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INVESTIGATING THE CORRELATION BETWEEN PHOSPHOLIPID PROFILE WITH CONSUMER FLAVOR LIKING OF NEW ZEALAND GRASS- AND U.S. GRAIN- FED BEEF STRIPLOINS

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I. INTRODUCTION

Flavor is a major consideration and purchase motivator for beef. Phospholipids have been implicated as major contributors to overall beef flavor, rather than triglycerides [2], due to their susceptibility to oxidation which impacts the formation of volatile lipid compounds, and ultimately influences beef flavor [3]. Grass- and grain-fed beef have well established differences in flavor [4]. We hypothesize that differences in beef flavor can be explained by their diverse phospholipid profiles. Thus, the objective of this study was to utilize grass- and grain-fed beef as a model to better understand the relationship between beef phospholipid profile with consumer liking and beef flavor.

II. MATERIALS AND METHODS

Collection, fabrication, and consumer sensory analysis are described by Lucherk et al. [5]. Grass- and grain-fed beef striploins (IMPS #180) representing five USDA quality grades (Standard, Select, Choice, Upper 2/3 Choice, and Prime) were utilized (*N*=200). Grain-fed striploins were collected from a commercial packing facility in Nebraska, USA, while grass-fed striploins were collected from a commercial plant on the North Island of New Zealand where cattle had year-long access to grass. Following collection, striploins were fabricated into steaks and frozen within 5 d postmortem at Texas Tech University Gordon W. Davis Meat Laboratory. Consumers were recruited for their participation in 25 incentivized panels held in cities across the across the U.S. with five panels in each city, (Lubbock, Texas; San Francisco, California; Gainesville, Florida; Manhattan, Kansas; and State College, Pennsylvania). Consumers evaluated samples on a continuous 10-cm line scale with a zero anchor of dislike extremely and a 10-cm anchor of like extremely. Steaks designated for lipidomic analysis were frozen, pulverized and sent to Kansas State University Meat Chemistry Laboratory. Lipid samples were extracted from each steak and submitted to the Kansas Lipidomic Research Center to determine the comprehensive phospholipid profile using electrospray ionization tandem mass spectrometry (ESI-MS/MS). To analyze the phospholipid profile, a SAS macro was developed to automate the comparison of individual phospholipid species across treatments using the GLIMMIX procedure. The PROC CORR procedure of SAS was used to determine Pearson's correlation coefficient between phospholipid species and consumer flavor liking and overall liking. Statistical significance was determined at $P < 0.05$.

III. RESULTS AND DISCUSSION

There were 353 unique phospholipid species identified through the targeted lipidomics. Significant correlation coefficients for the phospholipid species content and consumer sensory characteristics can be found in Table 1. For phosphatidylcholine (PC), total PC had a negative relationship with both consumer flavor liking (r = -0.26; P <0.01) and overall liking (r = -0.26; P <0.01). As a result, many individual species like PC 36:3 and 36:4 were found to share negative relationships with flavor liking (r = -0.20 and -0.22, respectively; P <0.01) and overall liking (r = -0.28 and -0.25, respectively; P <0.01). However, a few PC species, like PC 32:1 and 44:12, were positively correlated with both flavor (r = 0.15 and 0.19, respectively; P <0.05) and overall liking (r = 0.22 and 0.20, respectively; P <0.01). Only total sphingomyelin (SM) and SM 18:0, were significantly correlated with flavor and overall liking and both were negatively correlated with flavor (r = -0.19 and -0.27, respectively; P <0.01) and overall consumer liking (r = -0.17 and -0.25, respectively; P <0.05). Although the relative percentage of LPE is low compared to other phospholipid classes, many of the LPE species such as total LPE, 16:0, 20:0 and 20:5 shared a strong positive relationship with flavor liking (r = 0.19, 0.20, 0.26 and 0.21, respectively; P < 0.01) and overall liking (r = 0.16, 0.19, 0.27 and 0.20, respectively; P < 0.05). In contrast, only a single phosphatidylethanolamine (PE) species, PE 38:2, was negatively correlated to flavor (r = -0.26; P <0.01) and overall consumer liking (r = -0.25; P <0.01). In addition, several phosphatidylinositol (PI) species such as 34:1, 34:2, 38:2 and 40:0 had strong relationships with flavor (r =0.28, 0.26,

Table 1. Notable correlation coefficient (*r*) of phospholipid species with flavor and overall liking in striploins from grass- and grain-fed cattle.

Phospholipid Species	Flavor Liking	Overall Liking
Phosphatidylcholine (PC)		
32:1	0.15*	0.22**
36:2	-0.16*	-0.23**
36:3	-0.20**	-0.28***
36:4	-0.22**	-0.25**
38:5	-0.23**	-0.15*
40:7	-0.19**	-0.24**
42:9	-0.20**	-0.15*
44:12	0.19*	0.20**
Total	-0.26**	-0.26**
Sphingomyelin (SM)		
18:0	-0.27**	-0.25**
Total	-0.19**	-0.17*
Lysophosphatidylethanolamine (LPE)		
16:0	0.20**	0.19*
16:1	0.15*	0.20**
20:0	0.26**	0.27**
20:3	0.17*	0.15*
20:5	0.21**	0.20**
Total	0.19**	0.16*
Phosphatidylethanolamine (PE)		
38:2	-0.26**	-0.25**
Phosphatidylinositol (PI)		
34:1	0.28***	0.27**
34:2	0.26**	0.26**
36:3	-0.24**	-0.20**
36:6	0.20**	0.20**
38:0	0.19**	0.21**
38:2	-0.26*	-0.28**
38:5	-0.23**	-0.16*
40:0	0.37***	0.33***
40:1	0.21**	0.19**
42:4	0.19**	0.19**
Phosphatidylserine (PS)		
36:3	-0.26**	-0.24**
38:0	0.22**	0.23**
40:6	-0.20**	-0.16*
42:6	0.22**	0.15*

*P <0.05
**P<0.01
***P<0.001

-0.26 and 0.37, respectively; P <0.01) and overall liking (r =0.27, 0.26, -0.28 and 0.33, respectively; P <0.01). Finally, several phosphatidylserine (PS) species were significantly correlated, specifically, PS 36:3 and 38:0 had the strongest relationship with flavor liking (r = -0.26 and 0.22, respectively; P <0.01) and overall liking (r = -0.24 and 0.23, respectively; P <0.01).

IV. CONCLUSION

The factors controlling beef flavor are complex and multifaceted. Our data showed that phospholipid class PC and LPE appear to have a direct relationship with the overall consumer liking and beef flavor liking. PC seems to negatively influence consumer flavor and overall liking, while LPE positively influence those characteristics. On the other hand, strong correlations suggest PI and PS play a significant role in influencing beef flavor and overall likability, but on a more individual species basis. This is one of the first explorations into the dynamic impact of phospholipid profile on beef flavor. Future research is needed to further identify fatty acid location and composition of the phospholipid to unravel the intricacies of beef flavor and aroma.

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