Correspondence Analysis for the Questionnaire Investigation

on Rare Sugars

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Abstract. The Rare Sugars exist naturally and have many kinds (more than 50). They have good effect for health such as prevention of increasing the a blood-sugar level after eating, suppression of fat accumulation, suppression of increasing the blood pressure, and antioxidative effect etc. It is in the spotlight for many people especially for those who are in the metabolic syndrome. There are few related papers concerning the marketing research and its utilization of this matter. In this paper, a questionnaire investigation is executed in order to clarify consumers' current condition and their consciousness, and to seek the possibility of utilizing the rare sugars. Correspondence Analysis was executed based on that. Some interesting and instructive results were obtained.

Keywords: the rare sugars, health, consumer, correspondence analysis

1. INTRODUCTION

The Rare Sugars' study has launched on 1980th by Professor Takeshi Izumori (Kagawa University). The way to the mass production was developed by the method of enzymatic reaction. The International Society of Rare Sugars was established in 2001. Local government of Kagawa Prefecture comes to assist this research activity on this big innovation newly born in Kagawa Prefecture. The Rare Sugars have advantage that a blood-sugar level does not increase so much after eating, in spite of it being a sugar. And it also hold the upturn of the blood pressure. Therefore it is expected as a new functional material for the prevention of metabolic syndrome.

By the way, one kind of the Rare Sugar D-psicose has the following characteristics.

- (1) a sweetening made by the natural starch
- (2) non calorie and its sweetness is 70% to those of sugar

③ organoleptic property of coolness and sharpness in taste

Many medical research papers are published on the Rare Sugars as follows.

Analysis of the function of D-psicose ; [1], [3], [4], [10], [12], [13]

Analysis of the function of D-allose ; [2], [5], [6], [7], [8], [9], [11], [14]

On the other hand, these are few papers analyzed by the viewpoint from consumers. The Rare Sugars is good for the health and is sold in the market as a sweetening, seasoning or functional ingredient for food.

In this paper, a questionnaire investigation is executed in order to clarify the recognition level among consumers and to pursue the future possibility of the Rare Sugars. Basic statistical analysis and Correspondence Analysis are conducted.

The rest of this paper is organized as follows. In

section 2, outline of the questionnaire investigation and its basic statistical results are exhibited. In section 3, Correspondence Analysis is conducted, which is followed by the remarks of section 4.

2. OUTLINE AND THE BASIC STATISTICAL RESULTS OF THE QUESTIONNAIRE RESEARCH

2.1 Outline of the Questionnaire Research

A questionnaire investigation is executed in order to clarify the recognition level among consumers and to pursue the future possibility of the Rare Sugars. The outline of the questionnaire research is as follows. The questionnaire sheet is attached in Appendix.

- (1) Scope of investigation: Participants to the cooking class in Kagawa Prefecture
- (2) Period: April June 2015
- (3) Method: Leave until called for
- (4) Collection: Number of distribution 300, Number of collection 171 (collection rate 57.0%)

2.2 Basic Statistical Results

Now, we show the main summary results by single variable.

2.2.1 Basic characteristics of answerer

Q32 Sex				
Frequency %				
Male	30	18		
Female	137	82		
Total	167	100		
Q33 Age				
	Frequency	%		
-19	54	32.1		
20-29	18	10.7		
30-39	8	4.8		
40-49	15	8.9		
50-59	17	10.1		
60-	56	33.3		
Total	168	100		

Q34 Occupation

	Frequency	%
Student	68	40.7
Officer	8	4.8
Company Employee	14	8.4
Clerk of Organization	3	1.8
Independents	6	3.6
Part-timer	9	5.4
Housewife	49	29.3
Miscellaneous	10	6
Total	167	100

2.2.2 Summary results for the items used in Correspondence Analysis

Q1 Do you know the Rare Sugars?						
	Frequency	%				
Know	152	89.9				
Do not know	17	10.1				
Total	169	100				
Q2 Where did you know the Rare Sugar?						
Q2 ①TV						
	Frequency	%				
Know	81	52.6				
Do not know	73	47.4				
Total	154	100				
Q2 2 Magazin	e					
	Frequency	%				
Know	8	5.2				
Do not know	146	94.8				
Total	154	100				
Q2 ③Newspap	per					
Frequency %						
Know	31	20.1				
Do not know	123	79.9				
Total	154	100				
Q2 ④Shop						
	Frequency	%				
Know	33	21.4				
Do not know	121	78.6				
Total	154	100				
Q2 ⁽⁵⁾ Vending Machine						
	Frequency	%				
Know	2	1.3				
Do not know	152	98.7				
Total	154	100				

Q2 ⁽⁶⁾Seminar

Q2 @Seminar				
	Frequency	%		
Know	28	18.2		
Do not know	126	81.8		
Total	154	100		
Q2 ⑦Internet				
	Frequency	%		
Know	10	6.5		
Do not know	144	93.5		
Total	154	100		
Q2 [®] Hear from	another person			
	Frequency	%		
Know	36	23.4		
Do not know	118	76.6		
Total	154	100		
Q2 (9) Miscellane				
	Frequency	%		
Know	28	18.2		
Do not know	126	81.8		
Total	154	100		
	v that the Rare Su			
-	ntion and/or diabe	-		
on obese preve		%		
Know	Frequency 126	79.7		
Do not know	32	20.3		
	158	*******		
Total		100		
-	ard the syrup which			
Kare Sugar "Ra	re Sugar Sweet"?			
	Frequency	<u>%</u>		
Heard	126	79.7		
Not heard	32	20.3		
Total	158	100		
-	ed the syrup whic			
Rare Sugar "Ra	re Sugar Sweet"?			
	Frequency	%		
Used	126	79.7		
Not used	32	20.3		
Total	158	100		
Q6 Have you drunk or eaten the food which				
includes the Ran	re Sugar?			
	Frequency	%		
Yes	124	79.0		
No	33	21.0		
Total	157	100		

Q9 What kind of food do you want to eat if the Rare Sugar is included? Q9 ①Cake

Q9 UCar	ke					
	Frequency	%				
Yes	81	52.6				
No	73	47.4				
Total	154	100				
Q9 ②Juio	ce					
	Frequency	%				
Yes	8	5.2				
No	146	94.8				
Total	154	100				
Q9 ③Jap	anese food					
	Frequency	%				
Yes	31	20.1				
No	123	79.9				
Total	154	100				
Q9 ④Western food						
	Frequency	%				
Yes	33	21.4				
No	121	78.6				
Total	154	100				
Q9 ⑤Chi	nese food					
	Frequency	%				
Yes	2	1.3				
No	152	98.7				
Total	154	100				
Q9 ⁽⁶⁾ Miscellaneous						
	Frequency	%				
Yes	28	18.2				
No	126	81.8				
Total	154	100				

Q7 Was the Rare Sugar effective after using it for more than one month?							
	Think it	Slightly	5	Slightly do	Do not	Total	
	very much	think so	either	not think so	think so		
Frequency	3	31	76	6	4	120	
<u>%</u>	2.5	25.8	63.3	5.0	3.3	100	
				which the Rar			
Frequency	26	30	14	1	2	73	
%	35.6	41.1	19.2	1.4	2.7	100	
	to use it in the	¥			1		
Frequency	45	65	34	10	7	161	
%	28.0	40.4	21.1	6.2	4.3	100	
Q11 I can ea	asily use it if t	here is a rec	eipe.				
Frequency	87	49	20	3	3	162	
%	53.7	30.2	12.3	1.9	1.9	100	
Q12 I want	to know when	re I can buy	it because I	want to use it	as a seasoni	ing.	
Frequency	8	56	47	29	20	160	
%	5.0	35.0	29.4	18.1	12.5	100	
Q13 I want	to know when	re I can get	information l	because I wan	t to use it as	a supplemer	
Frequency	61	66	26	7	1	161	
%	37.9	41.0	16.1	4.3	0.6	100	
Q14 I want	to know the h	nospital whe	re the Rare S	ugar is used a	s a tool for t	reatment.	
Frequency	26	85	37	12	2	162	
%	16.0	52.5	22.8	7.4	1.2	100	
Q15 I want	to know how	long I shou	ld use it in or	der to confirm	n the effectiv	veness.	
Frequency	18	43	53	36	11	161	
%	11.2	26.7	32.9	22.4	6.8	100	
Q16 It is no	t so popular.				:		
Frequency	39	72	37	6	7	161	
%	24.2	44.7	23.0	3.7	4.3	100	
Q17 It seem	s to be expen				i		
Frequency	29	69	35	14	13	160	
%	18.1	43.1	21.9	8.8	8.1	100	
Q18 I canno	ot grasp the co	oncrete effect	et.				
Frequency	26	38	31	26	36	157	
%	16.6	24.2	19.7	16.6	22.9	100	
	ot have confid				1		
Frequency	37	56	43	17	7	160	
%	23.1	35.0	26.9	10.6	4.4	100	
	nding people of			10.0		100	
Frequency	24	72	51	9	2	158	
%	15.2	45.6	32.3	5.7	1.3	100	
				e Rare Sugar		100	
Frequency	40	<u>u in the shoj</u> 74	<u>31</u>	13	<u>1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 </u>	159	
%	25.2	46.5	19.5	8.2	0.6	100	
70	23.2	40.5	19.5	0.2	0.0	100	

Q7 Was the Rare Sugar effective after using it for more than one month?

3. CORRESPONDENCE ANALYSIS

Now we execute the correspondence analysis. We made two way of analysis as follows.

- Common part questions (Q7,Q8,Q25,Q26,Q27) and positive part questions (Q10,Q11,Q12,Q13,Q14,Q15)
- Common part questions (Q7,Q8,Q25,Q26,Q27) and negative part questions (Q16,Q17,Q18,Q19,Q20,Q21, Q22,Q23)

3.1 Common part + Positive (1-9)

We can observe the following result from Fiture3.1. From the data, an eigenvalue of Dimension 1 axis is 0.572 and those of Dimension 2 is 0.428. We can extract 5 clusters. We can assume that the first cluster (Right center) shows "Have interest in the Rare Sugars and Want to use them" (Can easily use them if there is a recipe, Want to eat or drink food in which the Rare Sugar is included, Careful for the health, Want to use the Rare Sugars in cooking, Want to know where I can get information in using it as supplement and Want to know the hospital where the Rare Sugars are used as a tool for treatment). The second one (Lower right) is a single cluster composed of "Have interest in diet". The third one (Lower center) is also a single cluster composed of "Have interest in the designated health food". The fourth one (Lower left) would mean "The method to use and confirm the effect" (Want to know where I can buy them because I want to use them as a seasoning and Want to know how long I should use them in order to confirm the effectiveness). The fifth one (Left upper) is a single cluster composed of "The Rare Sugars were effective after using them for more than one month".

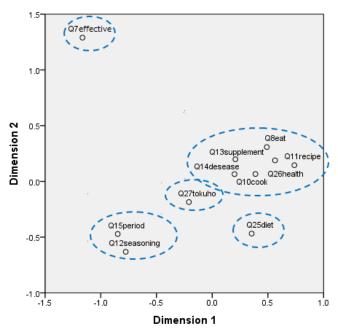


Figure 1: Correspondence Analysis for Common part + Positive (1-9).

3.2 Common part + Negative (1-10)

We can observe the following result from Figure 3.2. From the data, an eigenvalue of Dimension 1 axis is 0.506 and those of Dimension 2 is 0.494. We can extract 3 clusters. The first cluster (Upper right) is a single cluster composed of "The Rare Sugar was effective after using it for more than one month". The second one (Center left) shows "The Rare Sugar is not so famous and feel anxiety although I have interest in the health" (Cannot guess how I should use the Rare Sugar to what kind of cooking, Surrounding people do not use it so often, Not so famous, Cannot find the food in the shop in which the Rare Sugars is included, Cannot have confidence that it is safe for anybody, It seems to be expensive, Want to try to eat or drink the food in which the Rare Sugar is included, Have interest in the designated health food, Have interest in a diet, Careful for the health). The third cluster (Lower left) is a single cluster composed of "Cannot grasp the concrete effect".

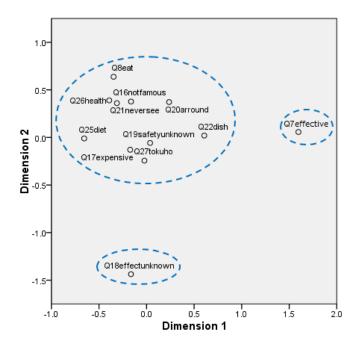


Figure 2: Correspondence Analysis for Common part + Negative (1-10).

4. REMARKS

In the correspondence analysis, 5 clusters could be confirmed in the "Common part + Positive (1-9)" analysis. We could also confirm 3 clusters in the "Common part + Negative (1-10)" analysis. In the "Common part + Positive (1-9)" analysis, Right center cluster and Lower left cluster mainly correspond to the positive questions. On the other hand, Left center cluster mainly corresponds to the negative questions in the "Common part + Negative (1-10)" analysis. "The Rare Sugar was effective after using them for more than one month" appears as a single cluster in each analysis and it shows that it is a rather different item from others. We could grasp the relation among questions group on the whole.

5. CONCLUSION

The Rare Sugars exist naturally and have many kinds (more than 50). They have good effect for health such as prevention of increasing the a blood-sugar level after eating, suppression of fat accumulation, suppression of increasing the blood pressure, and antioxidative effect etc. It is in the spotlight for many people especially for those who are in the metabolic syndrome. There are few related papers concerning the marketing research and its utilization of this matter. In this paper, a questionnaire investigation is executed in order to clarify consumers' current condition and their consciousness, and to seek the possibility of utilizing the rare sugars. Correspondence Analysis was executed based on that. Some interesting and instructive results were obtained.

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Various cases should be examined hereafter.

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APPENDICES

Questionnaire about the Rare Sugars

♦Questionnaire about the Rare Sugars **♦**

2015/6/15

The Rare Sugars exist naturally and have many kinds (morethan 50). They have good effect for health such as prevention of increasing the a blood - sugar level after eating, suppression of fat accumulation, suppression of increasing the blood pressure, and antioxidative effect etc. It is in the spotlight for many people especially for those who are in the metabolic syndrome.

Pleas	e select the appropriate item in each column.(Plural answers are allowed for Q2, 9, 24, 28. Select $\textcircled{0}\sim$	5) in the rig	ght colum f	or Q7, 8,	10-23, 25-27	1.)	
	1.We ask you about the Rare Sugars.						
	1-1. Do you know the Rare Sugars?						
Q1	\bigcirc Choice \bigcirc Do not know (⇒ Proceed to Q8 who has selected $\textcircled{2}$ and answer until to the last.)						
	1-2. We ask you who have selected ①. Where did you know the Rare Sugar? [Plural answers are allowed]						
Q2	①TV ②Magazine ③Newspaper ④Shop ⑤Vending Machine ⑥Seminar ⑦Internet ⑧Hear from another person ⑨Miscellaneous()						
	1-3. Do you know that the Rare Sugar has effect on obese prevention and/or diabetes prevention etc.?						
Q3	①Know ②Do not know						
	1-4. Have you heard or used the syrup which includes Rare Sugar "Rare Sugar Sweet"?						
Q4	①Heard ②Not heard						
Q5	①Used ②Not used						
	1-5. Have you drunk or eaten the food which includes the Rare Sugar?						
Q6	①Yes ②No						
Q7	1-6. We ask you who have selected ① in Q6.Was the Rare Sugar effective after using it for more than one month? (⇒Proceed to Q9)	①Think it very much	②Slightly think so	③Cannot say either	Slightly do not think so	⑤Do not think so	
	1-7. We ask you who have selected ② in Q1,② in Q6. Do you want to try to eat or drink the food in which the Rare Sugar is included?	①Think it very much	②Slightly think so	③Cannot say either	Slightly do not think so	©Do not think so	
	1-8. What kind of food do you want to eat if the Rare Sugar is included? [Plural answers are allowed]						
Q9	①Cake ②Juice ③Japanese food ④Western food ⑤Chinese food ⑥Miscellaneous()			
	1-9.How do you want to use the Rare Sugar?						
Q10	a. I want to use it in the cooking.	①Think it very much	②Slightly think so	③Cannot say either	Slightly do not think so	⑤Do not think so	
Q11	b. I can easily use it if there is a recipe.	Think it very much	@Slightly think so	Cannot say either	Slightly do not think so	Do not think so	
Q12	c. I want to know where I can buy it because I want to use it as a seasoning.	①Think it very much	Slightly think so	③Cannot say either	Slightly do not think so	⑤Do not think so	
Q13	d. I want to know where I can get information because I want to use it as a supplement.	①Think it very much	②Slightly think so	③Cannot say either	Slightly do not think so	⑤Do not think so	
Q14	e. I want to know the hospital where the Rare Sugar is used as a tool for treatment.	①Think it	②Slightly	③Cannot	Slightly do	⑤Do not	
Q15	f. I want to know how long I should use it in order to confirm the effectiveness.	very much (D) Think it very much	think so ②Slightly think so	say either ③Cannot say either	not think so Slightly do not think so	think so (5) Do not think so	

[1-10.Do you have a question(doubt) or anxiety for the Rare Sugar?				1			
	1-10-D0 you have a question (uoubl) of anxiety for the Kare Sugar:	0	8 m	A a b	0	A -		
Q16	a. It is not so popular.	①Think it very much	②Slightly think so	③Cannot say either	Slightly do not think so	⑤Do not think so		
Q17	b. It seems to be expensive.	①Think it	②Slightly	3Cannot	Slightly do	⑤Do not		
x =-		verv much	think so	sav either	not think so	think so		
Q18	c. I cannot grasp the concrete effect.	①Think it very much	②Slightly think so	③Cannot say either	Slightly do not think so	⑤Do not think so		
Q19	d. I cannot have confidence that it is safe for anybody.	①Think it very much	②Slightly think so	③Cannot say either	Slightly do not think so	⑤Do not think so		
Q20	e. Surrounding people do not use it so often.	①Think it very much	②Slightly think so	③Cannot say either	④Slightly do not think so	⑤Do not think so		
Q21	f. I cannot find the food in the shop in which the Rare Sugar is included.	①Think it very much	②Slightly think so	③Cannot say either	Slightly do not think so	⑤Do not think so		
Q22	g. I cannot guess how I should use the Rare Sugar to what kind of cooking?	①Think it very much	②Slightly think so	③Cannot say either	Slightly do not think so	⑤Do not think so		
Q23	h. Miscellaneous ()	①Think it very much	②Slightly think so	③Cannot say either	Slightly do not think so	⑤Do not think so		
	1-11.Choose the drink that you are interested in. [Plural answers are allowed]				1			
Q24	Daojiru 200S-1 (oral rehydration solutionDrink for sports) 3 sports drink 4 designated health drink 5 drink with	the Rare Su	1gar @Noi	ne ⑦Miscel	llaneous ()		
			②Slightly	③Cannot	Slightly do	(5)Do not		
Q25	1-12. Do you take interest in a diet?	very much	think so	say either	not think so	think so		
Q26	1-13. Are you careful for the health?	①Think it very much	②Slightly think so	③Cannot say either	Slightly do not think so	⑤Do not think so		
Q27	1-14. Do you take interest in the designated health food?	①Think it very much	@Slightly think so	③Cannot say either	Slightly do not think so	Do not think so		
	1-15. Which method would be suitable for the Rare Sugar to become popular?							
	①TV CM ②Use Twitter, Facebook ③Advertisement by the company ④Spread the way of cooking ⑤Sell can							
Q28	⑥Sell juice with the Rare Sugar ⑦Restaurant at which the Rare Sugar is used in the cooking ⑧Use it in the foo	d at the ho	spital (9)S	ell it as a su	1pplement 🔟	Make		
	promotion by utilizing famous sportsmen or entertainers)						
	2.What is your hobby? (Select only one in the right hand column)							
Q29	2-1.Playing Sports: ①Baseball ②Football ③Tennis ④Golf ⑤Miscellaneous ()		②Slightly like it	③Ordinary level				
Q30	2-2. Watching Sports: (1)Baseball (2)Football (3)Tennis (4)Golf (5)Miscellaneous ()	①Like it very much	②Slightly	③Ordinary level				
Q31	2-3. Drinking: ①Beer ②Wine ③Japanese wine-sake ④Japanese liquor-shochu ⑤Whisky	@Like it	②Slightly	③Ordinary				
Q31	6 Miscellaneous ()	very much	like it	level				
	3. We ask you questions about your current condition.							
Q32	3-1. Sex: ①Male ②Female							
Q33	3-2. Age: 1)~19 2)20~29 3)30~39 4)40~49 5)50~59 6)More than 60							
Q34	3-3. Occupation: ①Student ②Officer ③Company Employee ④Clerk of Organization ⑤Independents ⑥Part-timer ⑦Housewife ⑧Miscellaneous()							
Q35	5 3-4. Address: ①Prefecture()②City()							
036	3-5. What kind of lifestyle do you like?: ①Outdoor ②Indoor ③Not either							