Full paper

Sensory Research of Soup of Goat Meat in Okinawa

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ABSTRACT Sensory research was carried out in order to investigate the consumer palatability of goat meat. One of traditional Okinawa dish, soup of goat meat was investigated by panel test. The sensory research was conducted by 123 ordinary consumers (male: 83, female: 40). The survey research was carried out based on a questionnaire about taste, aroma, toughness, and greasiness of the meat, where each question was made of five choices. Factors related to profile of the panelists were sex, age, place of origin and preference of the panelists were investigated. In toughness and greasiness, female panelists tended to evaluate the meat more tough and greasy than male panelists ($P < 0.05$). In toughness, the panelists in age of 21-60 class tended to evaluate the meat more tough than panelists of under 20 ($P < 0.05$). In aroma and aggregate score, local panelists tended to evaluate the meat stronger smell than visitors ($P < 0.05$). This survey study reveals preference of the panelists for goat soup is the most important factor to make favor/disfavor decision. This tendency was especially significant in evaluation of aroma, where more local panelists tend to favor the aroma of goat soup.

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Keywords：Goat meat, Okinawan traditional dish, Sensory study, Panel test.

INTRODUCTION

In main island of Japan, the custom of eating goat meat is rare. But in Okinawa, people have distinctive carnivorous culture of eating goat meat such as dishes of sliced raw meat and soup of whole goat meat (Shinjyo *et al.* 1978; Babiker *et al.* 1990; Hirayama *et al.* 2002a). And smell of meat from billy goat is favored among a certain group of people who loves goat meat (Shinjyo 2010). Okinawa is located on the ark of Ryukyu Islands, 700 km south of main island of Japan, where climate zone is categorized into subtropics. Demand of goat meat is such high in Okinawa that Okinawa imports approximately 170 tons of dressed carcass annually from other region of Japan and even from foreign countries (Ministry of Agriculture, Forestry and Fisheries 2009).

On the other hand, goat farming is a key sector in food production chain in developing countries (JLTA 2009) because it is closely related to protein supply to local people via milk production and meat production. In fact, wide spread of the goat production can be explained by their good adaptation to many different climates (ecological adaptation) and small flock size which is common in these countries (Rector 1983; Bauni 1993). Production cycle of goat is shorter than other domestic animals because it reaches mature size earlier and has higher fertility rate. Therefore goat meat production is the most important sector in the region as supply source of protein ingredient (USDA 1999).

Recent situation surrounding goat production in Okinawa reveals that requirement for supplying goat meat from tourism sector is increasing as a part of regional tourism attraction, the carnivorous culture in this region (Kesava *et al.* 1984; Matsuoka *et al.* 1992). However, a certain proportion of consumer even in Okinawa tended to have an attitude of avoiding peculiar smell of goat meat (Shinjyo *et al.* 1978). Goat meat has less fat than sheep meat because distribution of fat is mainly around organs and not between muscles, however, which is main source of fat in sheep (JLTA 2009). Meat of sexually mature billy goat has a strong smell of odor, which may

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or may not be appreciated (JLTA 2009). Therefore, it is necessary to examine characteristic feature of consumer awareness on goat meat in Okinawa (Hirayama *et al*. 2002b). In this research, a sensory research was carried out in order to investigate the consumer appraisal on goat meat.

MATERIALS AND METHODS

In this examination, sensory research was carried out in order to investigate the consumer appraisal on goat meat. One of traditional Okinawa dish, soup of goat meat soup of goat was investigated by panel test. Goat meat was processed, prepared and cooked according to a traditional Okinawan recipe (Shinjyo 2010). Meat-on-the-bone meat, the stomach, and intestines were boiled together, and then it was seasoned only with salt. Goat was adult male crossbred (1.5 years old). Smell of meat from billy goat is favored among a certain group of people who loves goat meat (Shinjyo 2010).

The sensory research was conducted by 123 ordinary consumers (female: 40, male: 83). Profile of panelists participating in this research was presented in Table 1. In terms of age class, number of panelists under 20 was 19, that in 21 to 40 was 46, that in 41 to 60 was 28 and that over 60 was 30. In terms of place origin, number of local panelists was 108 and that of visitors was 15. And in terms of preference of the panelists, number of inexperienced panelists for goat meat was 51, number of panelists who favor goat meat was 56 and number of panelist who disfavor goat meat was 16. The sensory research was made based on a questionnaire about taste, aroma, toughness and greasiness, and each question was made of five choices (Excellent: 2, Good: 1, normal: 0, bad: -1, inferior: -2). Aggregate score was made by summation of these scores. Preliminary statistical analysis and analysis of variance were conducted by a statistical analysis system, Spss ver. 20 (IBM Corp. 2011). General linear model (GLM) was used for the analysis of variance because the data structure was unbalanced, however, all subclasses were filled. Test of significance was based on type 3 sum of squares in GLM. Fixed effect in a linear model included sex (male and female), age (0-20, 21-40, 41-60, 60-; 4 classes), preference for goat meat (favor, disfavor, other and inexperienced) and place origin of the panelists (locals and visitors). After all of two-way interactions were examined, only significant interaction was included in the model.

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Table1 Profile of panelists participating in this study.

Sex	Male	83
	Female	40
Age	Under 20	19
	21-40	46
	41-60	28
	Over 60	30
Place of Origin	Local	108
	Visitor	15
Preference	Inexperienced	51
	Favor	56
	Disfavor	16

Total number of panelists: 123

RESULTS AND DISCUSSION

Result of analysis of variance by general linear model was shown in Table 2. The sex effect was significant in toughness and greasiness ($P < 0.05$). The age effect was significant only in toughness ($P < 0.05$). The effect of place of origin was significant in aroma and aggregate score ($P < 0.05$). The preference effect was highly significant in all of items in the appraisal, taste, aroma, toughness and greasiness, and their aggregate score ($P < 0.001$). The interaction between sex and preference was significant in taste, aroma and aggregate score ($P < 0.05$) and highly significant in toughness ($P < 0.01$). Thus factors characterizing profile of the panelists affected most of the items of sensory research. And

Table 2 Result of analysis of variance (mean squares) by general linear model for sensory research.

Source	DF	Taste	Aroma	Toughness	Greasiness	Aggregate score
Sex	1	0.557	0.015	3.767*	5.221*	0.328
Age	3	1.574	0.577	2.820*	3.208	0.554
Place of Origin	1	2.828	5.267*	0.063	0.025	4.473*
Preference	3	9.309***	18.908***	4.319***	9.078***	11.970***
Sex × Preference	3	2.845*	3.473*	2.463**	-	2.628*
Residual	111	0.923	1.244	0.620	0.972	0.727

Significant level: * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

the preference effect interacted with the sex effect in taste, aroma, toughness, indicating that preference was different between male and female in these items of appraisal.

Result of least square means of the sex effect was presented only for significant two items, toughness and greasiness in Fig. 1. In these items, female panelists tended to evaluate the meat tougher and greasier than male panelists ($P < 0.05$). Thus female seems to be more sensitive to toughness and greasiness of goat meat. In the other items such as taste, aroma and aggregate score, the sex effect was insignificant by GLM analysis.

Least square means of the age effect was presented in Fig. 2. In toughness, two age classes, age of 21-40 and age of 41-60 tended to evaluate the meat tougher than panelists of under 20 ($P < 0.05$). This result suggested that young person do not concern much about physical component of meat taste. In taste, aroma, greasiness and aggregate score, the age effect was insignificant.

Least square means of the place of origin effect was presented in Fig. 3. In aroma and aggregate score, local person tended to evaluate smell of the goat meat stronger than visitors ($P < 0.05$). This difference seems to be caused by imprinting effect for smell of goat because local person have more opportunity to get in touch with live goat and wide variety of dishes of goat meat. In the other items of appraisal; taste, toughness and greasiness, the effect of place of origin was insignificant.

Least square means of the preference effect was presented in Fig. 4. Panelists favoring goat meat tended to evaluate all of the items higher than the others ($P < 0.05$). This result suggested person favoring goat meat tend to admire soup of goat in terms of all of items in appraisal; taste, aroma, toughness and greasiness. Their high score for taste and aroma was within our expectation, however, the high score for toughness and greasiness was unexpected. The latter may be caused by their strict standard for evaluating soup of goat meat.

Difference of the least square means between panelists in favor and inexperienced was largest in aroma. It is often commented in Okinawa that the more experienced the person get with goat meat, the more they like aroma of goat soup. This result was consistent with our previous result that the consumption of goat meat was closely related with its characteristic smell (Hirayama *et al.* 2002b).

The result suggested that female consumer tend to avoid tough and greasy meat in goat soup.

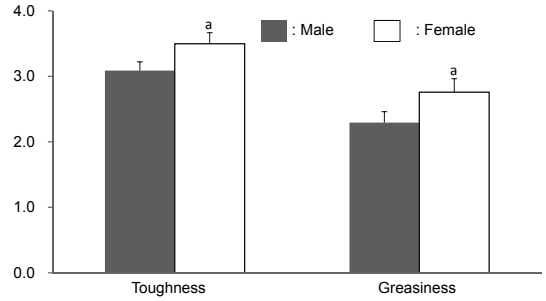

Figure 1 Least square means of sex effect in toughness and greasiness (Error bars = SE). Different letter indicates statistical significance between sexes by Bonferroni's multiple comparison ($P < 0.05$).

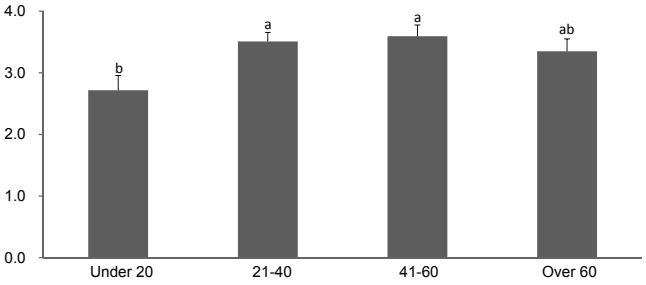

Figure 2 Least square means of age effect in toughness (Error bars = SE). Different letter indicates statistical significance between age effect by Bonferroni's multiple comparison ($P < 0.05$).

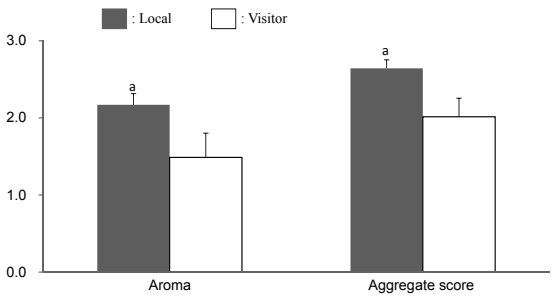

Figure 3 Least square means of place of origin effect in aroma and aggregate score (Error bars = SE). Different letter indicates statistical significance between the place effect by Bonferroni's multiple comparison ($P < 0.05$).

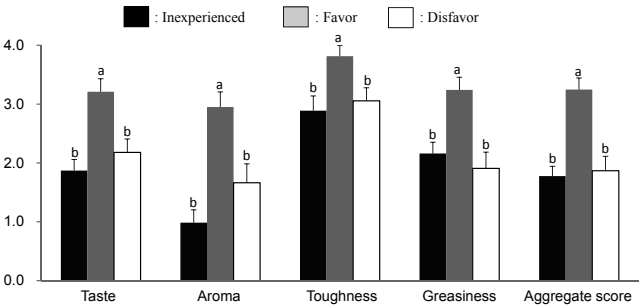

Figure 4 Least square means of preference effect in scores (Error bars = SE). Different letter indicates statistical significance between preference effect by Bonferroni's multiple comparison ($P < 0.05$).

Therefore, a key factor to expand consumption of goat meat is improvement of meat quality of goat meat, such as having more tenderness and less greasiness. Consumption of goat meat will not expand without preference of female consumers because they tend to choose food ingredients more occasionally. Other factor which is critical for increase of consumption is the preference effect because more experienced female panelists tended to evaluate the goat meat more tender. And more, it is necessary to consider about the preference effect interacted with the sex effect in taste, aroma, toughness.

The result of this sensory research revealed that preference of the panelists was the most important factor to determine evaluation of the goat soup. The preference effect influenced every item of the appraisal indicating that early experience of food ingredients considerably affect behavior of consumers. Thus it seems to be highly effective to expose goat meat to consumers more regularly. And the preference effect may affect consumer's allowance of aroma. Furthermore this aroma of goat meat will play a key role for expanding consumption of goat meat because it has possibility to attract more consumers to goat meat.

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要　約

ヤギ汁の食味試験による官能評価

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ヤギ汁の食味試験による官能評価を行う目的で、沖縄県内において最も普通に食されている手法で調理したヤギ汁を用いて、食味試験を実施した。食味試験は男性 83 名、女性 40 名の計 123 名を無作為に抽出して実施した。試験は味、香り、硬さ、および脂っこさの項目について 5 段階評価（最も良い：2、良い：1、普通：0、悪い：-1、最も悪い：-2）として、試食後に速やかに記入させた。

女性は男性に比べヤギ汁の肉を堅く評価し、さらに脂っこいと評価した（$P < 0.05$）。またヤギ汁肉に対する硬さは 21-60 歳までが他の年代よりも有意に硬いと評価した（$P < 0.05$）。被験者の出身地では、地元の人が県外の人よりもヤギ汁の匂いおよび総合評価において高く評価した（$P < 0.05$）。ヤギ汁の経験では、ヤギ汁を好む人が未経験および嫌いとする人に比べ有意に味、香り、硬さ、脂っこさおよび総合評価の全ての項目において高く評価した（$P < 0.05$）。今回の試験から、ヤギ汁の経験が評価に大きな影響を与えていることが示唆された。これらの結果から、今後、ヤギ肉の消費拡大を検討する場合、ヤギ汁の食経験をいかに拡げていくかが重要であると考えられた。その上で、女性にも食べやすいような調理法の工夫などが必要であろうと考えられる。

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