COMBINATION OF CHECK-ALL-THAT-APPLY (CATA) METHOD AND BINOMINAL LOGIT MODEL ANALYSIS FOR CHARACTERIZATION OF CONSUMER PERCEPTION FOR ROASTED PORK LOIN

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I. INTRODUCTION

Consumer-perceived meat attributes are very important factors similarly to objective sensory characteristics assessed by a trained panel for consumer satisfaction of meat and meat products. Check-All-That-Apply (CATA) method has been developed and employed to determine what kind of sensory characteristic is perceived by untrained consumers. We previously characterized sensory traits of beef texture using CATA questions in a trained panel [1], therefore CATA is useful to characterize sensory traits of meat with simple and easy questions. For statistical analysis of CATA data, Cochran's *Q* test and correspondence analysis have mainly been recommended [2]. However, these analytical procedures could not investigate the effects more than the differences in samples, i.e. serving order, replication, and participants, which were generally designated as effects in mixed model procedure for traditional descriptive sensory data analysis. On the other hand, generalized linear model using logit model as a link function has been developed and applied to binominal data analysis in consumer studies, i.e. discrete choice study. CATA also provide binominal data, therefore binominal logit model analysis may be useful for characterization of consumer sensory perception assessed by CATA. In the present study, we carried out to analyze CATA data using logit model to characterize consumer perception for sensory traits in roasted pork loin.

II. MATERIALS AND METHODS

Nine types of pork loin subprimals, which were produced at 5 different farms using several types of pork breeds and feedstuffs, e.g. barley, rice grain, and food-co-products, were used for sensory sessions. Samples were formed into 4-mm x 25-mm x 50-mm, and were dipped into 5% NaCl solution before cooking treatment. Then the samples were heat-treated using steam-convection oven set at 230 C for 4 min and kept in a warmer set at 70 C immediately before presentation to the consumer test.

A total of 117 consumers were recruited from general citizens around Tsukuba city (Ibaraki Prefecture, approximately 60-km from Tokyo). Each participant was isolated from the others by a desk partition. Between each sample evaluation, consumers took a one-minute break and rinsed their mouth using bottled purified water. A term list including 19 sensory attributes (Table 1) were presented in CATA questions. Each participant tested 9 samples and chose the attributes that were suitable for sensory characteristics of each pork sample. A Latin square design was used to investigate the effects of serving order.

Statistical analyses were performed using SAS (version 9.12, SAS Institute, Cary, NC). For generalized linear model procedures, the GENMOD procedure of the SAS was employed. CATA data was analyzed using binominal logit model. Y_{ij} is the judgement in each respondent *i* for each sensory term *j* as suitable ($Y_{ji} = 1$) or unsuitable ($Y_{ij} = 0$) as characteristic attribute of each sample. The probability of $Y_{ij} = 1$ in each attribute

was analyzed by GENMOD procedure; the types of pork and serving order were designated as fixed effects; with participants as a random effect using REPEATED option of the GENMOD procedure.

III. RESULTS AND DISCUSSION

The effects of pork type and serving order on the probability of Y*ij* = 1 in 19 sensory attributes were presented in table 1. Probabilities of choice in nine attributes such as “sweet taste”, “oily odor”, “pork-like odor”, “tender”, “tough”, “juicy”, “dry”, “fat melting”, and “smooth” were significantly (P<0.05) differed between 9 pork samples. Serving order also affected the probabilities of choice in 4 attributes such as “sweet taste”, “sweet odor”, “fat melting” and “firm fat”. These results indicated that both the pork type and serving order affected consumer CATA results. However, results of “sour taste” and “pork-like odor” were different between logit model analysis and traditional Cochran’s *Q* test. Therefore, the effects of both sample and serving order should be analyzed independently in sensory CATA questions similarly to traditional descriptive sensory analysis.

Table 1 Effects of the types of pork and serving order on the probability of choice of sensory attribute analysed by binominal logit model.

Attribute	Effects		Attribute	Effects	
	Pork	Order		Pork	Order
Taste			*Texture*		
Brothy	ns	ns	Tender	***	ns
Sour	ns	ns	Tough	***	ns
Sweet	**	**	Juicy	**	ns
Fatty	ns	ns	Dry	***	ns
Bitter	ns	ns	Fat melting	**	**
Odour			Firm fat	ns	*
Sweet	ns	*	Smooth	***	ns
Butter-like	ns	ns	Rough	ns	ns
Beast	ns	ns			
Bloody	ns	ns			
Oily	*	ns			
Pork-like	*	ns			

ns, P≥0.05, *; P<0.05, **; P<0.01, ***; P<0.001.

IV. CONCLUSION

Combination of CATA questions and generalized linear model analysis using binominal logit model as a link function is useful for characterization of consumers’ sensory perception for meat and meat products with reducing the load in participants. Furthermore, serving order should be designated as an effect for consumer CATA experiments, because the sample serving order affects CATA answers in consumers.

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REFERENCES

1. Sasaki, K., Motoyama, M., Yasuda, J., Yamamoto, T., Oe, M., Narita, T., Imanari, M., Fujimura, S. & Mitsumoto, M. (2010). Beef texture characterization using internationally established texture vocabularies in ISO5492:1992: Differences among four different end-point temperatures in three muscles of Holstein steers. Meat Science 86: 422-429.
2. Mayners, M. & Castura, J.C. (2014). Check-All-That-Apply Questions. In P. Varela, & G. Ares, Novel techniques in sensory characterization and consumer profiling (pp 271-305). Boca Raton: CRC Press.