COMPOSITION OF SOUTH AFRICAN BEEF CARCASSES

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SUMMARY

Beef carcasses in South Africa are classified according to three age classes (from zero permanent incisors to more than six) and six visual fatness classes depending on % subcutaneous fat. Carcasses (ranging in weight from 190-230 kg), selected on the commercial market, were evaluated for physically dissected (subcutaneous fat, meat and bone) and chemical cut composition (fat, nitrogen, moisture and ash). Percentages of total fat and muscle of each cut and carcass were calculated from the physical and proximate analyses. Equations were developed from these composition results, to accurately predict carcass and cut composition of the carcasses on the market, within the above-mentioned fat range. A-age carcasses showed the highest muscle to bone ratios, while B-age carcasses had the highest total fat, when compared at a common subcutaneous fat level (%).

Introduction

Creating the opportunity for a full scale, continuous food product promotion to stimulate the market, requires a complete description of the product in terms of composition, eating quality and nutritional content. The South African Meat Board identified this need for beef in 1987, and contracted the Animal Production Institute to provide this broad picture for beef in the South African beef carcass classification system. This article describes only the compositional characteristics of beef. In this regard carcass and primal cut composition were determined for beef carcasses within the different fatness categories. The objectives of this trial are therefore as follows:

-To describe the physical and chemical composition of beef carcasses in the South African beef carcass classification system.
-To provide a data bank for the trade (wholesale & retail) in carcass value and price formation.
-To be of scientific value, e.g. the identification of the cut(s) which is the most accurate predictor of carcass composition.

Materials and methods

Within each of the three age groups, viz. A (no permanent incisors), B (1-6 permanent incisors) and C (more than 6 permanent incisors), carcasses were selected on the South African beef market to represent the six fat classes of the beef carcass classification system. These six fat classes are described in Table 1, together with the number of carcasses selected per fat class. Although fat classes are correctly described by means of fat thickness ranges in the beef carcass classification regulations, the specific subcutaneous fat ranges (Table 1) are visually assessed in the practical appreciation of the system. However, a recent evaluation of the system found that fat classification in practice differed from the classes of the current regulation. Therefore, new fat ranges have been proposed (Table 1), according to which the data of Tables 4 - 6 is reported.

Carcass composition

All carcasses were sectioned into the 15 wholesale cuts (including fillet). Each cut was then accurately weighed and dissected into subcutaneous fat, meat (muscle and intermuscular fat) and bone, in order to determine the physical composition of each cut and the entire carcass. The dissected meat and subcutaneous fat of each cut was minced together and a representative sample was analysed for protein, moisture, fat and ash content (A.O.A.C., 1985). These chemical results were combined with the subcutaneous fat and meat content results of the same cut for calculation of muscle and total fat content of the specific cut.

Statistical analysis

The regression equation $Y = A + BX$ was used for data analyses. In this equation the subcutaneous fat and total fat (%) of the carcass (X) were respectively tested against the subcutaneous fat, total fat, meat, bone and muscle (%) (Y) of each cut and of the entire carcass. Subcutaneous and total fat (%) were also tested against "cut mass as a percentage of carcass mass". The accuracy of these formulae were determined by the R^2 (percentage accuracy) and residual standard deviation - RSD (fault variance around regression line) to obtain repeatable and reliable predictions of carcass and cut composition. In order to obtain the highest accuracy, the respective independent variables in the equation (subcutaneous and total fat % - X) were transformed to X^2, X^3, $\sqrt{x}$ and ln x (natural log). These four transformations, together with the natural x, were combined in a forward stepwise regression analysis and tested against the different carcass/cut compositional characteristics. The specific form of x with the highest accuracy was maintained in the final formulae. These formulae were used for predicting carcass/cut composition if $R^2 \geq 50$ %. The carcass/cut compositional characteristics were otherwise submitted to an analysis of variance for the six fat and 3 age classes, yielding average values for the 18 cells (6 fat code x 3 age groups).

Results and discussion

Should the subcutaneous fat (%) of the carcass (X) and thus fat class (see Table 1) be used to predict carcass/cut composition (Y), the accuracies of the respective regression equations/formulae would be as indicated in Tables 2 and 3 (fore and hind quarter respectively). Only data for the A-age group are presented.

In predicting the muscle and total fat (%) of the carcass and of different cuts, a high degree of accuracy ($R^2 \geq 50$ %) was obtained for most cuts and the carcass (Tables 2 and 3). However, for bone and cut (%) in all instances, with the exception of cut (%) for thin flank, the R^2 was smaller than 50 %. This observation indicates that an analysis of variance (average values/fat class) would have to be performed on these characteristics, while a regression equation could be used with confidence for most cuts in predicting muscle and total fat (%).

Examples of the above-mentioned regression equations (muscle and total fat %) and average values (bone %) for the entire carcass and the prime rib are presented in Tables 4 to 6 (for all three age groups). As far as the muscle (%) of the carcass is concerned (Table 4), it is evident that within the 4-8 % subcutaneous fat range (fat classes 2-3: most preferred in SA) A-age carcasses would yield a higher muscle (%), compared to B- and C-age carcasses. Within the same subcutaneous fat range, B-age carcasses would yield a somewhat higher total fat (%), relative to A- and C-age carcasses, indicating a higher deposition of intermuscular fat in B-age carcasses (Table 5). C-age carcasses yielded a higher bone (%) in the carcass, compared to the A and B-age groups (Table 6). Should the muscle:bone ratio thus be used as an indicator of carcass value, it is evident that, besides the more tender meat of the younger A-age carcass (Klingbiel, 1984), these carcasses would also be characterised by a higher muscle:bone ratio and carcass value.

The prime rib is the single cut in the beef carcass of which the composition corresponds most closely with that of the entire carcass of A-age animals (Naudé, 1972). A close association could thus be expected, should the composition of the carcass be compared with that of the prime rib (Table 4, 5 & 6). The differences between the three age groups, especially regarding the muscle and total fat (%) were, however, much more pronounced in the prime rib than in the carcasses.

Conclusion

-Within a carcass classification system with subcutaneous fat as criterion for fat class allocation, regression equations could be used for predicting muscle and total fat (%) accurately (R^2>50%)
-Carcasses of the younger A-age classes are characterised by a more favourable carcass composition (higher muscle:bone ratio).

References

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KLINGBIEL, J.F.G., 1984. Ontwikkeling van 'n graderingstelsel vir beeskarkasse. D.Sc. Agric. Tesis, Universiteit van Pretoria.
NAUDé, R.T., 1972. Die bepaling van spier, vet en been in karkasse van jong osse. S. Afr. Tydskr. Veek. 2,35.

Table 1: The six fat classes of the South African beef classification system (Klingbiel, 1984: Current regulation and proposed regulation) and number of carcasses per fat class
Table 2: The accuracy of predicting (R-squared) carcass and cut (fore quarter) composition from the subcutaneous fat (%) of the carcass
Table 3: The accuracy of predicting (R-squared) cut composition of the hindquarter from the subcutaneous fat (%) of the carcass
Table 4: The muscle (%) of the carcass and prime rib for the six fat classes within the three age groups
Table 5: The total carcass fat (%) of the carcass and prime rib for the six fat classes within the three age groups
Table 6: The bone (%) of the carcass and prime rib for the six fat classes within the three age groups