EFFECT OF LOW-TEMPERATURE PRE-COOKING ON CONSUMER LIKING OF BEEF LOIN STEAKS

Carolina E. Realini[1*], Enrique Pavan[1,2], Renyu Zhang[1], Arvind K. Subbaraj[3] and Santanu Deb-Choudhury[3]

[1]Food Technology & Processing, AgResearch Ltd., Palmerston North, New Zealand

[2]Unidad Integrada Balcarce (FCA, UNMdP - INTA, EEA Balcarce), Balcarce, Argentina

[3] Proteins and Metabolites, AgResearch Ltd., Lincoln, New Zealand

*Corresponding author email: carolina.realini@agresearch.co.nz

I. INTRODUCTION

Cooking methods can significantly influence tenderness, juiciness and flavour impacting the eating quality of meat. Low-temperature long-time cooking (e.g., *sous-vide*) has been suggested to improve tenderness of cooked meat [1]. However, the development of meaty flavours requires high cooking temperatures (e.g., 180-200 °C) to produce volatile compounds resulting from complex biochemical reactions (e.g., Maillard reaction and Strecker degradation) during cooking. This study aimed to investigate the effect of low-temperature pre-cooking methods (oven and *sous-vide*) on consumer liking of beef loin steaks.

II. MATERIALS AND METHODS

Loin sections (*M. longissiums lumborum*) were obtained from five Angus steers at 24 h post-mortem, vacuum packed and wet-aged at -1.5 °C for 14 d, and then frozen at -20 °C until consumer evaluation. Before cooking, loins were thawed at 0 °C for 24 hrs and subsequently cut into 2.5 cm thick steaks. Steaks were cooked using three methods: (1) P: steaks were cooked on pan fry until the core temperature reached 59 °C (control). (2) OP: steaks were overwrapped individually in cooking paper and pre-cooked in oven at 49ºC for 16 hrs followed by cooking on pan fry until reaching 59 °C. (3) SVP: steaks were vacuum-packed and cooked *sous vide* in a water bath at 49 °C for 1 hr followed by cooking on pan fry until reaching 59 °C. Consumers (n=133) evaluated 3 samples corresponding to the different cooking methods from the same animal in each of 12 sessions with 10-12 consumers per session. Samples were served monadically to each panellist in individual booths in different order following a Williams square design. Each consumer rated liking of flavour, juiciness, tenderness, and overall liking by using a 100 mm non-structured line scale anchored at each end (0: dislike extremely to 100: like extremely). Consumer liking scores were normalized for each consumer ($Y_{ij} = X_{ij}$-$X_{.j}$/Standard deviation$_{.j}$) and analysed using a complete randomized design by ANOVA and Proc Mixed from SAS (SAS Institute Inc., Cary, NC, USA). The model included cooking method as fixed effect and loin as a fixed block effect. Session and panellist within session were included in the model as random effects. An agglomerative hierarchical cluster analysis was performed on the square Euclidean distance matrix to identify consumer clusters based on standardized overall liking scores using the Ward method and Proc Cluster from SAS. Consumer data were then analysed by CLUSTER using the same model described above. When the treatment effect was significant ($P < 0.05$), Ls-means were separated using a Tukey test. Correlation analyses were performed using Proc Corr from SAS.

III. RESULTS AND DISCUSSION

The effects of cooking methods on consumer liking of beef by all consumers and by consumer clusters are shown in Table 1. When considering all consumers, overall liking was higher for SVP than OP or P ($P<0.05$). While tenderness liking was not affected by cooking methods ($P>0.05$), liking scores of juiciness and flavour were higher for SVP and OP than for P ($P<0.05$). Two consumer clusters were identified based on overall liking scores, with 52% of participants in Cluster 1 (CL1) and 48% in Cluster 2 (CL2). In CL1, all liking scores were higher ($P<0.05$) for OP than P, while SVP

was intermediate, being lower than OP and higher than P ($P<0.05$), except for juiciness liking that was similar ($P>0.05$) between SVP and OP. Consumers in CL2 showed opposite preferences to CL1, with higher liking scores for P than OP, while SVP was intermediate between the other cooking methods for overall liking and tenderness liking scores. Flavour liking scores were similar for SVP and P and juiciness liking scores did not differ between SVP and the other cooking methods ($P>0.05$). All correlations between tenderness, juiciness and flavour liking with overall liking scores were positive and highly significant ($P<0.05$). Flavour and tenderness liking appear as similar and stronger drivers of overall liking than juiciness for all consumers. Flavour and juiciness liking showed higher correlations than tenderness with overall liking in CL1, while tenderness had the highest correlation with overall liking in CL2. Consumers in CL1 preferred the flavour of meat from OP over the control (P) which could be associated with the changes in volatile profile of cooked steaks. Volatile analysis of the cooked beef samples showed that 25 out of 65 significant metabolic features differentiating the 3 cooking methods, were tentatively identified comprising amines, aldehydes, furans, pyrazines, and alcoholic compounds. Pan fried samples showed highest concentrations of a maximum number of compounds compared to OP and SVP (data not shown). The differences in the volatile profile can be explained by the flavour of low-temperature long-time cooked meat that was dominated by non-volatile compounds and volatiles from lipid degradation, however, amino acids and/or thiamine played a greater role in the definition of cooked meat flavour with the increase of cooking temperatures also reported by other authors [1,2]. Further, consumers in CL2 assigned lower overall liking and tenderness and flavour liking ratings to steaks cooked by OP compared to the other methods. The lower generation of volatile flavour compounds during OP over the traditional cooking with pan-frying can partly explain the preference for P steaks by consumers in CL2.

Table 1. Effect of cooking method on consumer liking scores of beef loin steaks from all consumers and consumers in Cluster 1 and Cluster 2, and correlations among sensory variables.

Sensory attribute	Cooking method*			SEM	P-value	Correlation with Overall liking [y]
	P	OP	SVP			
All consumers (n=133)						
Overall liking	58.172 [b]	62.324 [b]	65.698 [a]	1.667	0.0005	-
Tenderness liking	59.344	55.261	57.206	2.107	0.1472	0.6833****
Juiciness liking	56.583 [b]	63.999 [a]	64.913 [a]	1.686	<0.0001	0.5943****
Flavour liking	58.199 [b]	66.691 [a]	67.425 [a]	1.727	<0.0001	0.6877****
Cluster 1 (n=69, 52%)						
Overall liking	47.111 [c]	70.514 [a]	67.866 [b]	2.069	<0.0001	-
Tenderness liking	50.365 [c]	65.041 [a]	59.623 [b]	2.585	<0.0001	0.5814****
Juiciness liking	49.611 [b]	70.033 [a]	67.987 [a]	2.259	<0.0001	0.7005****
Flavour liking	47.750 [c]	71.810 [a]	67.763 [b]	2.292	<0.0001	0.7721****
Cluster 2 (n=64, 48%)						
Overall liking	70.128 [a]	53.664 [c]	63.391 [b]	2.236	<0.0001	-
Tenderness liking	69.192 [a]	45.042 [c]	54.767 [b]	2.649	<0.0001	0.7924****
Juiciness liking	64.281 [a]	57.779 [b]	61.779 [ab]	2.311	0.0145	0.4758****
Flavour liking	69.690 [a]	61.503 [b]	67.287 [a]	2.343	0.0001	0.5973****

[a-c]Ls-means within the same row with different superscript letter differ ($P<0.05$). [y] Pearson correlation coefficients. **** $P<0.0001$.
*P = pan-frying (control). OP = oven pre-cooking finished with pan-frying. SVP = *sous-vide* pre-cooking finished with pan-frying.

IV. CONCLUSION

Sous-vide pre-cooking at a short time will allow more control over meat doneness during pan-frying leading to more consistent eating quality and a wider preference by consumers. Segmentation results indicate that low-temperature long-time oven pre-cooking is a promising approach to meet the preferences of about half of consumers over the traditional pan-fried beef steaks.

REFERENCES

1. Dominguez-Hernandez, E., Salaseviciene, A., & Ertbjerg, P. (2018). Low-temperature long-time cooking of meat: Eating quality and underlying mechanisms. Meat Science 143: 104–113.
2. Ayub, H., & Ahmad, A. (2019). Physiochemical changes in sous-vide and conventionally cooked meat. International Journal of of Gastronomy and Food Science 17: 100145.