics of being able to eat both raw and cooked by Kanagawa Prefectural Agricultural Technology Center. It has an abundance of the functional ingredient *lycopene* compared with larger varieties [3]. *Lycopene* is a red pigment found in vegetables such as tomatoes and watermelons, and fruits such as pink grapefruit, and is a type of carotenoid [4, 5]. *Lycopene* intake was associated with a decrease in systolic blood pressure (5 reports), and continued intake of tomatoes or tomato products was associated with a decrease in blood lipids (LDL-C (6 reports)), IL-6 (3 reports)), and an increase in vasodilation (FMD) (3 reports)) [6]. The Shonan Pomoron tomato also has the functional ingredient *GABA*, found in vegetables such as tomatoes, and plants such as tea, rice, and soybean. *Shonan Pomoron* is synthesized in vivo by decarboxylation of L-glutamate and acts as an inhibitory neurotransmitter in the brain [4, 5] *Shonan Pomoron* is thus characterized by its content.

3.2 Method

The label is designed; there is a visual difference between the black label with the functional display and the white label without the functional display. This is to investigate possibilities to display consumer-friendly promotional information on the properties of the tomato, as consumer sensitivity, and behavior gleaned. In this qualitative survey, we first conducted a group interview to explore the consumers' degree of understanding of foods with functional claims and the ideas about the commercial value of *Shonan Pomoron* juice. Second, we conducted a questionnaire survey to confirm 1) the functionality that consumers expect from the components *lycopene* and *GABA* and 2) how they intend to use the product upon purchase.

3.2.1 Survey 1: Group interview

We conducted group interviews 14 female participants in their 30 s and 60 s, in Chigasaki city, twice. The survey dates were November 27, 2019, and January 15, 2020.

The survey items included: the degree of recognition and understanding of foods with functional claims, a taste evaluation of Two types of tomato juices and ideas for commercialization.

As (1) Evaluation of the taste of *Shonan Pomoron* juice, two types of tomato juices were tested—with different label designs. The label of the prototype, which notifies the consumer of foods with functional properties, has a black background (Fig. 1).

Figure 1: Presentation of juice label design
Left: Black has a functional display,
Right: No functional display

As (2) Degree of recognition of foods with functional claims, The interview items are below,

"Have you ever heard Food with Functional Claims?"

As (3) The image that consumers associate with the functional ingredient's *lycopene* and *GABA* "What image do you have associated with *lycopene*?" and "What do you imagine from the actual *lycopene* functionality labeling?" and "What image do you associate with *GABA*?" and "What do you imagine from the actual *GABA*"

3.2.2 Survey 2: Questionnaire

There were 128 participants (35 female, 93 male) as Visitors to JA Sagami Materials Exhibition in Fujisawa City, Japan. The survey dates were December 6 and 7, 2019. This questionnaire survey was respondents place stickers on the survey board in the appropriate areas. The survey items were: 1. Taste evaluation of heated juice (hot tomato juice, unseasoned). 2. Images associated with the functional components of tomatoes (*lycopene* and *GABA*).

Regarding survey item 1. We offered a tasting of *Shonan Pomoron* tomato juice that was boiled in hot water (hereinafter referred to as hot tomato juice), and the respondents answered the relevant questions on the survey board.

Regarding survey item 2, the participants were asked to select from the following the functionalities they expected from *lycopene* and *GABA*. Functional properties of *lycopene*; function to increase bad cholesterol, function to reduce bad cholesterol, effect of beautiful skin, anti-aging, none of the above. Functional properties of *GABA*; functions to relieve mental stress, ability to lower higher blood pressure, helpful for healthy sleep, none of the above.

The scientific information that can be displayed about *lycopene* and *GABA* in tomato juice is that it "reduces bad cholesterol," and "lowers high blood pressure," respectively. As the purpose of the survey is to ask consumers about the image that they associate with and the action that they expect from the functional ingredients, we extracted information from the website of company A and devised multiple question items. We explained that the functional claims that can be made about tomato foods on the labels are limited to cholesterol and blood pressure before the respondents answered the questions.

4. FUNCTIONAL EVALUATION

4.1 Manufacturing method of *Shonan Pomoron* juice

We examined the demonstration exhibition of the "*Shonan Pomoron Red*" tomato cultivated in approximately four locations from early July to mid-August 2019.

The ripe juice was frozen and stored at –30°C as a pretreatment and post-processing raw material.

4.2 Functional evaluation

We processed 50 kg per lot four times to obtain four batches of tomato juice. Lot 4 had high sugar content, hardness load and adhesiveness. *Lycopene* and glutamic acid reflected the sugar content (concentration rate) as well as the physical characteristics. (Table 1).

We surveyed consumer evaluations of Lot 4 : functional juices and Lot 1: no functional juices.

5. INTERVIEW RESULTS AND CONSIDERATIONS

(1) Evaluation of the taste of *Shonan Pomoron* juice

Juices that can be labeled with health benefits are called "functional," and juices that are not notified are called "general." The impression after tasting each was that they were "easy to drink, " and the functionality was expressed as "feeling umami." Both were described as having "no sourness" and "not very sweet" (an open-ended question). A similar tendency was observed in the taste evaluation (Figure 2).

Table 1: Quality of "*Shonan Pomoron*" Juice

Batche No.	Brix (Bx)	hardness load (N)	adherability (J/m^3)	lycopene (mg/100g)	glutamate (mg/100g)
1	6.6	0.25	17.63	16.2	245
2	6.7	0.22	16.14	14.8	232
3	6.3	0.20	16.14	14.8	255
4	7.0	0.43	32.09	22.0	276
competitor's product *	5.6	0.15	8.26	–	171

* Tomato juice already commercially available using *Shonan Pomoron* Red as a raw material

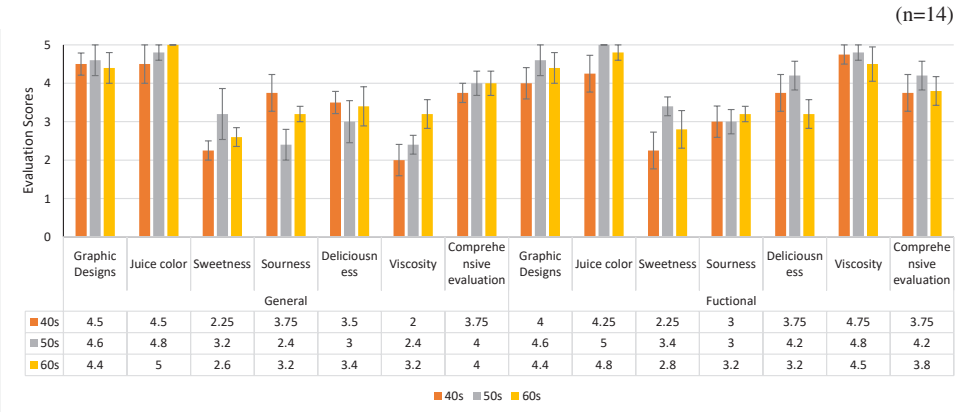

Figure 2: Evaluation of the taste of *Shonan Pomoron* juice

An interesting opinion was: "*Tokuho* is good for your health, so it doesn't have to be tasty, but foods with functional claims should be." The results indicate that consumers expect foods with functional claims to have a "good taste."

(2) Degree of recognition of foods with functional claims

None of the respondents knew what characterized food with specified health benefits (*Tokuho*) and had no knowledge about food with functional claims. However, upon further investigation, we found that consumers had experienced drinking oolong tea and eating chocolate with *Tokuho*, for example, and had purchased these without being aware of the health-giving properties. We would like to limit ourselves to stating the results in a limited way, as this is an evaluation of 14 subjects.

6. QUESTIONNAIRE SURVEY RESULTS AND CONSIDERATIONS

(1) Characteristics of the respondents

There were 128 respondents—93 male and 35 female. Attributes such as age were not investigated in this part of the study.

(2) Evaluation of the taste of the juice

After tasting *Shonan Pomoron* tomato juice, most participants answered that it was delicious (Table 2).

Table 2: Evaluation of the taste of the juice

Gender	Delicious	Neither	Not tasty	Total
Male	74	5	8	87
Female	28	0	0	28
Total	102	5	8	115
(%)	89%	4%	7%	100%

Respondents who do not like tomato juice or who do not have a habit of drinking it said that "hot juice is easy to drink." Those who were accustomed to drinking it said: "It is a juice without habit, but I do not feel the characteristics." Further opinions were also obtained.

(3) Efficacy that consumers expect from functional ingredients

Lycopene has four efficacy items according to the manufacturer's HP, and *GABA* has three. We set "None of them apply" to this and asked for multiple answers.

The expected effects of *lycopene* were: "increasing good cholesterol" and "reducing bad cholesterol," for men; and "skin-beautifying effects," for women. It is noteworthy that the selection rate for "skin-beautifying effects" was 46% for women (Fig. 3).

Similarly, the expected effects of *GABA* were "relieving mental stress" and "lowering high blood pressure," in that order. Compared to *lycopene*, the difference between males and females was small, and the response rate was

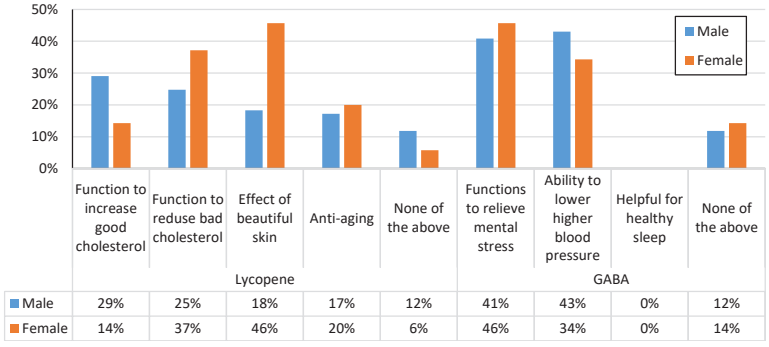

Figure 3: Expected functional ingredient of *lycopene* & *GABA*

high (Fig. 3). There were no answers regarding "useful for healthy sleep."

7. DISCUSSION

7.1 Interview survey

At the time of the Survey 1, we found that knowledge about foods with functional claims had not sufficiently permeated the consumer market. We found evidence of the association between the tomato and *lycopene*, but there was a difference between the function recognized by the respondents and the benefits that can be displayed on the label.

However, we did confirm that knowledge acquisition about foods with health benefits results in increased interest, and purchase motivation. We suggest providing a chance knowledge acquisition health benefits information to people with limited knowledge is one of the nudges. Therefore, for instance, we suggest that establishing product shelves for beginner-level knowledge acquirers where products are easy to pick up (easy to access) even for those who are not familiar with functional foods creating a functional food sales special floor. That design an environment in which information is given to consumers on demand, for instance creating a functional food sales special floor based on the concept of a choice architect.

Moreover, the evaluation of the "hot tomato juice" by the participants of the group interview was positive, and it contributed to a product proposal that capitalizing on the characteristics of the *Shonan Pomoron* hot tomato juice. The *Shonan Pomoron* tomato is not widely cultivated, so even the citizens of the prefecture have low awareness of the variety. Therefore, by marketing the product as "Shonan Pomoron Hot Tomato Juice", which is available only in winter, we propose that the brand will be recognized by consumers as a limited-edition product.

7.2 Questionnaire survey

The next step to examine is the display of functionality information on the demands. Regarding the effect of *lycopene* on cholesterol, we note that a high percentage of males respondents expected male expected "enhancing efficacy" and females expected "reducing bad effects on the body". Regarding *GABA*, there is no significant difference between males and females in the effect of "lowering high blood pressure," which can be displayed on vegetables (about 40%), so it can be said that blood pressure is a common concern for both.

Therefore, we suggest that this recognition would propose a way of designing an environment in which information is not only given to consumers with limited knowledge but also on demand.

8. CONCLUSION AND FUTURE DEVELOPMENTS

What is an available choice architects for consumers? This study the information such as *lycopene* or *GABA* on consumers' perceptions with limited knowledge of functional foods and their health awareness when purchasing functional foods. It is an attempt to show the importance of designing the way. We reported consumer responses about the taste and functionality of the *Shonan Pomoron* tomato which had been working on breeding first-generation tomato hybrids (F1) since 1995, focusing on the characteristics of being able to eat both raw and cooked by Kanagawa Prefectural Agricultural Technology Center—as a food with a functional claim of being rich in *lycopene*.

We had three kinds of insight from three experiments/surveys revealed that first, most participants have limited knowledge of functional food. Second, a high percentage of males expected "enhancing efficacy" and females expected "reducing bad effects on the body". Therefor we propose a way of designing an environment in which information is not only given to consumers with limited knowledge but also on demand. This recognition would propose a way of designing an environment in which information is given to consumers with limited knowledge, for instance, establishing product shelves for beginner-level knowledge acquirers where products are easy to pick up (easy to access) even for those who are not familiar with functional foods creating a functional food sales special floor as choice architect. We conclude this choice architects that guide people's behavior in the desired direction.

Moreover, this is also quite related to the theme of consumer perceptions in the broader *Kansei* field. The field of sensibility regarding how consumer expectations of the taste of the food may differ, depending on the differences in the images that consumers perceive, is an interesting theme for future research.

NOTE

At the time of the survey, the participants were informed of the purpose of the research, and they provided voluntary consent verbally. They were also informed that their personal information would be anonymized.

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