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BACKFAT QUALITY OF SOUTH AFRICAN BACONER PIGS WITH DIFFERENT CARCASS CLASSIFICATION CHARACTERISTICS

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Introduction

Wood (1984) defined good quality fat in pigs as firm and white. He defined poor quality fat as soft, oily, wet, grey and floppy. Processed meat products like bacon and fermented sausages are especially affected by soft, unsaturated fat of poor quality (Fischer, 1989). Feed ingredients commonly used in pig diets in South Africa are rich in unsaturated fatty acids and have the potential to produce soft backfat with poor technological properties (van der Merwe, 1985; Madsen, Jakobsen & Mortensen, 1992). Other factors that may contribute to inferior fat quality are the very low slaughter weights and constant decrease in backfat thickness of South African pigs over the last decade (SAMIC, 2005).

Iodine value is the parameter mostly used to evaluate subcutaneous pork fat quality (Häuser & Rhyner, 1991). Extractable fat content, refraction index, content of individual fatty acids and ratios thereof have also been used to predict fat quality (Hart, 1956; Enser, 1983; Houben & Krol, 1983; Honkavaara, 1989; Haüser & Prabucki, 1990; Prabucki, 1991; Warnants, Van Oeckel & Boucqué, 1998). A need exists for a rapid method for identifying poor fat quality. A system worth evaluating for application in South Africa is the French system of predicting fat quality. This system entails the selection of adipose tissue using an indirect method based on carcass grading information (Davenel et al., 1999). In the current South African pork classification system, lean meat content is calculated by means of a single backfat and muscle thickness measurement (between the 2^{nd} and 3^{rd} last rib, 45 mm from the carcass midline) in the case of the Hennesey Grading Probe or only backfat thickness in the case of the Intrascope (Bruwer, 1991).

Objectives

The objectives of this study were to obtain an overview of the situation regarding fat quality of pig carcasses in South Africa, to determine whether fat quality of pigs in different classification groups differed and whether backfat thickness and lean meat content groups in the South African pig classification system (PORCUS) could be used to predict fat quality of pig carcasses.

Methodology

Over a one year period, a total of 2107 pig carcasses from all classification groups were sampled at a major South African pig abattoir. A backfat sample was removed at the midline position of each carcass perpindicular to the hole made by the Hennessey Grading probe. Total lipid was extracted from the backfat, according to the method of Folch, Lees & Sloane-Stanley (1957). Fatty acid methyl esters (FAME) was prepared using methanol-BF3 (Slover & Lanza, 1979). Fatty acid methyl esters were quantified using a Varian GX 3400 flame ionization gas chromatograph, with a capillary column (Chrompack CPSIL 88, 100 m length, 0.25 μm ID, 0.2 μm film thickness). Identification of FAME was made by comparing retention times with those of standards obtained from SIGMA (189-19). The following fatty acid ratios were calculated: saturated fatty acids (SFA), mono unsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), stearic to linoleic acid ratio (C18:0/C18:2) and double bond index (DBI). Iodine value was determined by means of the Hanus method (AOAC, 2000). Refraction index was determined with an Abbe refractometer (AOAC, 2000). Analysis of variance (ANOVA) and the Tukey-Kramer multiple comparison test was used to determine whether fat quality parameters of pig carcasses in different classification groups differ significantly (NCSS, 2004).

Results & Discussion

Significant differences were observed between classification groups for carcass mass, backfat thickness, muscle thickness and lean meat content (Table 1). Backfat thickness values of the O, R, C, U and S classification groups, conformed to the minimum backfat thickness value of 15 mm proposed by Davenel et al. (1999). The P classification group had an average lean meat content of 70.10 % and the S classification group an average lean meat content of 60.44 %. Lean meat content from all classification groups were higher than the maximum value of 57 % proposed by Davenel et al. (1999) for good fat quality.

In Table 1, extractable fat content showed a significant ($P < 0.001$) increase with decreased lean meat content and increased backfat thickness (i.e. from the P to the S classification group). None of the groups reached the minimum value of 84 % proposed by Prabucki (1991) for good fat quality. Iodine values showed a significant decrease with increased backfat thickness and decreased lean meat content (Table 1). Only the C, U and S classification groups had average iodine values lower than 70 proposed by Barton-Gade (1987) as the maximum for good fat quality. No classification group could reach a refraction index value of below 1.4598 proposed by Hart (1956) as the maximum for good fat quality.

Both palmitic (C16:0) and C18:0 levels increased significantly ($P < 0.001$) from the P to S classification groups. Good quality fat should contain more than 12 % C18:0 (Houben & Krol, 1983), a criterion fulfilled only by the R, C, U and S classification groups. A significant ($P < 0.001$) increase in oleic acid (C18:1) was observed with increased backfat thickness and decreased lean meat content. Linoleic acid content decreased significantly

Table 1. Average carcass classification and fat quality measurements of pig carcasses within the different classification groups of the SA pig classification system.

Classification group	**P**	**O**	**R**	**C**	**U**	**S**	**All pigs**
% Lean meat content range	≥ 70	68–69	66–67	64–65	62–63	≤ 61	-
Backfat thickness range (mm)	≤ 12	13–17	18–22	23–27	28–32	> 32	-
Number of pigs	539	539	544	347	102	36	2107
Classification parameters:							
Carcass mass (kg)	**69.83**^{a} (5.73)	**73.25**^{b} (5.70)	**74.72**^{c} (5.78)	**76.44**^{d} (5.52)	**78.10**^{d} (5.59)	**77.36**^{cd} (6.10)	**73.58** (6.24)
Backfat thickness (45mm)	**11.61**^{a} (1.15)	**15.05**^{b} (1.26)	**18.77**^{c} (1.32)	**22.97**^{d} (1.35)	**26.95**^{e} (1.39)	**31.41**^{f} (2.55	**17.29** (5.00)
Muscle thickness (mm)	**53.86**^{e} (5.32)	**52.55**^{d} (5.13)	**51.20**^{c} (5.23)	**50.19**^{c} (5.74)	**48.22**^{b} (5.72)	**44.54**^{a} (7.70)	**51.80** (5.68)
Lean meat content (%)	**70.10**^{f} (0.50)	**68.43**^{e} (0.56)	**66.64**^{d} (0.56)	**64.65**^{c} (0.57)	**62.70**^{b} (0.57)	**60.44**^{a} (1.15)	**67.36** (2.40)
Chemical parameters:							
Extractable fat (%)	**70.22**^{a} (5.07)	**74.43**^{b} (3.89)	**77.00**^{c} (3.01)	**78.69**^{d} (2.80)	**79.94**^{e} (2.16)	**79.95**^{de} (3.28)	**75.08** (5.03)
Iodine value	**76.95**^{d} (5.15)	**73.01**^{c} (4.61)	**70.65**^{b} (4.20)	**68.97**^{a} (4.00)	**68.21**^{a} (3.86)	**67.46**^{a} (3.67)	**72.42** (5.45)
Refraction index	**1.46152**^{d} (0.00061)	**1.46102**^{c} (0.00054)	**1.46073**^{b} (0.00049)	**1.46056**^{a} (0.00042)	**1.46047**^{a} (0.00044)	**1.46036**^{a} (0.00047)	**1.46096** (0.00064)
Individual fatty acids:							
C16:0	**20.73**^{a} (1.37)	**21.73**^{b} (1.29)	**22.43**^{c} (1.22)	**22.92**^{d} (1.14)	**23.19**^{d} (1.05)	**23.53**^{d} (1.16)	**21.95** (1.52)
C18:0	**11.06**^{a} (1.33)	**11.68**^{b} (1.27)	**12.15**^{c} (1.31)	**12.51**^{d} (1.26)	**12.66**^{d} (1.24)	**13.00**^{d} (1.25)	**11.85** (1.41)
C18:1	**39.13**^{a} (2.26)	**40.52**^{b} (2.00)	**41.15**^{c} (1.88)	**41.41**^{c} (1.96)	**41.45**^{c} (1.60)	**41.25**^{bc} (2.02)	**40.53** (2.20)
C18:2	**20.13**^{b} (3.44)	**17.27**^{b} (3.03)	**15.76**^{b} (2.63)	**14.89**^{a} (2.67)	**14.55**^{a} (2.42)	**14.27**^{a} (2.59)	**17.04** (3.58)
Fatty acid ratios:							
SFA (%)	**33.61**^{a} (2.54)	**35.20**^{b} (2.35)	**36.36**^{c} (2.33)	**37.17**^{d} (2.16)	**37.60**^{d} (2.13)	**38.27**^{d} (2.17)	**35.59** (2.73)
MUFA (%)	**43.42**^{a} (2.45)	**45.08**^{b} (2.19)	**45.64**^{c} (1.89)	**45.85**^{c} (2.11)	**45.79**^{c} (1.81)	**45.47**^{bc} (1.98)	**44.97** (2.35)
PUFA (%)	**22.33**^{d} (3.74)	**19.20**^{c} (3.23)	**17.53**^{b} (2.81)	**16.59**^{a} (2.88)	**16.23**^{a} (2.66)	**15.88**^{a} (2.73)	**18.94** (3.87)
C18:0/C18:2	**0.57**^{a} (0.15)	**0.70**^{b} (0.17)	**0.80**^{c} (0.20)	**0.88**^{d} (0.23)	**0.90**^{d} (0.22)	**0.95**^{d} (0.22)	**0.74** (0.22)
DBI	**90.49**^{d} (6.12)	**85.61**^{c} (5.27)	**82.56**^{b} (4.86)	**80.73**^{a} (4.65)	**79.84**^{a} (4.59)	**78.79**^{a} (4.51)	**84.87** (6.48)

The value in brackets refer to standard deviation. Means with different superscripts within the same row differ significantly ($P < 0.001$)

($P < 0.001$) from the P to S classification groups. Only the C, U and S classification groups complied with the 15 % maximum C18:2 content proposed by Enser (1983) for good fat quality.

A significant ($P < 0.001$) increase in total SFA content was observed from the P to S classification groups. No group as a whole could comply with the 41 % minimum SFA content proposed by Haüser & Prabucki (1990) for good fat quality. A significant ($P < 0.001$) increase in the total MUFA content was also observed from the P to C classification groups, but a decrease in the MUFA content in the U and S groups were found. All classification groups complied with the 57 % maximum MUFA content proposed by Haüser & Prabucki (1990) for good fat quality. A significant ($P < 0.001$) decrease was observed in total PUFA content from the P to the S classification groups. No classification group could comply with the 15 % maximum PUFA content proposed by Warnants et al. (1998). The C18:0/C18:2 ratio increased significantly with increased backfat thickness and decreased lean meat content. No group could comply with the minimum C18:0/C18:2 ratio of 1.2 proposed by Honkavaara (1989) for good fat quality. A significant decrease was observed in DBI from the P to the S groups. Only the U and S groups could comply with the maximum DBI value of 80 proposed by Prabucki (1991) for good fat quality, while individual pigs from all the groups had DBI values of less than 80.

In spite of the fact that the Hennessey measured backfat thickness from most classification groups conformed to Davenel et al.'s (1999) requirement of more than 15 mm, no classification group could conform to their requirement of < 57 % lean meat for good fat quality. Fat quality from the R, C, U and S classification groups conformed to some of the international fat quality requirements (Table 1). This clearly illustrated that the maximum value of 57 % lean meat content and minimum value of 15 mm backfat thickness used by the French to predict good fat quality are not applicable to South African conditions and that these values will have to be recalculated for the South African pig classification system.

Conclusions

This research indicated that significant differences exist in backfat quality of pigs in different classification groups. Increased backfat thickness and decreased lean meat content were associated with good fat quality. From the data discussed above it is clear that the fat quality of pigs in the P and O classification groups sampled in this survey was generally inferior to those from the R, C, U and S classification groups. Due to the demand for the carcasses of leaner pigs in South Africa, higher prices per kg are generally paid for carcasses from the P and O classes than from the R, C, U and S classes (i.e. those with thicker backfat of better quality).

In pigs and other monogastric animals, the fatty acid composition of the fat tissue triglycerides (particularly in subcutaneous fat) can be changed by altering the fatty acid composition of dietary fat, which is absorbed intact from the small intestine and incorporated directly into fat tissue (Rhee, Davidson, Cross, & Ziprin, 1990). This means that it is possible to modify the fatty acid composition of pigs by the strategic use of specific dietary fat sources (Morgan, Noble, Cocchi & McCartney, 1992). This implies that by including feedstuffs with a more saturated fatty acid profile, dietary manipulation may be used to solve the problem of soft and low quality backfat of pigs in especially the P and O classification groups.

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