A STANDARD METHOD FOR JOINTING CAMEL CARCASSES WITH REFERENCE TO THE EFFECT OF SLAUGHTER AGE ON CARCASS CHARACTERISTICS IN NAJDI CAMELS. I. WHOLESALE CUT WEIGHT

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Summary

A procedure to standardize camel carcass fabrication is proposed. This includes a definitive method of jointing the carcass into wholesale neck, shoulder, brisket, rib, plate, loin, flank, rump and leg cuts. Carcass cutout data were collected from the right sides of 21 Najdi male camels averaging 8, 16 and 26 months of age in order to determine the influence of age on the weight of each wholesale cut. The weight of body, empty body, hot carcass, cold carcass, hump fat, kidney, pelvic and heart fat (KPH) and each wholesale cut increased ($p < .01$) with age. Except for percent shrinkage and wholesale rump weight, all studied traits increased ($p < .01$) linearly as the age increased. This change was most pronounced in wholesale flank and plate cuts, increasing by 4.2 and 3.4 times, respectively, while the rump and shoulder cuts changed the least, increasing by 1.8 and 1.9 times, respectively. Allometric growth coefficients indicated that as the camel grew, the weight of rib, brisket, plate and flank cuts increased relatively more rapidly than did cold carcass or empty body weight and that the weight of wholesale shoulder, neck, leg and rump increased less rapidly than did cold carcass or empty body weight.

(Key Words: Arabian Camels, Carcass Jointing, Slaughter Age, Wholesale Cuts)

Introduction

The role of the camel as a beast of burden has greatly declined, but an attentive future for the animal is as a meat or milk producer (Knoess, 1977; Wilson, 1984). There is sufficient evidence that the one-humped camel possesses practical and unique attributes for meat production under intensive management in aried areas (Wilson, 1984). Shalash (1979) found that camel's meat varies in amount, composition and quality with age, sex and feeding. Generally, the meat of young camels (below 3 yr) is comparable in taste and texture to beef (Khatami, 1970; Knoess, 1977).

Despite the socio-economical importance of camel meat production in Saudi Arabia, studies determining the carcass characteristics of indigenous camels *Camelus dromedarius*, including the Najdi camel which is the predominant breed in the central region, are limited. The primary objectives of this study were to develop a procedure for jointing camel carcasses and to study the effect of slaughter age on the weight of each wholesale cut. The proposed procedure could provide a standard method enabling comparisons of results among researchers working on camel carcasses.

Materials and Methods

Twenty-one Najdi male camels with an average age of 8 months were selected randomly from the Najdi camel productivity project (AR 6-60) at King Saud University, Riyadh, Saudi Arabia, and assigned to three slaughter age groups (8, 16 and 26 months) of seven animals each. The calves were creep fed on alfalfa hay and commercially formulated dairy calf starter concentrate (18 % crude protein and 12.54 MJ ME/kg) and weaned at 9 months of age. After weaning, they were group-fed in a feedlot on a diet at an average daily consumption rate of 2.1 kg dry matter of feed per 100 kg body weight. The diet was formulated to contain 9.86 MJ ME/kg and consisted of 40% alfalfa hay, 15 % wheat straw and 45 % commercial concentrate. Water, salt and mineral mixture were provided.

The body weight of each camel was recorded to the nearest 1 kg after an 18-hr period without feed. Immediately after weighing, camels were

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slaughtered at a commercial slaughterhouse. After skinning, the contents of the gastrointestinal tract were removed and discarded. The empty gastrointestinal tract and all internal organs were weighed to the nearest 50 g. Hot carcass weight 30 to 45 min after slaughter was measured to the nearest 0.5 kg using a sling balance. Carcass weight included all meat and bones posterior to the atlas joint except below the fore shanks and hind shanks, and included the kidney, pelvic and heart fat (KPH) and hump fat. Carcasses were allowed to chill for 36 h at 10 °C before recording cold carcass weight. Thereafter, chilled carcasses were returned to the University Meat Laboratory for processing. The KPH fat and hump fat were removed by careful trimming from the underlying tissues and their weights recorded to the nearest 50 g. The carcasses were split down the center of the backbone into right and left sides. Since camels have 12 pairs of ribs (Kanan, 1977), the carcass side was divided into forequarter and hindquarter by cutting between the 11th and 12th ribs as shown in figure 1 (line AB). The forequarter was divided into five wholesale cuts, namely neck, shoulder, brisket, rib and plate, and the hindquarter into four wholesale cuts: loin, flank, rump and leg. Using an electric saw, the right forequarter and hindquarter of each carcass were then fabricated (figure 1) according to the following procedures:

1. The flank cut was removed by a cut following the contour of the leg and continued laterally along the lower edge of the loin cut (ventral to the longissimus dorsi) to the end of the 12th rib, a distance equal to the width of the longissimus muscle (line CD).

2. The leg cut was removed by a cut which began at the sacral/caudal junction (E) and passed through a point anterior to the prominence of the ischium bone. This cut continued on a straight line out through the ventral part of the hindquarter and exposed the ball of the femur (line EF).

3. The rump cut was separated from the loin cut by a cut through the tissues perpendicular to the backbone at the seventh lumbar vertebra passing immediately in front of the ilium bone (line GH).

4. The rib and plate cuts were separated from the shoulder and brisket cuts by a cut between the fifth and sixth thoracic vertebrae (line IJ).

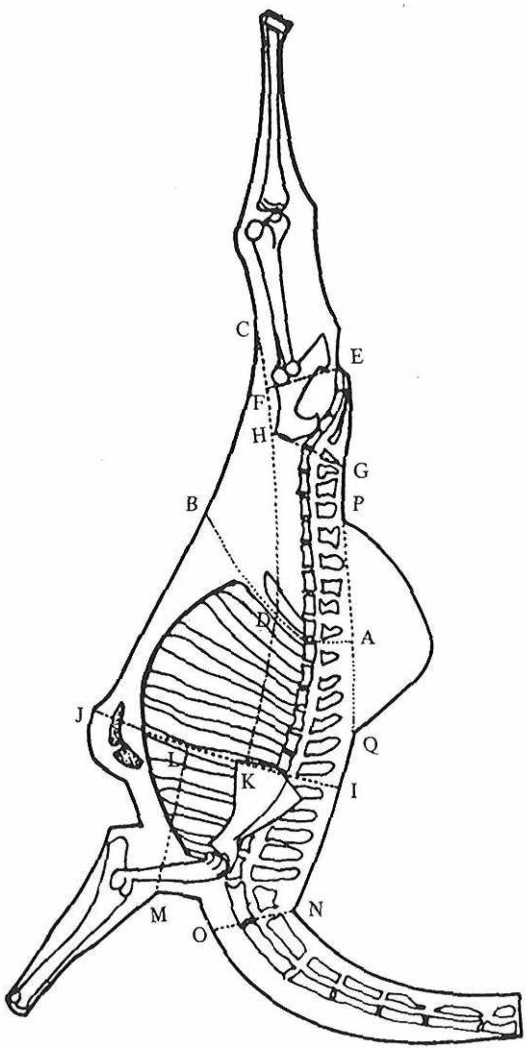

Figure 1. Scheme for jointing the right side of camel carcass into nine wholesale cuts. EFC, leg; GHFE, rump; DBC, flank; ADHG, loin; IKDA, rib; KJBD, plate; QP, hump fat; NOMLI, shoulder; MJL, brisket; NO, neck.

The plate cut was then separated from the rib cut by a cut 20 cm from the dorsal edge of the body of the thoracic vertebra on the loin side end and 15 cm from the tip of the spinous process on the shoulder side end (line DK).

5. The shoulder cut was separated from the brisket cut by a cut across the distal end of the humerus at a point 10 cm above the knuckle and continued on a straight line (LM) parallel to the dorsal edge of the shoulder.

6. The neck cut was separated from the shoulder by a cut which passed between the sixth and seventh cervical vertebrae (line NO).

The bone-in wholesale cuts were weighed to the nearest 50 g and means for each cut within each slaughter age group were calculated. Duncan's multiple range test was used to detect differences between individual group means. The weight of wholesale cuts, body and carcass data were also analyzed by regression analyses. The relationship of the weight of each wholesale cut (Y) to cold carcass or empty body weight (X) were examined using the allometric formula, $Y = \alpha x^{\beta}$ (Seebeck, 1968). The allometric growth coefficients (β) were used to classify the wholesale cuts into three impetus groups: positive growth impetus ($\beta > 1.1$), isometric growth impetus ($.9 \leq \beta \leq 1.1$) and negative growth impetus ($\beta < .9$). All statistical analyses used the statistical analysis system (SAS, 1986).

Results and Discussion

Means of various body and carcass traits for camels slaughtered at the three ages are shown in table 1. The weight of live body, empty body, hot carcass, cold carcass and hump fat increased ($p < .01$) as the slaughter age increased. Empty body weight of Najdi male camels accounted for nearly 90.9 to 92.9 % of live body weight. Wet digesta weight increased with increasing age and while this weight decreased somewhat as a percentage of body weight (9.1 % for younger camels to 7.4 % for older camels), it averaged about 7.9 %. A similar observation was reported by Barber et al. (1981) for Angus and Charolais steers. The reason that wet digesta weight decreased as percentage liveweight is probably explained by the difference in maturation rate for various body organs. Palsson (1955) stated that digestive tract matured earlier than carcass tissues. Therefore, at an older age the proportion of such early maturing tissue, like the gastrointestinal tract and its contained digesta, would decrease as a percentage of the live body weight of the animal. Shrinkage percent and KPH fat weight increased ($p < .01$) with increasing camel slaughter age. In contrast, Bailey and Cox (1976) and Sents et al. (1982) stated that for any given conditions in chilling, the evaporation losses from small, poorly covered sides will be greater than those from large sides having a good fat cover. However, the authors were unable to find a reasonable explaination for this discrepancy. All formerly mentioned

TABLE 1. MEANS FOR VARIOUS BODY AND CARCASS CHARACTERISTICS FROM NAJDI MALE CAMELS SLAUGHTERED AT 3 AGES AND THEIR REGRESSION COEFFICIENTS AS REGRESSED ON AGE

Character	Age (months)						
	8	16	26	SE	b^a	SE	R^2
No. of animals	7	7	7				
Body wt (kg)	171.2^b	295.4^c	450.9^d	14.2	14.67**	1.25	.93
Empty body wt (kg)	155.6^b	274.3^c	417.5^d	13.2	13.69**	1.21	.92
Hot carcass wt (kg)	107.3^b	180.7^c	281.7^d	6.6	9.25**	.69	.94
Cold carcass wt (kg)	105.3^b	176.8^c	273.4^d	6.3	8.90**	.70	.94
Dressing percent[e]	61.5	59.9	60.6	2.4	−.01	.01	.01
Shrinkage percent	1.9^b	2.2^{bc}	2.9^c	.1	.05	.03	.11
KPH fat wt (kg)	1.0^b	1.7^{bc}	2.5^c	.2	.08**	.02	.61
Percentage of KPH fat[e]	.9	1.0	.9	.1	−.01	.01	.02
Hump fat wt (kg)	4.8^b	11.1^c	17.1^d	1.7	.65**	.14	.66
Percentage of hump fat[e]	4.6	6.3	6.3	.8	.08	.06	.11

[a]Regression coefficient; ** $p < .01$.

[b,c,d]Means in the same line bearing different superscripts differ ($p < .01$).

[e]Expressed as a percentage of cold carcass wt.

body and carcass traits increased linearly ($p < .01$) with age except for shrinkage percent. On the other hand, dressing percent, KPH fat and hump fat expressed as percentage of cold carcass weight did not change ($p > .01$) as camel slaughter age increased.

Means of wholesale cut weight in the cold carcass side from the three slaughter age groups are shown in table 2. The weight of wholesale neck, shoulder, brisket, rib, loin, plate and leg cuts increased ($p < .01$) as age increased from 8 to 16 months and from 16 to 26 months. Moreover, the weight of flank cut increased ($p > .01$) from 8 to 16 months of age and ($p < .01$) from 16 to 26 months of age, whereas wholesale rump cut weight significantly increased ($p < .01$) only from 8 to 16 months of age. The change in weight of the flank, plate and brisket cuts between 8 and 26 months of age was greater, reaching 4.2, 3.4 and 3.3 times respectively, than the rump and shoulder cuts

TABLE 2. MEANS FOR VARIOUS WHOLESALE CUT WEIGHTS IN COLD CARCASS SIDE FROM NAJDI MALE CAMELS SLAUGHTERED AT 3 AGES AND THEIR REGRESSION COEFFICIENTS AS REGRESSED ON AGE

Wholesale cut	Age (months)						
	8	16	26	SE	b[a]	SE	R^2
No. of animals	7	7	7				
Neck wt (kg)	4.7[b]	7.4[c]	10.7[d]	.36	.31**	.03	.88
Shoulder wt (kg)	9.6[b]	14.0[c]	18.2[d]	.62	.46**	.08	.76
Brisket wt (kg)	6.3[b]	12.5[c]	20.8[d]	1.10	.76**	.10	.85
Rib wt (kg)	4.7[b]	8.4[c]	15.4[d]	.77	.59**	.05	.92
Loin wt (kg)	4.4[b]	7.0[c]	11.1[d]	.40	.36**	.06	.76
Rump wt (kg)	4.0[b]	5.9[c]	7.3[c]	.31	.14*	.01	.43
Plate wt (kg)	3.6[b]	7.0[c]	12.2[d]	.33	.46**	.05	.89
Flank wt (kg)	1.0[b]	1.8[b]	4.2[c]	.05	.19**	.04	.70
Leg wt (kg)	11.6[b]	17.9[c]	27.1[d]	1.37	.83**	.09	.94
Total side wt (kg)	49.9[b]	81.9[c]	127.0[d]	4.78			

[a]Regression coefficient; * $p < .05$; ** $p < .01$.
[b,c,d]Means in the same line bearing different superscripts differ ($p < .01$).

which increasing by 1.8 and 1.9 times, respectively. These data, however, showed a trend of a dorso-ventral growth wave on the whole body of the camels, confirming partly the findings of Fortin et al. (1980) that abdominal muscles were later developing than the muscles surrounding the spinal column for Angus and Holstein cattle. Detailed physical dissection data of the same carcasses showed that the pronounced change in weight of brisket and flank cuts was partly due to a rapid increase in lean weight (Abouheif et al., unpublished data). Other reports on cattle (Koch et al., 1981), sheep (Abouheif et al., 1988) and camels (Abouheif et al., unpublished data) showed that the flank and plate cuts are the site of a large amount of fat deposition, which is known to be a late maturing tissue. Further, the weight of all wholesale cuts increased ($p < .01$), except for rump weight ($p < .05$), in a linear manner as slaughter age increased. The linear relationship with leg and rib cut weight as indicated from R^2 values were relatively stronger than those calculated for the remaining wholesale cut weights.

The percentage distribution of cold carcass side weight to the wholesale cuts are shown in figure 2. Except for shoulder, brisket, rump and plate cuts, wholesale cuts expressed as a percentage of cold side weights were not significantly affected by slaughter age. As age increased from 8 to 26 months, there was a decrease ($p < .01$) in the percentage of shoulder and rump cuts and an increase ($p < .01$) in brisket and plate cuts. In general, the value obtained for carcass forequarter to carcass weight showed differences between

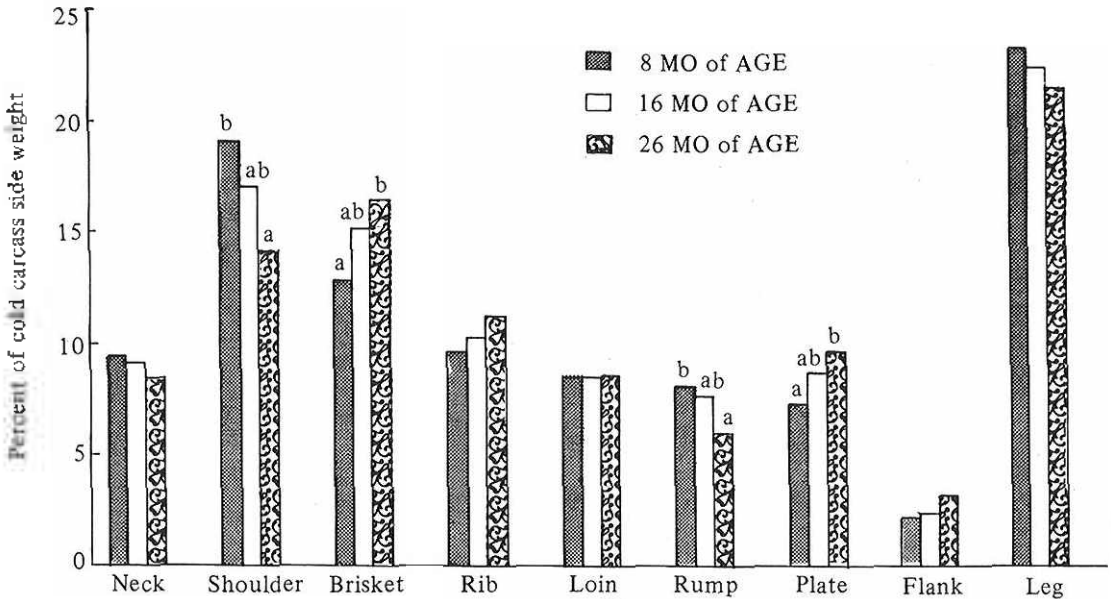

Figure 2. The distribution percentages of cold carcass side weight among the wholesale cuts from Najdi male camels slaughtered at different ages. Columns within each wholesale cut with different superscripts differ ($p < .01$).

camel and cattle or sheep carcasses. The weight percentage of the forequarter of the camel's carcass (60%) exceeded lamb, veal and beef carcasses (Forrest et al., 1975). This may simply be due to conformational differences between the species especially the heavy neck in camel which accounted for about 8.5-9.5% of the carcass weight or it may reflect differences in the anatomical boundaries of wholesale cuts between the different species.

Allometric growth coefficients (β) relating the KPH fat, hump fat and wholesale cut weight to

TABLE 3. ALLOMETRIC GROWTH COEFFICIENTS (β) RELATING EACH WHOLESALE CUT WEIGHT IN COLD CARCASS SIDE (Y) TO COLD CARCASS WEIGHT OR EMPTY BODY WEIGHT (X) IN NAJDI MALE CAMELS

Trait (Y)	Cold carcass wt (X)			Empty body wt (X)		
	β	SE	R^2	β	SE	R^2
KPH fat wt	$.97^{de}$	.22	.63	$.95^{de}$	.21	.65
Hump fat wt	1.42^{g}	.25	.74	1.40^{g}	.26	.71
Neck cut wt	$.84^{c}$	.07	.94	$.82^{c}$	.06	.95
Shoulder cut wt	$.70^{b}$	.08	.88	$.69^{b}$	.07	.90
Brisket cut wt	1.21^{f}	.10	.93	1.16^{f}	.11	.91
Rib cut wt	1.23^{f}	.10	.94	1.20^{f}	.09	.95
Loin cut wt	1.03^{e}	.11	.89	$.98^{e}$	.13	.84
Rump cut wt	$.55^{a}$	.13	.60	$.53^{a}$	.13	.59
Plate cut wt	1.27^{f}	.07	.97	1.21^{f}	.10	.93
Flank cut wt	1.51^{g}	.21	.82	1.46^{g}	.21	.81
Leg cut wt	$.89^{cd}$	.03	.99	$.86^{cd}$	.04	.97

^{a,b,c,d,e,f,g}Values in the same column bearing different superscripts differ ($p < .01$).

cold carcass or empty body weight are presented in table 3. The results revealed that using either cold carcass or empty body weight as an independent variate (X) in the allometry formula produced relatively similar growth coefficient values for all dependent traits (Y). All dependent traits were classified into three growth impetus groups on the basis of the growth coefficients. Wholesale brisket, rib, plate and flank cuts and hump fat were considered to have a positive growth impetus, whereas wholesale shoulder, neck, leg and rump cuts had a negative growth impetus. The growth impetus for loin cut and KPH fat were isometric. The results also indicated that, within the positive growth impetus group, flank cut and hump fat were growing at a relatively fast rate as cold carcass or empty body weight increased. These results agreed partly with findings in sheep (Notter et al., 1983), cattle (Tatum et al., 1986) and swine (Tess et al., 1986) which showed that growth coefficients for fat measures and fat tissues were greater than unity, reflecting the increase in fat weight that occurs with increased body weight.

In conclusion, these results permit some useful valid generalizations about Najdi camel carcass, but further studies are needed to identify the carcass composition at different stages of maturity in relation to camel age.

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