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Fatty Acid Composition of Fresh Pork Bellies -Implications to Bacon Production?

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Fatty Acid Composition of Fresh Pork Bellies — Implications to Bacon Production?

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Summary and Implications

Commercial bacon processors often raise concerns regarding the management practice of frozen storage of the bellies prior to curing and processing for sliced bacon. Deterioration of quality measures is a concern and is usually attributed to freezer storage. A secondary issue, in the production of bacon including those processed from frozen bellies, is the effect of breed and sex of pigs. Therefore, an experiment was conducted to determine the effect of a 15-day frozen storage time, the genetics, and sex of the pig on the quality and fatty acid profile of pork bellies. Frozen storage of fresh pork bellies did not pose any significant quality problems. However, significant differences in the fatty acid profile of fat from the bellies were observed between breeds of pigs. Fat accounts for about 60% of the composition of a slice of bacon. Thus, fatty acid differences of fresh bellies due to breed effects may have a significant impact on bacon fatty acid composition.

Introduction

Consumer demand for lean meat products certainly has extended to cured and smoked sliced bacon. Consumer purchases of bacon are based on leanness, rather than brand name reputation and price. The largest growth in demand for sliced bacon has been in the food service industry recently, where bacon is seen as a flavor contributor for sandwiches, casseroles, salads, and other condiment uses. Consumers say that the amount, composition and consistency of fat are very important to their purchasing decision-making process. Sliced bacon quality problems are associated with fat separation, color of fat, color of lean, consistency and flavor.

Understanding the role of fat in bacon begins with an understanding of the variables that impact the amount and quality of the fat found in the bacon. The fatty acid composition of the fat found in the belly will potentially impact the processing characteristics of the belly, such as the slicing, cooking and eating quality of the bacon. Many factors can influence fatty acid composition including the breed and sex of the pigs as well as other management strategies.

This study is a continuing effort of the National Pork Board to characterize lean growth in pigs and the production of pork products. Additionally, the bellies were evaluated to understand the impact of freezing of raw bellies prior to production of bacon. Frozen storage of fresh bellies is a common practice to manage the cyclical and seasonal supplies of pork bellies. Yet freezing does not usually improve the quality of meat and certainly not the quality of fat and its role on the ultimate eating quality of the bacon.

Procedures

The animals in this study included barrows and gilts (n=578) from six genetic lines: Chester White, Berkshire,

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Table 1. Least square means ± S.E. of the fatty acid profile for sex, line and treatment effects.

Effect	14:0	16:0	16:1	18:0	18:1	18:2	18:3	20:1
Barrows	1.35 ± 0.01	24.04 ± 0.15^{a}	2.64 ± 0.03	11.59 ± 0.13	44.98 ± 0.27	$11.27 \pm -.31$	0.69 ± 0.03	0.80 ± 0.01
Gilts	0.32 ± 0.01	23.17 ± 0.13^{b}	2.58 ± 0.03	11.36 ± 0.11	45.27 ± 0.23	12.06 ± 0.26	0.69 ± 0.02	0.77 ± 0.00
Berkshire	1.36 ± 0.01^{b}	25.09 ± 0.14^{a}	2.88 ± 0.03^{b}	11.89 ± 0.12^{ab}	45.78 ± 0.27^{ab}	9.45 ± 0.27^{b}	0.42 ± 0.03^{b}	0.76 ± 0.00^{b}
Chester White	1.49 ± 0.02^{a}	24.84 ± 0.27^{ab}	3.07 ± 0.06^{a}	11.45 ± 0.24^{b}	45.48 ± 0.48^{c}	9.74 ± 0.54^{b}	0.45 ± 0.06^{b}	0.80 ± 0.01^{bc}
Duroc	1.30 ± 0.01^{c}	22.27 ± 0.12^{d}	2.13 ± 0.02^{e}	11.99 ± 0.11^{a}	41.90 ± 0.22^{e}	15.66 ± 0.25^{a}	1.15 ± 0.02^{a}	0.78 ± 0.00^{b}
Landrace	1.28 ± 0.02^{cd}	23.20 ± 0.33^{c}	2.61 ± 0.07^{c}	11.27 ± 0.30^{b}	47.28 ± 0.66^{ab}	10.17 ± 0.67^{b}	0.46 ± 0.07^{b}	0.77 ± 0.02^{bc}
Poland China	1.30 ± 0.03^{cd}	24.31 ± 0.35^{b}	2.66 ± 0.08^{c}	11.54 ± 0.32^{ab}	47.35 ± 0.63^{a}	9.25 ± 0.71^{b}	0.46 ± 0.08^{b}	0.80 ± 0.02^{ac}
Yorkshire	1.26 ± 0.01^{d}	21.95 ± 0.14^{d}	2.30 ± 0.03^{d}	10.69 ± 0.12^{c}	42.98 ± 0.25^{d}	15.73 ± 0.28^{a}	1.18 ± 0.03^{a}	0.81 ± 0.01^{ac}
Fresh	1.33 ± 0.01	23.79 ± 0.13^{a}	2.63 ± 0.03	11.59 ± 0.12	45.12 ± 0.25	11.36 ± 0.27	0.67 ± 0.03	0.78 ± 0.00
Frozen	1.34 ± 0.01	23.42 ± 0.14^{b}	2.59 ± 0.03	11.35 ± 0.12	45.14 ± 0.26	11.97 ± 0.28	0.70 ± 0.03	0.78 ± 0.00

[a,b,c,d,e]Means within a column with different superscripts are significant $P<0.05$.

Table 2. Least square means ± S.E. for saturated and unsaturated fatty acid content by sex, line and treatment effect.

	Unsaturated Fatty Acids - %	Saturated Fatty Acids - %
Barrows	61.43 ± 0.26^{a}	37.71 ± 0.27^{a}
Gilts	62.51 ± 0.22^{b}	36.59 ± 0.23^{b}
Berkshire	60.20 ± 0.23^{c}	39.05 ± 0.24^{a}
Chester White	60.51 ± 0.46^{c}	38.57 ± 0.47^{a}
Duroc	62.89 ± 0.21^{b}	36.22 ± 0.22^{c}
Landrace	62.40 ± 0.57^{b}	36.64 ± 0.59^{bc}
Poland China	61.46 ± 0.60^{c}	37.82 ± 0.62^{ab}
Yorkshire	64.35 ± 0.24^{a}	34.60 ± 0.25^{d}
Fresh	61.69 ± 0.23	37.44 ± 0.23
Frozen	62.24 ± 0.24	36.86 ± 0.25

[a,b,c]Means with a column for an effect with different superscripts are significant $P<0.05$.

Duroc, Landrace, Poland China and Yorkshire, slaughtered at markets weights starting at 245 pounds. After slaughter, the bellies were fabricated according to industry standards. Bellies were randomly assigned a treatment of fresh (stored only under refrigeration) or frozen (stored frozen for a minimum of 15 days). Prior to processing, frozen bellies were defrosted, removed from the storage packaging, a fat sample removed from the anterior end of the belly for fatty acid analysis. The samples were frozen for subsequent methylation and fractionation by gas chromatography. The fatty acid composition was determined for saturated fatty acids including myristic (C14:0), palmitic (C16:0), stearic and unsaturated fatty acids including palmitoleic(C:16:1), oleic (C18:1) linoleic (C18:2), linolenic (C18:3), and 11-eciosenoatic (C20:1). These were selected as they account for over 95% of the total fatty acids typically found in pork bellies. Each fatty acid was reported as a percentage of total.

Results and Discussion

Barrows and Gilts Comparisons

The only difference ($P<0.05$) observed between sexes (Table 1) showed a minor difference for palmitic (C16:0) acid, although this may not be of biological significance. Barrows had greater levels($P<0.05$) of unsaturated fatty acids (Table 2) with 61.43% for barrows and 62.51% for gilts and saturated fatty acids 37.71% for barrows compared to 36.59% for gilts. Gilts had 1.08% more unsaturated fatty acids than barrows ($P<0.05$). This difference becomes part of the variability often seen during packaging of sliced bacon. This is well within the range that impacts slicing efficiency found in commercial slicing operations.

Breed Comparisons

Fatty acid profiles for the six different breeds were compared. Yorkshire pigs had the most unsaturated fat (64.35%), Landrace and Duroc were intermediate (62.40% and 62.89%) and the Poland China, Chester White and Berkshire were lower in unsaturated fatty acids (61.46%, 60.51% and 60.20%, respectively). The range for unsaturated fatty acids within the 6 breeds evaluated was 4.15 percentage units (Table 2).

The breed influence illustrated in the five largest percent fatty acids reflects the breed differences for specific fatty acids. For C 16:0 palmitic acid there was 3.14 percentage unit variation between the Berkshire (25.09%) and the Yorkshire pigs (21.95%). The other saturated fatty acid, C 18:0, stearic had low variability between the breeds represented in this study with a difference of only 1.40 percentage units from the Durocs (11.99%) to the Yorkshire pigs (10.69%). The most variation was found for fatty acids C 18:1 and 18:2, oleic and linoleic, both unsaturated fatty acids. The variation was 5.45 percentage units for the oleic and 6.48 percentage units

for the linoleic acid within the breeds evaluated. These results clearly show differences exist between breeds in the fatty acid profile belly fat. The magnitude, while statistically significant, would be hard to use for sorting and/or altered processing conditions in the commercial setting due to management problems associated with sorting or knowing the genetic background of the pigs. Understanding and recognizing this source of variation can aid management in refining processes and adjusting the machinery used to slice bacon.

Fresh vs. Frozen Bellies

The characterization of fresh and frozen storage involved a minimal freezing time of at least 15 days before processing. There was no significant (P>0.05) difference found between the fresh and frozen bellies. As would be expected, much longer freezing times would likely be needed to measure loss in quality, particularly of fat as a result of freezer storage. This was not possible in this study. It can be concluded that short time frozen storage had no effect of the bacon quality in this study. While longer storage times are often encountered, they would certainly be more likely undesirable. This study did demonstrate that the act of freezing the bellies posed little quality damage to the bacon nor changes in the fatty acid profiles, often a concern to processors.

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[2]Appreciation expressed to Tommi Jones and Jennifer Sherrill for laboratory assistance.