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The Analysis of Hypothesis Testing 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 blood-sugar level after eating, suppression of fat accumulation, suppression of increasing the blood pressure, and anti-oxidative 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 to the student of Kagawa Junior College in order to clarify consumers' current condition and their consciousness, and to seek the possibility of utilizing the Rare Sugars. Hypothesis testing was executed based on that. Some interesting and instructive results were obtained.

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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 holds 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 to the student of Kagawa Junior College in order to clarify the recognition level among consumers and to pursue the future possibility of the Rare Sugars. Basic statistical analysis and hypothesis testing are conducted. The following three main issues are set.

A) Those who have interest in the Rare Sugars have also interest in health.

B) Those who do not know the Rare Sugars feel anxiety for them.

C) Generally, female have much more interest in the Rare Sugars than male.

Then, 6 sub issues are set and hypothesis testing is executed.

The rest of this paper is organized as follows. In section 2, outline of the questionnaire investigation and its basic statistical results are exhibited. After that, hypothesis testing is performed in section 3, 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 to the student of Kagawa Junior College 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 : Student of Kagawa Junior College

(2) Period : April – June 2015

(3) Method : Leave until called for

(4) Collection : Number of distribution 186

Number of collection 186 (collection rate 100.0%)

Valid answer 186

2.2 Basic Statistical Results

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

(1) Basic characteristics of answerers

Q32 Sex

	Frequency	%
Male	19	10.98266
Female	154	89.01734
Total	173	100

Q33 Age

	Frequency	%
-19	139	80.34682
20-29	33	19.07514
50-59	1	0.578035
Total	173	100

Q34 Occupation

	Frequency	%
Student	171	98.84393
Housewife	1	0.578035
Miscellaneous	1	0.578035
Total	173	100

(2) Summary results for the items used in Hypothesis Testing

Q1

	Frequency	%
Know	150	86.7052
Do not Know	23	13.2948
Total	173	100

Q3

	Frequency	%
Know	107	61.84971
Do not Know	40	23.12139
Miscellaneous	26	15.0289
Total	173	100

Q6

	Frequency	%
Yes	111	64.16185
No	38	21.96532
Miscellaneous	24	13.87283
Total	173	100

Q10 I wont to use it in the cooking.

	Think it very much	Slightly think so	Can not say either	Slightly do not think so	Do not think so	Miscellaneous	Total
Frequency	41	55	62	11	2	2	173
%	23.69942	31.79191	35.83815	6.358382	1.156069	1.156069	100
Q18 I cannot grasp the concrete effect.							
Frequency	36	53	38	28	17	1	173
%	20.80925	30.63584	21.96532	16.18497	9.82659	0.578035	100
Q20 Surrounding people do not use it so often.							
Frequency	37	67	56	11	1	1	173
%	21.38728	38.72832	32.36994	6.358382	0.578035	0.578035	100
Q25 Do you take interest in a diet?							
Frequency	65	52	24	15	15	2	173
%	37.57225	30.0578	13.87283	8.67052	8.67052	1.156069	100

3 Hypothesis testing

Hereinafter we make hypothesis testing based upon the questionnaire investigation data.

(1) Setting Hypothesis

First of all, we start from the hypothesis testing. Three main issues are set as follows.

A) Those who have interest in the Rare Sugars have also interest in health.

B) Those who do not know the Rare Sugars feel anxiety for them.

C) Generally, female have much more interest in the Rare Sugars than male.

Next, we set the following 6 themes (sub issues) before setting Null Hypothesis.

A-1) Those who know that the Rare Sugars are effective for obese prevention and/or diabetes prevention have eaten or drunk food in which the Rare Sugars is contained.

A-2) Those who have eaten or drunk food in which the Rare Sugars is contained have interest in diet.

B-1) Those who do not know the Rare Sugars do not understand the concrete effect of them.

B-2) Those who do not know the rare Sugars have acquaintances who do not use the Rare Sugars.

C-1) Female know the Rare Sugar much more than male.

C-2) Female want to use the Rare Sugars for cooking more than male.

Now, we set the following 6 Null hypothesis.

A-1) There is not so much difference concerning that they have experience of eating and drinking food in which the Rare Sugars are contained between those who know that the Rare Sugars are effective for obese prevention

and/or diabetes prevention and those who do not know.

A-2) There is not so much difference concerning that they have interest in diet between those who have eaten or drunk food in which the Rare Sugars are contained and those who have not.

B-1) There is not so much difference concerning that they do not know the concrete effect of the Rare Sugars between those who know the Rare Sugars and those who do not.

B-2) There is not so much difference concerning that they do not have acquaintances who do not use the Rare Sugars between those who know the Rare Sugars and those who do not.

C-1) There is not so much difference concerning that they know the Rare Sugars well between male and female.

C-2) There is not so much difference concerning that they want to use the Rare Sugars for cooking between male and female.

(2) Hypothesis Testing

x^2 hypothesis testing is executed for about consumers' consciousness on the Rare Sugars. x^2 hypothesis testing is to clarify the difference between the expected value and the observed data, which is shown in Eq.(1).

$$x^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i} \tag{1}$$

Where O_i is an observed data and E_i is an expected value. The results of statistical hypothesis testing are as follows.

Null Hypothesis **A-1)**: There is not so much difference concerning that they have experience of eating and drinking food in which the Rare Sugars are contained between those who know that the Rare Sugars are effective for obese prevention and/or diabetes prevention and those who do not know.

Summary table for Null Hypothesis **A-1)** is exhibited in Table 1.

Table 1. Summary table for Null Hypothesis **A-1)**

	<Observed data>				<Expected value>			
	Think so	Do not think so	Total		Think so	Do not think so	Total	x^2 value
YES	86	21	107	YES	79.34014	27.65986	107	7.947469
NO	23	17	40	NO	29.65986	10.34014	40	P value
Total	109	38	147	Total	109	38	147	0.004815

(Rejection region is over 6.6349 for 1% significance level, 3.841 for 5%

significance level, 3.537 for 6% significance level and 2.874 for 9% significance level by 1 degree of freedom.) The null hypothesis is rejected with 1% significance level. It can be said that those who know that the Rare Sugars are effective for obese prevention and/or diabetes prevention have eaten or drunk food in which the Rare Sugars is contained.

Null Hypothesis **A-2)**: There is not so much difference concerning that they have interest in diet between those who have eaten or drunk food in which the Rare Sugars are contained and those who have not.

Summary table concerning Null Hypothesis **A-2)** is exhibited in Table 2.

Table 2. Summary table for Null Hypothesis **A-2)**

	<Observed data>				<Expected value>			
	Think so	Do not think so	Total		Think so	Do not think so	Total	x^2 value
YES	79	18	97	YES	79.152	17.848	97	0.007082
NO	23	5	28	NO	22.848	5.152	28	P value
Total	102	23	125	Total	102	23	125	0.932933

The null hypothesis is not rejected. It can be said that there is not so much

difference concerning that they have interest in diet between those who have eaten or drunk food in which the Rare Sugars are contained and those who have not.

Null Hypothesis **B-1)**: There is not so much difference concerning that they do not know the concrete effect of the Rare Sugars between those who know the Rare Sugars and those who do not.

Summary table concerning Null Hypothesis **B-1)** is exhibited in Table 3.

Table 3. Summary table for Null Hypothesis **B-1)**

	<Observed data>				<Expected value>			
	Think so	Do not think so	Total		Think so	Do not think so	Total	x^2 value
YES	70	45	115	YES	76.3806	38.6194	115	11.19394
NO	19	0	19	NO	12.6194	6.380597	19	P value
Total	89	45	134	Total	89	45	134	0.000821

The null hypothesis is rejected with 1% significance level. It can be said that those who do not know the Rare Sugars do not understand the concrete effect of them.

Null Hypothesis **B-2)**: There is not so much difference concerning that they do not have acquaintances who do not use the Rare Sugars between those who know the Rare Sugars and those who do not.

Summary table concerning Null Hypothesis **B-2)** is exhibited in Table 4.

Table 4. Summary table for Null Hypothesis **B-2)**

	<Observed data>				<Expected value>			
	Think so	Do not think so	Total		Think so	Do not think so	Total	x^2 value
YES	90	12	102	YES	91.44828	10.55172	102	1.837104
NO	14	0	14	NO	12.55172	1.448276	14	P value
Total	104	12	116	Total	104	12	116	0.175291

The null hypothesis is not rejected. It can be said that There is not so much difference concerning that they do not have acquaintances who do not use the Rare Sugars between those who know the Rare Sugars and those who do not.

Null Hypothesis **C-1)**: There is not so much difference concerning that they know the Rare Sugars well between male and female.

Summary table concerning Null Hypothesis **C-1)** is exhibited in Table 5.

Table 5. Summary table for Null Hypothesis **C-1)**

	<Observed data>				<Expected value>			
	Think so	Do not think so	Total		Think so	Do not think so	Total	x^2 value
YES	13	137	150	YES	16.47399	133.526	150	6.190157
NO	6	17	23	NO	2.526012	20.47399	23	P value
Total	19	154	173	Total	19	154	173	0.012846

The null hypothesis is rejected with 2% significance level. It can be said that female know the Rare Sugar much more than male.

Null Hypothesis **C-2)**: There is not so much difference concerning that they want to use the Rare Sugars for cooking between male and female.

Summary table concerning Null Hypothesis **C-2)** is exhibited in Table 6.

Table 6. Summary table for Null Hypothesis **C-2)**

	<Observed data>				<Expected value>			
	Think so	Do not think so	Total		Think so	Do not think so	Total	x^2value
YES	8	88	96	YES	7.926606	88.07339	96	0.006211
NO	1	12	13	NO	1.073394	11.92661	13	P value
Total	9	100	109	Total	9	100	109	0.937185

The null hypothesis is not rejected. It can be said that there is not so much difference concerning that they want to use the Rare Sugars for cooking between

male and female.

4 Remarks

The Results for Hypothesis Testing are as follows. Main issue A consists of 2 sub issues (**A-1**,**A-2**). One of their Null Hypotheses was rejected and another one was not rejected. It can be said that those who know that the Rare Sugars are effective for obese prevention and/or diabetes prevention have eaten or drunk food in which the Rare Sugars is contained. 2 sub issues were set for the main issue B (**B-1**, **B-2**). One of their Null Hypotheses was rejected and another one was not rejected. It can be said that those who do not know the Rare Sugars do not understand the concrete effect of them. 2 sub issues were set for the main issue C (**C-1**, **C-2**). One of their Null Hypotheses was rejected and another one was not rejected. It can be said that female know the Rare Sugar much more than male.

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 blood-sugar level after eating, suppression of fat accumulation, suppression of increasing the blood pressure, and anti-oxidative 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 was executed to the student of Kagawa Junior

College in order to clarify consumers' current condition and their consciousness, and to seek the possibility of utilizing the Rare Sugars. Hypothesis testing was conducted based on that. We have set three main issues as follows.

A) Those who have interest in the Rare Sugars have also interest in health.

B) Those who do not know the Rare Sugars feel anxiety for them.

C) Generally, female have much more interest in the Rare Sugars than male.

For the A part, it consists of 2 sub issues. One of their Null Hypotheses was rejected and another one was not rejected. It can be said that those who know that the Rare Sugars are effective for obese prevention and/or diabetes prevention have eaten or drunk food in which the Rare Sugars is contained. For the B part, 2 sub issues were set and one of their Null Hypotheses was rejected and another one was not rejected. It can be said that those who do not know the Rare Sugars do not understand the concrete effect of them. For the C part, 2 sub issues were set and one of their Null Hypotheses was rejected and another one was not rejected. It can be said that female know the Rare Sugar much more than male.

Further study on this should be executed such as multivariate analysis. Various cases should be investigated here after.

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◆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.

Please select the appropriate item in each column.(Plural answers are allowed for Q2, 9, 24, 28. Select ①～⑤ in the right colum for Q7, 8, 10-23, 25-27.)

	1.We ask you about the Rare Sugars.					
	1-1. Do you know the Rare Sugars?					
Q1	①Know ②Do not know (⇒ Proceed to Q8 who has selected 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**	**④Slightly do not think so**	**⑤Do not think so**
Q8	**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**	**④Slightly do not think so**	**⑤Do 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**	**④Slightly do not think so**	**⑤Do not think so**
Q11	b. I can easily use it if there is a recipe.	**①Think it very much**	**②Slightly think so**	**③Cannot say either**	**④Slightly do not think so**	**⑤Do 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**	**②Slightly think so**	**③Cannot say either**	**④Slightly 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**	**④Slightly 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 very much**	**②Slightly think so**	**③Cannot say either**	**④Slightly do not think so**	**⑤Do not think so**
Q15	f. I want to know how long I should use it in order to confirm the effectiveness.	**①Think it very much**	**②Slightly think so**	**③Cannot say either**	**④Slightly do not think so**	**⑤Do not think so**
	1-10.Do you have a question(doubt) or anxiety for the Rare Sugar?					
Q16	a. It is not so popular.	**①Think it very much**	**②Slightly think so**	**③Cannot say either**	**④Slightly do not think so**	**⑤Do not think so**
Q17	b. It seems to be expensive.	**①Think it very much**	**②Slightly think so**	**③Cannot say either**	**④Slightly do not think so**	**⑤Do not think so**
Q18	c. I cannot grasp the concrete effect.	**①Think it very much**	**②Slightly think so**	**③Cannot say either**	**④Slightly 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**	**④Slightly 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**	**④Slightly 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**	**④Slightly do not think so**	**⑤Do not think so**
Q23	h. Miscellaneous( )	**①Think it very much**	**②Slightly think so**	**③Cannot say either**	**④Slightly do not think so**	**⑤Do not think so**
	1-11.Choose the drink that you are interested in.【Plural answers are allowed】					
Q24	①aojiru ②OS-1(oral rehydration solutionDrink for sports) ④designated health drink ⑤drink with the Rare Sugar ⑥None ⑦Miscellaneous( )					
Q25	**1-12. Do you take interest in a diet?**	**①Think it very much**	**②Slightly think so**	**③Cannot say either**	**④Slightly do not think so**	**⑤Do not think so**
Q26	**1-13. Are you careful for the health?**	**①Think it very much**	**②Slightly think so**	**③Cannot say either**	**④Slightly do not think so**	**⑤Do not think so**
Q27	**1-14. Do you take interest in the designated health food?**	**①Think it very much**	**②Slightly think so**	**③Cannot say either**	**④Slightly do not think so**	**⑤Do not think so**
	1-15. Which method would be suitable for the Rare Sugar to become popular?					
Q28	①TV CM ②Use Twitter,Facebook ③Advertisement by the company ④Spread the way of cooking ⑤Sell candy with the Rare Sugar ⑥Sell juice with the Rare Sugar ⑦Restaurant at which the Rare Sugar is used in the cooking ⑧Use it in the food at the hospital ⑨Sell it as a supplement ⑩Make promotion by utilizing famous sportsmen or entertainers ⑪Miscellaneous( )					
	2.What is your hobby? (Select only one in the right hand column)					
Q29	2-1.Playing Sports: ①Baseball ②Football ③Tennis ④Golf ⑤Miscellaneous ( )	**①Like it very much**	**②Slightly like it**	**③Ordinary level**		
Q30	2-2. Watching Sports: ①Baseball ②Football ③Tennis ④Golf ⑤Miscellaneous ( )	**①Like it very much**	**②Slightly like it**	**③Ordinary level**		
Q31	2-3. Drinking: ①Beer ②Wine ③Japanese wine-sake ④Japanese liquor-shochu ⑤Whisky ⑥Miscellaneous ( )	**①Like it very much**	**②Slightly like it**	**③Ordinary level**		

	3. We ask you questions about your current condition.
Q32	3-1. Sex: ①Male ②Female
Q33	3-2. Age: ①~19 ②20～29 ③30～39 ④40～49 ⑤50～59 ⑥More than 60
Q34	3-3. Occupation: ①Student ②Officer ③Company Employee ④Clerk of Organization ⑤Independents ⑥Part-timer ⑦Housewife ⑧Miscellaneous( )
Q35	3-4. Address: ①Prefecture( ) ②City( )
Q36	3-5. What kind of lifestyle do you like? : ①Outdoor ②Indoor ③Not either

Appendix Questionnaire about the Rare Sugars