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Relationship between ham composition and carcass composition in finishing swine

Abstract
The relationship between ham and carcass composition of 120 barrows with an average initial weight of 130 lb was used to develop prediction equations to determine carcass composition based on ham composition. Eighty pigs were slaughtered to determine total body and ham composition. The first half were slaughtered at 230 lb and the second half at 280 lb. Longissimus muscle area, backfat thickness, whole ham weight, and trimmed ham weight of each pig were recorded 24 h following slaughter. The right ham and the right side of each carcass were ground and analyzed for protein, lipid, moisture, and ash contents. A correlation analysis was conducted at each slaughter weight to determine the relationship between total carcass and ham composition. Based on the results of the correlation analysis, we determined that it would be beneficial to run a regression analysis to develop prediction equations for carcass protein, lipid, and moisture contents. The ash content of the carcass did not appear to be highly correlated to any of the variables tested and, thus, a prediction equation for total body ash was not formulated. Using a stepwise regression analysis, the following equations and correlation coefficients were developed to determine total carcass composition at a slaughter weight of 230 lb: 1) carcass moisture = .4019 + .3911 (ham moisture) - .5301 (ham lipid) (R2 = .73); 2) carcass lipid = .3325 - .3787 (ham moisture) + .7334 (ham lipid) (R2 = .75); and 3) carcass protein = .1985 + .6757 (ham protein) + .0914 (longissimus muscle area) (R2 = .49). For pigs fed to the heavier slaughter weight of 280 lb, the prediction equations were: 1) carcass moisture = 1.2852 - 1.0558 (ham lipid) - 5.5573 (ham ash) - .0165 (whole ham weight) (R2 = .54); 2) carcass lipid = -.1650 + 1.0089 (ham lipid) + .0085 (whole ham weight) (R2 = .74); and 3) carcass protein = .4528 + 2.6234 (ham moisture) - 1.8241 (ham lipid) - 10.4795 (ham ash) + .4690 (ham protein) (R2 = .86). These results indicate that ham composition can be used to predict total carcass composition.; Swine Day, Manhattan, KS, November 18,1993

Keywords
Swine day, 1993; Kansas Agricultural Experiment Station contribution; no. 94-194-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 695; Swine; Body composition; Heavy weight; Carcass

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RELATIONSHIP BETWEEN HAM COMPOSITION AND CARCASS COMPOSITION IN FINISHING SWINE

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Summary

The relationship between ham and carcass composition of 120 barrows with an average initial weight of 130 lb was used to develop prediction equations to determine carcass composition based on ham composition. Eighty pigs were slaughtered to determine total body and ham composition. The first half were slaughtered at 230 lb and the second half at 280 lb. Longissimus muscle area, backfat thickness, whole ham weight, and trimmed ham weight of each pig were recorded 24 h following slaughter. The right ham and the right side of each carcass were ground and analyzed for protein, lipid, moisture, and ash contents. A correlation analysis was conducted at each slaughter weight to determine the relationship between total carcass and ham composition. Based on the results of the correlation analysis, we determined that it would be beneficial to run a regression analysis to develop prediction equations for carcass protein, lipid, and moisture contents. The ash content of the carcass did not appear to be highly correlated to any of the variables tested and, thus, a prediction equation for total body ash was not formulated. Using a stepwise regression analysis, the following equations and correlation coefficients were developed to determine total carcass composition at a slaughter weight of 230 lb: 1) carcass moisture = .4019 + .3911 (ham moisture) - .5301 (ham lipid) (R^2 = .73); 2) carcass lipid = .3325 - .3787 (ham moisture) + .7334 (ham lipid) (R^2 = .75); and 3) carcass protein = .1985 + .6757 (ham protein) + .0914 (longissimus muscle area) (R^2 = .49). For pigs fed to the heavier slaughter weight of 280 lb, the prediction equations were: 1) carcass moisture = 1.2852 - 1.0558 (ham lipid) - 5.5573 (ham ash) - .0165 (whole ham weight) (R^2 = .54); 2) carcass lipid = -.1650 + 1.0089 (ham lipid) + .0085 (whole ham weight) (R^2 = .74); and 3) carcass protein = .4528 + 2.6234 (ham moisture) - 1.8241 (ham lipid) - 10.4795 (ham ash) + .4690 (ham protein) (R^2 = .86). These results indicate that ham composition can be used to predict total carcass composition.

(Key Words: Body Composition, Heavy Weight, Carcass.)

Introduction

Recently, swine producers have started to feed their finishing pigs to a heavier market weight. As a general rule, these heavier pigs have a higher percentage of body fat and a lower percentage of protein when an analysis of total carcass composition is conducted. Occasionally, performing an analysis of body composition is important to researchers to help determine the efficiency of the pigs at different market weights and the value of slaughtering pigs at that particular weight. However, to conduct a total carcass composition analysis is time consuming and costly. An entire side of the pig's carcass must be ground to obtain the necessary data. If equations could be developed to predict the total carcass composition based on a smaller portion of the carcass, time and money could be saved.

Therefore, the objective of this experiment was to determine the relationship between ham composition and total carcass composition in finishing pigs slaughtered at 230 and 280 lb.

Procedures

One hundred twenty crossbred barrows (Duroc × Yorkshire × Hampshire) averaging 130 lb were allotted on the basis of weight and ancestry to 40 pens with three pigs per pen. Pigs were housed in a modified open-front building with solid concrete floors. Pigs had ad libitum access to feed and water. Pigs were weighed at 14-d intervals until the mean weight of the pigs in a pen reached 230 lb. At this time, one pig per pen was randomly selected for slaughter and analysis of carcass composition. The other two pigs remained on their experimental treatments until they reached a final mean weight of 280 lb. One of the two remaining pigs was then randomly selected for slaughter and analysis of total carcass composition. Carcasses of pigs slaughtered at 230 and 280 lb were split in half and chilled at 40°C for 24 h. Then, average backfat thickness and longissimus muscle area (LEA) were measured and recorded. The right ham was removed from each pig for evaluation. A whole ham weight was recorded and then the hams were trimmed to approximately .25 in fat thickness and a trimmed ham weight was recorded. The entire right side of each carcass, including the ham, was then briefly frozen, cut into small pieces, and passed twice through a grinder equipped with a 1/8 in plate. A 1 lb sample of the ground ham was obtained for determination of crude protein, lipid, moisture, and ash contents. The ground ham was then mixed with the rest of the ground carcass for 2 min in a twin ribbon mixer, and a 1 lb sample was obtained for determination of total carcass protein, lipid, moisture, and ash contents.

Results and Discussion

A correlation analysis was conducted at each slaughter weight using the following variables: ham moisture, ham protein, ham ash, ham lipid, carcass moisture, carcass protein, carcass ash, carcass lipid, LEA, average backfat, whole ham weight, and trimmed ham weight. With a perfect correlation being equal to 1 or -1, at 230 lb carcass moisture (r = .77) and carcass lipid (r = -.79) contents were both closely correlated to ham protein and to ham lipid (r = -.84 and .85, respectively) (Table 1). Carcass protein content showed the highest correlation to ham protein (r = .66), ham lipid (r = -.64), and ham moisture (r = .61). Carcass ash content did not appear to be highly correlated to any of the variables tested (r<.48). When pigs were slaughtered at 280 lb, carcass moisture was correlated with ham moisture (r = .61) and ham lipid (r = -.63) (Table 2). Carcass lipid content was closely related to ham lipid (r = .85), ham moisture (r =- .84), and average backfat thickness (r = .79). The protein content of the carcass at 280 lb showed a very close correlation to ham moisture content (r = .90), ham lipid content (r = -.88), and ham protein content (r = .84). As at 230 lb, the ash content of the carcass at 280 lb was not highly correlated to any of the variables tested (r<.50).

Based on the results of the correlation analyses, a stepwise regression analysis was performed to develop prediction equations to determine total carcass protein, lipid, and moisture contents from ham composition and standard carcass measurements. Because total carcass ash was not highly correlated to any of the variables tested, no regression equations were developed. The variables used in the regression analysis included: ham moisture, ham protein, ham lipid, ham ash, LEA, average backfat thickness, whole ham weight, and trimmed ham weight. The use of the stepwise procedure in the regression analysis allowed each variable to be tested, and if the variable was significant (P<.15) level, it was included in the equation.

At a slaughter weight of 230 lb, the equations for predicting total carcass moisture and lipid contents were based on ham moisture and ham lipid content. Of the two variables, ham lipid content was the more important, because this variable had an R^2

value of .70 for total carcass moisture and an R^2 of .73 for total carcass lipid content. The prediction equation derived using both variables was: total carcass moisture = .4019 + .3911 (ham moisture) - .5301 (ham lipid); and total carcass lipid = .3325 - .3787 (ham moisture) + .7334 (ham lipid). When both variables were used in the equations, total carcass moisture had an R^2 value of .73 and total carcass lipid had an R^2 of .75. The protein content of the carcass are not predicted as accurately as lipid and moisture. The equation included both ham protein content and LEA, but the R^2 value was just .49. If only one of these variables is used, ham protein content is better because it provides an R^2 value of .44. The prediction equation is: total carcass protein = .1985 + .6757 (ham protein) + .0914 (LEA).

When pigs were fed to the heavier slaughter weight of 280 lb, the prediction equation for total carcass moisture included ham lipid and ham ash contents and whole ham weight. Using all three variables in the model gave an R^2 value of .54. The equation developed was: total carcass moisture = 1.2852 - 1.0558 (ham lipid) - 5.5573 (ham ash) - .0165 (whole ham weight). The prediction equation for carcass lipid content was: total carcass lipid = -.1650 + 1.0089 (ham lipid) + .0085 (whole ham weight). The final prediction equation for carcass protein content developed for pigs at 280 lb was: total carcass protein = .4528 + 2.6234 (ham moisture) - 1.8241 (ham lipid) - 10.4795 (ham ash) + .4690 (ham protein). This model uses four variables with an R^2 value of .86, but the important variable to include is ham moisture, with an R^2 value of .82.

Although these prediction equations for total carcass composition are certainly not as accurate as performing the actual chemical analysis, they can provide an estimate for determining carcass composition in the pig. Use of these equations can save the researcher time and money and still provide valuable information.

Table 1. Correlation Coefficient between Ham and Total Carcass Composition for Pigs Slaughtered at 230 lb[a]

Variable	Ham Moisture	Ham Lipid	Ham Ash	Ham Protein	Whole Ham Wt	Trimmed Ham Wt	Average Backfat	LEA
Carcass moisture	.805	-.835	.320	.771	.347	.672	-.616	.617
Carcass lipid	-.799	.853	-.311	-.788	-.305	-.667	.593	-.629
Carcass ash	.327	-.485	-.014	.359	.208	.427	-.419	.345
Carcass protein	.613	-.644	.206	.662	.276	.505	-.401	.528

[a]The correlation analysis is based on carcass and ham data from 40 pigs.

Table 2. Correlation Coefficient between Ham and Total Carcass Composition for Pigs Slaughtered at 280 lb[a]

Variable	Ham Moisture	Ham Lipid	Ham Ash	Ham Protein	Whole Ham Wt	Trimmed Ham Wt	Average Backfat	LEA
Carcass moisture	.620	-.634	-.184	.503	-.084	.251	-.608	.408
Carcass lipid	-.838	.850	-.058	-.716	-.006	-.433	.789	-.550
Carcass ash	.412	-.400	.297	.439	-.122	.127	-.504	.237
Carcass protein	.904	-.811	.025	.839	.106	.550	-.804	.618

[a]The correlation analysis is based on carcass and ham data from 40 pigs.