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Comparison between Threshold of Bitterness Perception and Blood Pressure for Resident Health Examination in Yakumo Town

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Abstract- Japan is a super-aged society. Malnutrition, sarcopenia, and flail in the elderly are problems. It has also reported that abnormal olfaction and taste (function decline) occur as an early symptom of Alzheimer's dementia. Taste and smell have a close relationship with appetite. It is need to study the provision of meals that enhance and the combination of foods from the middle age to the elderly. Because Alzheimer's dementia gradually progresses from the middle-ages, and symptoms spear after becoming an older adult. For 16 years, we have conducted research on taste and olfaction in Yakumo town in Hokkaido, Japan, Where the population does not move much. In this report, we report on the results of the taste test using TASTDISC (Bitterness) in 2019 at Yakumo Town Resident Examination, which has been ongoing since 2007.

Keywords: *bitterness; taste; gender; healthy older adult; yakumo study.*

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Comparison between Threshold of Bitterness Perception and Blood Pressure for Resident Health Examination in Yakumo Town

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Abstract- Japan is a super-aged society. Malnutrition, sarcopenia, and flail in the elderly are problems. It has also reported that abnormal olfaction and taste (function decline) occur as an early symptom of Alzheimer's dementia. Taste and smell have a close relationship with appetite. It is need to study the provision of meals that enhance and the combination of foods from the middle age to the elderly. Because Alzheimer's dementia gradually progresses from the middle-ages, and symptoms spear after becoming an older adult. For 16 years, we have conducted research on taste and olfaction in Yakumo town in Hokkaido, Japan, Where the population does not move much. In this report, we report on the results of the taste test using TASTDISC (Bitterness) in 2019at Yakumo Town Resident Examination, which has been ongoing since 2007.From the database, 298 participants (169 females and 129 males) were selected form data in August 2019. The bitterness test performed using the bitterness test paper with liquid TASTEDISC (Sanwa Chemical Laboratory Co., Ltd) which include five different densities of Quinine hydrochloride on a liquid with test paper namely:, 1(0.001%), 2(0.02%),3(0.1%), 4(0.5%), 5(4.0%). As a result, 12males out of 129 male participants (9.3%) and 9females of 169 female participants (5.3%) had abnormal values in bitter taste test (Taste disc) results. Feeling bitterness can also protect us from ingesting dangerous foods (various toxins). However, a low threshold of bitterness in important toenjoy the taste of spring vegetables as such as wild vegetables and the delicious beer taste. Bitterness studies are increasingly needed.

Keywords: bitterness; taste; gender; healthy older adult; yakumo study.

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I. Introduction

Japan is aging and has become a super-aged society as of 2020. The Japanese government is working with prefectures to take measures to extend healthy life expectancy, aiming for healthy longevity. We are recruiting participants for various events, such as cooking classes for preventing under nutrition of the elderly, exercise for preventing dementia, and cooking classes. Taste mainly studied for saltiness and sweetness. This is because the salty taste is closely related to cardiovascular areas such as blood pressure, and the government calls for salt reduction from the perspective of preventing hypertension. Also, the sweetness is related to blood sugar level, HbA1c, etc. It is involved in obesity, diabetes, and even Alzheimer's dementia and a great deal of research has reported to improve lifestyle-related diseases. However, the taste has sourness, bitterness, and umami. Therefore, this study tries to understand what is the threshold value of the bitter taste that determines the taste of beer from the middle ages to the elderly. The bitterness is food is known as a poison such as an alkaloid mainly contained in vegetables. A small amount of bitter taste, like spices, can change the taste of a meal and help to create a variety of tastes. The best example is "the hops" which are indispensable for making beer. At first, even if there is resistance to bitterness, it is that we will want to repeat or eat it. We get used to it. A low threshold of bitterness to quickly detect dangerous tastes and avoid poisonous foods and drinks. From the above, it is also necessary to study the threshold of bitterness that decline with age. This time, we will report the results of a bitterness threshold test conducted at the time of resident screening in Yakumo Town in Hokkaido, Japan, where the population does not move much.

II. Materials and Methods

a) Participants

Yakumo is located in the south of Hokkaido, the northern island of Japan. Townspeople make a living mainly in agriculture and fisheries. The study in Yakumo

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is a prospective cohort study. This research has been ongoing since 1981. The reason is that Yakumo Town has the least migration of population in Japan. The participants had managed their everyday life themselves. And the Nagoya University Graduate School of Medicine, professionals in the fields of epidemiology, internal medicine, orthopedics, neuropsychology, ophthalmology, otolaryngology, and urology joined the Yakumo Study. The participants had been engaged in a variety of jobs. Therefore, this town can be regarded as representative of today's Japanese society. From the database, 298participants (169 females and 129 males) were selected form data in August 2019 (Table 1).

Table 1: Age composition of participants in Yakumo inhabitants examination (n=298)

Participants	40's	50's	60's	70's	80's
Male (129)	10	24	49	40	6
Female (169)	23	40	66	37	3
Total (298)	33	64	115	77	9

b) Assessment of bitter taste identification

The gustatory test was performed using test paper with liquid TASTEDISC (Sanwa Chemical Laboratory Co., Ltd) which include five different densities of Quinine hydrochloride on a liquid with test paper namely:, 1(0.001%), 2(0.02%),3(0.1%), 4(0.5%), 5(4.0%).The inspection method is as follows. 1) Show participants the taste choice paper: Sweet, Salty, Sour, Bitter. Taste something but I don't know, No taste. 2) Hold the filter paper disc with tweezers. The bitterening solution is dropped on it and moistened. 3) The moistened disc is gently placed on the canaliculus chordae tympani innervation area of the participant's tongue. The canaliculus chordaetympani innervation area is located 2 cm left and right from the tip of it. 4) Instruct the user to answer one of the taste choice paper in 2~3 seconds with the mouth open. 5) The examiner then removes the disc from the participant's tongue with tweezers. 6) If a correct answer is not obtained to the participants, the test is continuing to use a solution having a higher concentration in order. 7) After gargling with water to prevent residual teste, perform the next taste test at intervals of 1 minute or more. This method was in accordance with the test method of the teste test kit (TASTEDISC: Sanwa Chemical Laboratory Co., Ltd).

c) Ethical review board

This study is conducted with the approval of the Ethical Review Board (Nagoya women's university Ethics Committee: 'hito wo mochiita kennkyuu ni kansuru iinnkai'). The approval number is 30-14.

d) Statistical processing

The test results were confirmed to be normal distribution by F-test. Data that werethe tolerance range (in this study, it called the normal range) distributed were compared with Student-t without correlation of parametric test. The data that is not normally distributed was compared without correlated Mann-Whitney one of the non-parametric test.

III. Results

a) Participant's body composition and blood pressure

Data on body composition and blood pressure of participants show by age. The males showed in Table 2. And the females showed in Table 3. All data showed as averages by age. For both males and females, the mean values of blood pressure for each generation were in the normal range. Body fat percentage was higher in females than in males, and BMI and body fat were almost the tolerance range (in this study, it called the normal range) for both males and females.

Table 2: Bitterness test (Tastedisc) results and blood pressure and body composition results (Average for Males in their 40's to 80's)

	Number	Age	Height	Weight	Waist	BMI	Body fat rate	Systolic blood pressure	Dyastolic blood pressure
			cm	g	cm	kg/m/m	%	mmHg	mmHg
Average of 40's Male	10	45.5	170.1	74.2	84.8	25.7	23.7	136.8	80.9
Average of 50's Male	24	54.8	168.0	71.3	86.7	25.4	24.4	131.0	81.3
Average of 60's Male	49	64.8	167.3	68.9	86.5	24.6	24.7	138.3	83.1
Average of 70's Male	40	73.0	164.7	66.2	84.6	24.4	23.7	145.5	79.7
Average of 80's Male	6	84.8	159.1	63.5	87.4	25.1	24.3	134.7	66.2
Total average of Male	129	64.9	166.4	68.7	85.8	24.8	24.2	138.9	80.8

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Table 3: Bitterness test (Tastedisc) results and blood pressure and body composition results (Average for Females in their 40's to 80's)

	Number	Age	Height cm	Weight g	Waist cm	BMI kg/m/m	Body fat rate %	Systolic blood pressure mmHg	Dyastolic blood pressure mmHg
Average of 40's Female	**23**	**45.2**	**158.0**	**57.2**	**76.7**	**22.8**	**33.2**	**122.3**	**70.1**
Average of 50's Female	**40**	**54.3**	**155.5**	**56.4**	**76.8**	**23.3**	**33.4**	**131.6**	**77.4**
Average of 60's Female	**66**	**64.5**	**153.8**	**55.7**	**77.7**	**23.5**	**33.9**	**137.1**	**77.0**
Average of 70's Female	**37**	**72.8**	**150.6**	**52.8**	**76.2**	**23.3**	**33.1**	**140.1**	**74.7**
Average of 80's Female	**3**	**82.0**	**147.4**	**49.6**	**78.1**	**22.9**	**31.1**	**149.0**	**77.0**
Total average of Female	**169**	**61.6**	**154.0**	**55.3**	**77.0**	**23.3**	**33.4**	**134.7**	**75.7**

b) Assessment of bitter taste identification

Bitter taste identification performed by using test paper TASTDESC (Sanwa Chemical Laboratory Co., Ltd).Table 4 shows the bitterness measurement results for male and female by age. The bitterness results using TASTDISC can teste for sensitivity to Quinine hydrochloride concentrations. As a result, 12 males of 129 male participants (9.3%) and nine females of 169 female participants (5.3%) had abnormal values in the result of bitterness test. Males almost twice as many as females required consultation.

Table 4: Bitterness test (Tastedisc) results (Number of Males in their 40's to 80's)

	Tastedisc		
(n=298)	**Normal 0.001%, 0.02%**	**Observation 0.1%, 0.5%**	**Consultation 4.0% ormore**
Male 40's (n=10)	**4**	**4**	**2**
Male 50's (n=24)	**11**	**11**	**2**
Male 60's (n=49)	**27**	**17**	**5**
Male 70's (n=40)	**23**	**15**	**2**
Male 80's (n=6)	**2**	**3**	**1**
Male total (n=129)	**67**	**50**	**12**
Female 40's (n=23)	**16**	**7**	**0**
Female 50's (n=40)	**32**	**8**	**0**
Female 60's (n=66)	**45**	**16**	**5**
Female 70's (n=37)	**23**	**10**	**4**
Female 80's (n=3)	**3**	**0**	**0**
Female total(n=169)	**119**	**41**	**9**

c) Statistical processing results

The bitter test result was statistically processed. Table 5 and Table 6 show the results of comparison of the bitterness test results using TASTDISC with the tolerance range (in this study, it called the normal range) systolic and diastolic blood pressure values and others. The results did not show a statistically significant difference in either case.

Table 5: Results of statistical comparison of Bitterness test results between fasting systolic blood pressure level less than 120 (Normal value) and 120 or more

	Systolic biood pressure (mmHg)		Tastedisc test result (Normal=1, Ovservation = 2, Consultation =3)	
	Less than 120	**120 or more**	**Systolic blood pressure e Less than 120**	**Systolic blood pressure 120 or more**
Average±Standard deviaton	**108.934±19.003**	**144.616±16.889**	**1.459±0.601**	**1.435±0.625**
F test	**P=0.0001****		**P=0.326**	
Unpaired student − t test			**P=0.768**	
Mann-Whaitny test	**P=0.0001****			

*** P<0.05, ** P<0.01**

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Table 6: Results of statistical comparison of Bitterness test results between fasting systolic blood pressure level less than 90 (Normal value) and 90 or more

	Diastolic blood pressure (mmHg)		Tastedisc test result (Normal=1, Ovservation = 2, Consultation =3)	
	Less than 90	90 or more	Diastolic blood pressure Less than 90	Diastolic blood pressure 90 or more
Average±Standard deviaton	73.984±8.903	97.180±8.329	1.417±0.605	1.549±0.673
F test	P=0.291		P=0.183	
Unpaired student − t test	P=0.0001**		P=0.615	
Mann-Whaitny test				

Table 7 shows the results of the comparison of the bitterness test results using TASTDISC with the tolerance range (in this study, it called the normal range) BMI and others. The results did not show a statistically significant difference in either case.

Table 7: Results of statistical comparison of Bitterness test results between fasting BMI level less than 25.0 (Normal value) and 25.0 or more

	BMI (kg/m/m)		Saltness test result (Normal=1, Ovservation = 2, Consultation =3)	
	Less than 25.0	2.50 or more	BMI Less than 25.0	BMI 2.50 or more
Average±Standard deviaton	27.548±2.143	32.993±2.439	1.578±0.665	1.439±0.624
F test	P=0.0001**		P=0.246	
Unpaired student − t test			P=0.110	
Mann-Whaitny test	P=0.0001**			

*** P<0.05, ** P<0.01**

Table 8 shows the results of the comparison of the bitterness test results using TASTDISC with the tolerance range (in this study, it called the normal range) Body fat and others. The results showed that there was a statistically significant difference between the tolerance range (in this study, it called the normal range) Body fat range and the others. Participants with a high body fat percentage were able to feel bitterness at thin concentrations than those with a low body fat percentage.

Table 8: Results of statistical comparison of Bitterness test results between fasting Body fat level less than 25.0 (Normal value) and 25.0 or more

	Body fat (%)		Saltness test result (Normal=1, Ovservation = 2, Consultation =3)	
	Less than 25.0	2.50 or more	Body fat % Less than 25.0	Body fatt % 2.50 or more
Average±Standard deviaton	27.548±2.143	32.993±2.439	1.578±0.665	1.388±0.593
F test	P=0.0001**		P=0.097	
Unpaired student − t test			P=017*	
Mann-Whaitny test	P=0.0001**			

*** P<0.05, ** P<0.01**

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Table 9 and Table 10 shows the results of the comparison of the bitterness test results using TASTDISC with the tolerance range (in this study, it called the normal range) Waist circumference range and In Japan, the tolerance range (in this study, it called the normal range) waist circumference of the male is less than 85 cm (Table 9), and female is less than 90 Cm (Table10). The results did not show a statistically significant difference in either case.

Table 9: Results of statistical comparison of Bitterness test results between waist circumference level less than 85.0 (Normal value) and 85.0 or more for Male

	Waist circumference(cm)		Saltness test result (Normal=1, Ovservation = 2, Consultation =3)	
	Less than 85.0	85.0 or more	Waist Less than 85.0	Waist 85.0 or more
Average±Standard deviaton	78.327±4.478	91.603±4.721	1.5741±0.659	1.534±0.647
F test	P=0.334		P=0.440	
Unpaired student − t test	P=0.0001**		P=0.647	
Mann-Whaitny test				

* P<0.05, ** P<0.01

Table 10: Results of statistical comparison of Bitterness test results between waist level less than 90.0 (Normal value) and 85.0 or more for Female

	Waist (cm)		Salttness test result (Normal=1, Ovservation = 2, Consultation =3)	
	Less than 90.0	90.0 or more	Waist Less than 90.0	Waist 90.0 or more
Average±Standard deviaton	75.729±7.477	93.733±4.338	1.346±0.575	1.250±0.452
F test	P=0.0019**		P=0.175	
Unpaired student − t test			P=0.452	
Mann-Whaitny test	P=0.0001**			

* P<0.05, ** P<0.01

(Table 10). The results did not show a statistically significant difference in either case.

IV. Discussion

The taste is mainly divided into 5 flavors, sweetness, saltiness, sourness, bitterness, and umami[1,2,3,4]. It has reported that the cognitive threshold of taste changes with temperature[5]. Of these five tastes, saltiness and bitterness are to be thin when the temperature is high when the temperature is low[6]. Many medicines have a bitter taste and may be difficult for children to take, especially[7]. Many researchers have reported the results of studies of coating the bitter drug with another taste[8]. However, bitterness is an ability necessary to identify dangerous things (poisonous substances, etc.)[9]. The problem is that with age, the taste may deteriorate, and we may not feel the taste[10]. Particularly today, it has begun to be reported that taste perception due to Alzheimer's dementia deteriorates[11,12,13]. Furthermore, it has reported that patients were suffering from coronavirus report sysgeusia[14, 15]. It can say that it is need to study taste. According to the results of our previous research on saltiness, there was no statistically significant difference in saltiness threshold results between all normal ranges, such as blood pressure, BMI, body fat percentage, waist circumference, and the other values[15]. However, this time, when comparing bitterness with the normal range of blood pressure, BMI, body fat percentage, waist circumference as in the case of salty taste, there was a statistically significant difference in body fat percentage. Participants with a low body fat percentage had a high threshold of bitterness, and participants with abundant body fat percentage had a high sensitivity of bitterness. Regarding this result, we need to further investigate. And the relationship between diet and other factors which we need to study in the future.

V. Conclusions

We obtained bitterness test results, TASTDISC, at the time of health check-up in Yakumo Town, Hokkaido, where population migration is low. From the database, 298 participants (169 females and 129 males) were selected form data in August 2019. The Bitterness test performed using test paper with liquid TASTEDISC

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(Sanwa Chemical Laboratory Co., Ltd) which include five different densities of Quinine hydrochloride on a liquid with test paper namely:, 1(0.001%), 2(0.02%), 3(-.1%), 4(0.5%), 5(4.0%). As a result, 12 males out of 129 male participants (9.3%) and nine females of 169 female participants (5.3%) had abnormal values in the bitterness taste test (TASTEDISC) results. The tolerance range (in this study, it called the normal range) of bitterness, blood pressure (systole, diastole), and body composition (BMI, body fat percentage, abdominal circumference) compared with other values. As a result, there was no statistically significant difference in the bitterness threshold between the normal range of blood pressure, BMI, and abdominal circumference and the others. However, there was a statistically significant difference in the threshold of bitterness between the normal range of body fat percentage and the other range. Bitterness thresholds were lower in participants with high body fat than in participants with low body fat. It is necessary to increase the number of participants and analyse it in the future.

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