Short Communications / Kort Mededelings

Chemical composition of carcass sawdust residue as a predictor of the chemical composition of sheep carcasses

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Twenty sheep, ranging in body mass from 25 to 62 kg, were slaughtered to compare two methods of estimating the chemical composition of the carcass. One half of each carcass was ground in a carcass grinder equipped with a 6 mm sieve and a representative sample taken. The other half was frozen. The complete frozen half was sawed at 25 mm intervals into 'chop' portions with a bandsaw. The tissue residue in the saw was collected. Moisture, fat, protein and ash percentages of the samples were determined. The mean composition of the ground carcass and sawdust samples were respectively: moisture: 56.4 and 55.0% (r^2 = 0.737); fat: 21.2 and 23.1% (r^2 = 0.923); protein: 16.6 and 16.1% (r^2 = 0.154) and ash: 4.7 and 5.5% (r^2 = 0.235). The correlations between sampling techniques compare well with similar comparisons obtained from studies with cattle and pigs. This suggests that a reliable estimate of the fat and moisture content of the carcass can be obtained from the sawdust residue. The technique can be recommended for use in growth and feeding trials with sheep at locations where sophisticated instruments are not available to measure carcass composition.

Twintig skape met 'n liggaamsmassa van tussen 25 en 62 kg is geslag om twee metodes om die chemiese samestelling van karkasse te bepaal, te vergelyk. 'n Halwe karkas van elk is in 'n karkasmeule met 'n 6 mm sif gemaal en 'n monster is geneem. Die ander helfte is gevries. Die heel gevriesde helfte is in 25 mm 'kotelet'-stukke met 'n bandsaag gesaag en 'n monster is van die weefselresidu in die saag geneem. Vog-, vet-, proteïen- en asbepalings van die monsters is gedoen. Die gemiddelde samestelling van die gemaalde- en saagmonsters was respektiewelik soos volg: vog: 56.4 en 55.0% (r^2 = 0.737); vet: 21.2 en 23.1% (r^2 = 0.923); proteïen: 16.6 en 16.1% (r^2 = 0.154) en as: 4.7 en 5.5% (r^2 = 0.235). Die korrelasies tussen metodes van monsterneming stem goed ooreen met soortgelyke vergelykings van bees- en varkkarkasse. Die resultate dui daarop dat die saagresidu-metode van monsterneming betroubare skattings van die vet- en voginhoud van skaapkarkasse gee. Die metode kan by groei- en voedingsproewe met skape aanbeveel word in omstandighede waar gesofistikeerde instrumente om die bepalings te doen, nie beskikbaar is nie.

Keywords: Carcass chemical composition, fat, protein, ash, sawdust residue, sheep.

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In any growth and feeding study on animals, knowledge of the chemical composition of the carcass or the empty body is valuable for proper evaluation of responses to treatments. A standard method for determining the composition of a carcass is to grind up the carcass and to analyse a sample for moisture, protein, fat and ash (Shields *et al.*, 1983). This procedure is expensive due to the need for expensive grinding equipment and because the meat is greatly devalued. Various indirect approaches and methods have been proposed to estimate body and carcass composition. These methods include measuring the composition of the 9-10-11th rib cut; dissection of the carcass into fat, bone and lean meat; determining the thickness of the fat over the eye muscle (*m. longissimus dorsi*) at specific points on the back; determining the specific gravity of the carcass; using urea and other dilution techniques; implementing magnetic resonance imaging; etc. (Reid *et al.*, 1955; Hansard, 1967; Berg & Butterfield, 1976; Kock & Preston, 1979; Fuller *et al.*, 1990).

Vance *et al.* (1970) demonstrated that the chemical composition of untrimmed, wholesale beef cuts corresponded well with the composition of the residue in the saw, collected when the frozen carcasses were sliced into 25 mm cuts. Williams *et al.* (1974) conducted a similar study and reported correlations between the tissue sawdust residue from frozen beef carcasses and the ground carcasses of 0.82, 0.94, 0.64 and 0.68 for moisture, fat, protein and ash percentages respectively. A similar observation was made by Shields *et al.* (1983) on pig carcasses. This sawdust technique does not seem to have received much application in studies on cattle or pigs. The reasons could be that, in cattle, the sawing of carcasses into 25 mm cuts is not done commercially, and in pigs the more simple method of measuring backfat thickness is widely accepted in the determination of carcass composition. On the other hand, the sawing of a whole sheep carcass into 'chop' portions is frequently done commercially and does not render the meat unfit or unacceptable for human consumption. The use of the meat residue accumulated during sawing to predict the chemical composition of the carcass seems a feasible and inexpensive method of obtaining an objective measurement of the carcass composition of sheep used in growth and feeding trials. This investigation was conducted to establish whether the composition of carcass sawdust is reliable in estimating actual carcass composition of sheep.

Twenty SA Mutton Merino sheep, ranging from 25 to 65 kg live mass and 9 to 24 months of age, were slaughtered. The head, skin, internal organs and digestive tract were removed to obtain the carcass (including the kidney fat), as available commercially. Each carcass was carefully split in half along the spine. Once chilled, one half, taken at random, was ground three times through a carcass/meat grinder (Autio Company, Astoria, Oregon, USA) with a final sieve size of 6 mm, and a representative sample taken. The other half of the carcass was frozen (– 20 °C) before being cut into 'chop' portions at regular intervals of 25 mm with a bandsaw. The frozen ribs, sternum and flank were sawed into strips of 25 mm. The residue that accumulated during the sawing of each carcass was collected, mixed thoroughly and sampled. The temperature in the laboratory was kept at below 10 °C during these sample preparations to minimize moisture loss. The samples were frozen pending moisture, fat, protein and ash analyses.

Moisture content was determined in a forced circulation oven at 100 °C. The fat (lipid) was extracted from a separate sample in a two-step process, involving the removal of surplus fat using petroleum ether, followed by the extraction of

Table 1 Mean carcass composition (± std) of the ground carcass as compared to that obtained from the residue in the meat saw

Composition*	Ground		Sawdust		
%		CV%		CV%	r^2(adj)
Moisture	56.4 ± 4.8	24.1	55.0 ± 5.1	25.7	0.737
Fat	21.2 ± 5.1	25.3	23.1 ± 5.8	29.3	0.923
Protein	16.6 ± 2.0	9.8	16.1 ± 1.5	7.6	0.154
Ash	4.7 ± 1.2	5.9	5.6 ± 1.0	4.9	0.235

* Differences between sampling techniques are not significant

the remaining fat with petroleum ether in a Soxlett fat extraction apparatus (Kock & Preston, 1979). Protein (N × 6.25) and ash concentrations were determined on the fat-free sample — protein using the Kjeldahl technique (AOAC, 1985) and ash in a muffle furnace at 450°C. The data were compared statistically, using a Minitab statistical package (Minitab, release 9 for Windows, 1993, Minitab Inc. 3081 Enterprise Drive, State College, PA, USA).

The mass of the frozen carcasses ranged from 11.0 to 30.2 kg with a mean of 22.0 ± 5.19 kg. The composition of the carcasses, sampled according to the two methods, is presented in Table 1. The regression of the predicted fat percentage (ground) on observed fat percentage (sawdust) is depicted in Figure 1. The regression equations for sawdust sample (SAW) on ground sample (GR) were as follows:

Fat GR = 1.96 + 0.832 fat SAW (r^2 = 0.923)
Water GR = 11.6 + 0.814 water SAW (r^2 = 0.737)
Protein GR = 7.36 + 0.575 Protein SAW (r^2 = 0.154)
Ash GR = 1.30 + 0.630 Ash SAW (r^2 = 0.235)

The high correlation between the two sampling techniques for the fat and moisture content of the carcasses support the results, obtained on cattle and pigs, that the composition of sawdust residue can be used to predict the fat and water content of whole carcasses (Williams *et al.*, 1974; Shields *et al.*, 1983). According to Fortin *et al.* (1981), body fat is the most important parameter of the nutritional status of the body. In the present study, fat content ranged from 9.4 to 29.2%, thus covering a wide range of carcass conditions. The prediction of carcass fat and moisture content based on sawdust residue samples should give a reliable estimate of true carcass composition. The correlations coefficients (r) between fat and moisture concentrations of the ground carcasses and the sawdust residues were −0.814 and −0.925 respectively. These high negative correlations agreed well with results obtained in cattle carcasses (Reid *et al.*, 1955; Williams *et al.*, 1974) and support the well-documented inverse relationship which is used in many formulae to calculate body composition (Maynard *et al.*, 1979).

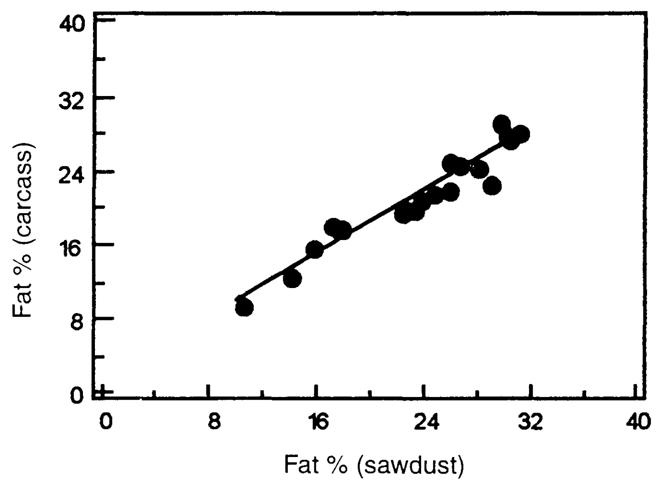

Figure 1 Regression of the fat percentage in sawdust samples on that in the ground carcass samples, Y = 196 + 0.832 X, r^2 = 0.923

Ash and protein concentrations showed very low correlations between sampling techniques. The small variation within protein and ash concentrations might have contributed to these relatively low correlations for these components. A similarly low correlation was reported by Shields *et al.* (1983) between ash concentrations obtained from the whole carcass sample and a sawdust residue sample of pig carcasses. The sawdust sample contained a higher, though not statistically significant, ash content than the ground sample. This may indicate that bone created slightly more sawdust than soft tissue, thus signifying a point of inaccuracy in the tissue sawdust method. Reid *et al.* (1955) reported that the protein and ash content of the empty, fat-free bovine body is practically constant at 80% and 20% respectively, irrespective of type of animal or sex. This was confirmed in other mammals (Maynard *et al.*, 1979). When the protein and ash contents were calculated on a dry, fat-free basis (Table 2), the composition of the carcass remained relatively constant, although percentages were slightly different to those reported for the empty body (Reid *et al.*, 1955; Hansard, 1967). This suggests that a determination of only the fat percentage in a carcass should provide valuable information regarding the chemical composition of the carcass.

Table 2 Percentage protein and ash (± std) in the dry, fat-free carcasses, obtained from a ground carcass and a sawdust residue sample

	Ground	Sawdust
Protein* (%)	77.9 ± 3.99	74.7 ± 3.85
Ash* (%)	22.1 ± 3.98	25.3 ± 3.85

* Differences between sampling techniques are not significant

The results of the present investigation suggest that an analysis of the composition of the sawdust residue can be recommended for estimating the fat and moisture content in the carcass of sheep at the end of a feeding trial. The method does not have the accuracy of sophisticated instruments and techniques which can be conducted at well-equipped laboratories. However, this technique would probably provide a more accurate and objective estimate of carcass fat content than a carcass grade and can replace or complement carcass grading in field experiments. The investigation did not include carcasses from fat-tailed and fat-rumped sheep and further investigations would be required before the sawdust residue technique can be recommended where these types of carcasses are involved. Furthermore, the analytical technique used to measure the fat content in the samples can be simplified and improved by freeze-drying the samples before extracting the fat.

Fortin *et al.* (1981) pointed out that the prediction of carcass composition using the specific gravity technique is too variable to allow for comparisons on an individual animal basis, although the technique is quite suitable for group comparisons. Likewise, a comparison of the chemical composition of sawdust among treatment groups would probably be more reliable than the evaluation of carcasses on an individual basis, considering that variation in fat content of carcasses at the end of a feeding trial would probably be less than the variation used in the present investigation.

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Effect of shelter on the performance of Friesian cows during winter in a mediterranean climate

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The effect of different shelters, that is, a shade structure (3.5 m high) in a dry lot and a tie-stall barn in comparison to a dry lot with no protection against climatic conditions (rain and wind), on the milk production and some physiological parameters of Dutch-type Friesian cows was determined over 53 days during winter in a temperate climate zone. A complete diet (13.5% CP and 9.6 MJ ME/kg DM) was fed ad libitum daily to cows. Ambient temperatures recorded during the trial were within the thermoneutral zone for dairy cattle (18.5 ± 4.0 and 8.7 ± 2.6 °C for maximum and minimum temperatures respectively). Total rainfall during the trial period was 180.6 mm. Daily precipitation higher than 5.0 mm was recorded on 12 days. Although dry matter intake differed (P < 0.01) between treatments, it was not related to treatment. Daily milk production and milk composition did not differ (P > 0.05) between treatments. Plasma cortisol and thyroxine levels of cows in the different housing systems also did not differ (P > 0.05), indicating no advantage in providing elaborate housing facilities for dairy cows under these climatic conditions.

Die invloed van verskillende beskuttingsfasiliteite, naamlik 'n skaduwee-afdak (3.5 m hoog) in 'n oop kamp en 'n intensiewe behuisingstelsel in vergelyking met 'n oop kamp waarin geen beskutting teen klimaatstoestande (reën en wind) verskaf is nie, op die melkproduksie en sekere fisiologiese maatstawwe van Hollandse tipe Frieskoeie is oor 'n periode van 53 dae gedurende die winter in 'n gebied met 'n gematigde klimaat bepaal. 'n Volledige dieet (13.5% RP en 9.6 MJ ME/kg DM) is op 'n *ad libitum*-basis daagliks aan koeie voorsien. Omgewingstemperature gedurende die proefperiode was binne die gemaklikheidsone vir melkkoeie (18.5 ± 4.0 en 8.7 ± 2.6 °C vir maksimum en minimum temperature onderskeidelik). Die totale hoeveelheid reënval gedurende die periode was 180.6 mm. 'n Daaglikse neerslag van hoër as 5.0 mm is op 12 dae aangeteken. Hoewel daaglikse droëmateriaal-innames tussen behandelings verskil het ($P < 0.01$), kan dit nie aan die behandelings toegeskryf word nie. Melkproduksie en melksamestelling van koeie binne die drie behuisingstelsels het nie verskil nie ($P > 0.05$). Bloedplasmapeile van kortisol en tiroksien het ook nie tussen die behandelings verskil nie ($P > 0.05$). Resultate dui op geen voordele in die voorsiening van uitgebreide behuisingsfasiliteite vir melkkoeie onder hierdie klimaatstoestande nie.

Keywords: Milk production, dry lot, tie-stall barn, shade structure, tyroxine, cortisol, temperate climate.

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Various factors such as climate, herd size, cost, management style and tradition influence dairy housing facilities (Larson, 1978). Although climatic conditions in South Africa during winter are relatively mild, dairy farmers are becoming increasingly more concerned about the negative effects of adverse climatic conditions that do occur and are therefore considering different sheltering facilities. In the Western Cape dairy cows are kept under zero grazing conditions in open camps (dry lots) with feed being provided to them on a daily basis. This area has a temperate climate with hot, dry summers and cool, wet winters. Almost 60% of the annual rainfall occurs during the winter (May to August). Wind and rain are significant components determining the coldness of an environment. The insulative value of an animal's hair coat is reduced by wind and rain while the surface heat exchange is increased (Webster, 1981). No information concerning the effect of various shelters on the milk yield of dairy cows is available in South Africa. A study was therefore conducted to determine the effect of providing protection during winter on the production performance of Friesian cows. Physiological parameters such as blood serum concentrations of thyroxine (T_4) and cortisol were also determined to evaluate the physiological responses to protection of cows during winter.