The West African Dwarf Sheep II. Carcass Traits Mutton Quality

by

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SUMMARY

CARCASSES of thirty African Dwarf ewes had a yield of 42.5%, about 5 mm backfat thickness and a loin eye of about 8 cm². Primal cuts made up 85% of the carcass. The best carcasses came from ewes slaughtered between two and four years of age. Average composition of retail cuts was 66.5% muscle, 26.5% bone and 7.0% fat.

Young ewes were superior to young rams both in dressing percent (yield) and primal cuts. The ewes dressed 44% as compared to 40%; their retail cuts contained 67% muscle and 26% bone against 65% and 28% respectively for rams.

Compared with mutton sheep of the temperate zone the West African Dwarf stand only 4/5 as high and are 2/3 as long, while weighing only 1/4 to 1/3 that of European sheep. Yet the leg, the preferred cut, was 36% of the dressed carcass as compared to European mutton.

INTRODUCTION

REPRODUCTIVE and growth performance of West African Dwarf sheep were evaluated in a previous paper (Dettmers, Igoche and Akinkuolie, 1976). It was found that ewes on the average stopped gaining weight after they had reached an age of about two years. Therefore it was recommended that sheep not retained as breeding stock but destined for slaughter should be killed from an age of two years onward.

This paper is concerned with mutton production of West African sheep in relation to age and sex of the animals.

MATERIALS AND METHODS

The sheep used in this study were from the University of Ibadan flock of West African Dwarf, whose management has been described by Hill (1960) and Dettmers, Igoche and Akinkuolie (1976).

One group of thirty ewes of different age and another group of thirteen young rams were slaughtered to obtain data on

their carcasses. On the day of slaughter the live weight and some linear body measurements were taken to describe body size. These included body length from tip of shoulder to tuber coxae and height at withers, both taken with a steel tape. Heart girth at the narrowest place behind the shoulders was measured with a cloth tape.

After slaughter the hot carcass weights were recorded. Then the carcasses were dressed and split into halves. Weights of fresh organs and full and empty viscera were also recorded.

After at least 24 hours of chilling the cold weight was obtained and one dressed carcass half was cut into six retail cuts which were individually weighed.

The carcasses were cut somewhat differently than is customary in the United States (National Livestock and Meat Board, 1969). Feet were separated at elbow and knee. Shank and breast were left together. The rack was cut at 4th and 12th rib, while the 13th rib was left on the loin which also included the flanks.

The backfat thickness was measured over the 13th rib on the loin cut. On the same side of the loin two tracings were made of the diameter of the longissimus muscle. The average of the two measurements was taken as the loin eye area.

The carcass yield was determined and also the percentage of retail cuts.

Retail cuts of ten carcasses were separated into bone, fat and lean tissue to determine carcass composition for an appraisal of mutton quality. Representative samples of each tissue from different cuts of an animal were mixed and a portion of it used for chemical analysis. Determined were moisture, fat, protein and ash content for each tissue. Moisture content was got after samples were oven-dried for 48 hours. The ether-extract (fat) was obtained by the

Soxhlet method, and the Kjeldahl method was used to measure the nitrogen content which was then multiplied by 6.25 to calculate protein on fat free basis, all procedures following the methods outlined by AOAC (1970).

breeds. For example Mutton Merino measure 69.8 cm at withers and are 79.3 cm long (rump); females weigh on the average 86 kg (Dechner, 1961). The white Head mutton sheep measure 71.0 and 83.9 cm respectively, and females weigh 78.5 kg

TABLE 1

Three body measurements in mature West African ewes

Measurement cm	(Mean)	(S.D.)	(C.V. %)	(Range)
Height at withers	58.0	3.48	6.0	52.1 - 46.8
Length	55.0	3.51	6.4	45.7 - 61.0
Heart girth	65.5	4.71	7.2	55.9 - 72.4

RESULTS AND DISCUSSION

Body Size

On seventeen ewes height, length and heart girth were measured. Averages of the three measurements are given in Table 1. The table shows that the sheep are truly small and therefore have been called dwarf, although one should be cautious in using that term since in a genetic context "dwarf" implies involvement of not normal genes for small size. Body size varied little so that this sample though small probably can be taken as representative for mature ewes.

West African Dwarf ewes stand about 80% as high, are 2/3 as long and weigh from 1/4 to 1/3 that of European mutton

(Leroy, Cralhet and Linnenkohl, 1961).

The Hot Carcass

Table 2 shows hot carcass weight of the 30 ewes in this study and the weights of different parts removed when the slaughtered animals were dressed.

Even though the age of the animals varied greatly (CV 51%) hot weight, blood, skin and empty viscera varied less namely between 21 and 24%, exceeded only by the variation in weight of full viscera, the latter due to feed intake before slaughter. Weights of head, tongue, feet, pluck varied less.

Internal fat included the mesenteric

TABLE 2

Weights (kg) of Different Parts of the Hot Mutton Carcass from 30 West African Dwarf Ewes

Variable	Mean	S.D.	C. V. %	Range
Age, months	43	22.1	51.1	16 - 84.5
Hot weight	8.403	1.791	21.3	4.768 - 11.578
Blood	0.916	0.222	24.2	0.568 - 1.132
Skin	1.769	0.394	22.3	1.132 - 2.836
Head	1.410	0.194	13.8	0.965 - 1.816
Tongue	0.066	0.012	18.2	0.043 - 0.089
Feet	0.572	0.086	15.0	0.454 - 0.790
GI tract, full	4.691	1.284	27.4	2.724 - 7.830
GI tract, empty	2.454	0.630	24.5	1.474 - 4.086
Internal fat	0.165	0.207	125.5	0 - 0.879
Pluck	1.097	0.217	19.8	0.796 - 1.586

TABLE 3

Weight (kg) of Different Parts of the Hot Carcass from 11 West African Dwarf Rams

Variable	Mean	S.D.	C.V. %	Range
Age, months	15			10 - 18
Hot weight	6.908	1.200	17.4	5.108 - 8.626
Blood	0.663	0.174	26.2	0.380 - 0.820
Skin	1.743	0.437	25.1	1.050 - 2.508
Head	1.417	0.339	23.9	0.650 - 1.816
Feet	0.472	0.101	21.4	0.350 - 0.622
Internal fat	0			
Pluck	0.776	0.238	30.7	0.454 - 1.022

fat and fat around kidneys, heart and lungs. Some ewes had no internal fat at all.

Compared with similar data obtained from young rams weights of body parts in the latter were lighter as expected with the exception of the head. The 15 months old rams had the same head size as ewes three times as old. It will be noted that variations in weights were somewhat larger in the rams than in the ewes. This is surprising since the rams varied little in age and less in hot weight than the ewes. None of the rams had any internal fat, while only some ewes were without, causing the high coefficient of variation (125.5%) in them.

Organ Weights

Fresh organ weights of ewes and rams are presented in Table 4. Organ weights were lower in the young rams but in relationship to body weight, except the weight of the diaphragm being higher in rams than in ewes. This cannot be explained and may be due to experimental error. Among the organs, size of heart and spleen showed the greatest variability in ewes (49 and 31% respectively). In general, rams' organ weights varied less, probably due to their narrow range in age. The exception was weight of testes varying 60% in size, probably in relation to age with regard to sexual maturity.

TABLE 4

Weight (g) of Fresh Organs of 30 Ewes and 11 Rams of the West African Dwarf Sheep

Organ(s)	Mean	S.D.	C.V. %	Range
E W E S				
Heart	122	59.7	48.9	67 - 401
Liver	366	94.9	25.9	229 - 622
Spleen	50	15.7	31.4	24 - 87
Lungs	278	68.1	24.5	188 - 411
Kidneys	60	13.2	22.0	35 - 94
Diaphragm	89	30.6	34.4	14 - 145
Trachea	51	18.2	35.7	26 - 93
Oesophagus	42	8.1	19.3	29 - 49
R A M S				
Heart	82	12.6	15.4	65 - 96
Liver	297	70.4	23.7	220 - 420
Spleen	27	2.9	10.7	22 - 29
Lungs	259	51.1	19.7	182 - 346
Kidneys	56	5.7	10.2	48 - 157
Diaphragm	112	7.0	6.3	105 - 119
Testes	114	68.6	60.2	79 - 119

Retail Cuts

The average weights of retail cuts for the 30 ewes are given in Table 5. Included are also live weight, yield, as well as age of the ewes and back fat thickness and loin eye area. Almost half of the carcasses had no measurable fat.

35.7% of the dressed carcass. This compares quite favourably with European mutton for which 32.7% is given (Haring, 1975), although the latter is cut including feet and one vertebra beyond the hip bone, butless some of the leg's underside which is left on the flank.

TABLE 5
Dressing percent, weight of retail cuts, backfat thickness and loin eye area of the chilled carcasses

Variable					
Age, months	43	22.1	51.1	16	- 84.5
Live weight, kg	19.4	3.74	19.3	12.7	- 26.3
Cold carcass, kg	8.2	1.68	20.4	4.7	- 11.3
Yield, %	42.5	4.07	9.6	25.9	- 48.0
Legs, kg	3.0	0.11	3.6	1.8	- 4.4
Loin, kg	0.9	0.21	24.7	0.4	- 1.2
Rack, kg	1.4	0.32	23.2	0.7	- 2.0
Shoulders, kg	1.7	0.40	23.4	0.8	- 2.4
Neck, kg	0.6	0.12	19.1	0.5	- 0.9
Shanks, kg	0.8	0.21	25.0	0.5	- 1.5
Backfat, mm *	5.3	1.90	35.9	3.2	- 10.0
Loin eye, cm ²	7.8	1.96	25.0	5.5	- 10.5

* Only the animals with backfat are included here

According to standards for mutton quality by yield (grades) used in the United States (Ensminger, 1969) a 50% yield is choice (with a range of 47-53%), good is 47% (45-50%), utility is 44% (42-46%) and cull 41% (38-44%) for sheep carcasses. The West African Dwarf sheep would be classified barely utility, when based on yield only.

The four primal cuts, shoulder, rack, loin and leg were about 85% of the carcass. In general, the cold carcass consists of equal parts of the hind saddle (leg and loin) and the fore saddle (rack, shoulder and breast) Ensminger, 1969). The carcasses of the West African Dwarf ewes included 51.3% hind saddle (legs, loin flanks) and 48.9% fore saddle (rack, shoulder, shanks+breast), the neck excluded. However, the neck is considered a preferred part, and it should therefore be among the primal cuts. When included the front part made up 53.6% and the hind quarters only 46.4%. Proportions of each retail cut of the carcass are shown in Table 6.

The leg, the best cut, accounted for

Correlations Between Weights and Carcass Traits

Phenotypic correlations were obtained between live weight and cold carcass weight and total retail cuts, average backfat thickness and loin eye area. Correlation coefficients are given in Table 7.

Baker, Chapman and Pope (1971) studied Hampshire lambs. They used shrunk live weight and trimmed hind saddle instead of unshrunk live weight and total cuts as was done in this study. Their correlations are listed under column 2 of Table 7. All correlations in their study showed the same trend as obtained here, and most coefficients were similar in size (underlined.) Live weight and carcass weight are good predictors of cuts and hind saddle respectively. While this study also showed a high correlation with loin eye, Baker, Chapman and Pope's did not. In both studies, total cuts and/or hind saddle were highly correlated with loin eye. In general, loin eye is considered a good measure for meatiness. If it is also

TABLE 6
Weight of Retail Cuts and Their Percentages of the Cold Carcass (Kg)

Retail cut	Weight	
Leg	3.0	36.7
Shoulder	1.7	20.25
Rack	1.4	16.7
Loin + Flanks	0.9	10.7
Shanks + Breast	0.8	9.5
Neck	0.6	7.15

TABLE 7
Correlations Between Live and Cold Weight and Retail Cuts, Backfat and Loin Eye

	Live weight		Cold weight		Total cuts		Backfat	
	1)	2)	1)	2)	1)	2)	1)	2)
Cuts	+0.85	+0.72	+0.95	+0.84				
Backfat	+0.10	+0.18	> 1	+0.23	+0.30	+0.02		
Loin eye	+0.61	+0.33	+0.82	+0.44	+0.74	+0.62	-0.05	-0.14

highly correlated (negatively) with backfat the latter can serve as an estimate of carcass merit and used in live selection. In both studies the correlation was negative but too small to be of any use.

There is a good agreement between the two reports. The figures given by Baker, Chapman and Pope (1971) were based on data from 289 ram lambs while the data in this study came from 30 ewes only. The values from the first investigation are no doubt more reliable. Nonetheless the results hint that relationships between weights and some carcass traits may be similar in an indigenous breed of sheep to a sheep breed in the temperate zone.

Age and Carcass Merit

The age of the slaughtered ewes varied greatly (Table 2), thus the total cuts, backfat thickness and loin eye area were regrouped by age of ewe as young, mature and old. The data are shown in Table 8. The yield was highest in ewes from 2½ to 4 years of age (second group), the loin eye area was the largest in this group also.

But the proportion of primal cuts was nearly equal to that of the young ewes, so was the thickness of the backfat layer. The second group had not only a little more

TABLE 8
Carcass Merit of Thirty Ewes Grouped by Age

Trait		Age groups		
Age, less months	(range)	Young 21 (16-27)	Mature 37 (30-48)	Old 71 (58-85)
Live weight, kg		17.4	19.4	21.5
Cold carcass weight, kg		7.5	8.5	8.8
Yield, %		42.9	43.6	40.9
Retail cuts, kg		6.4	7.2	7.3
Primal cuts, %		85.4	85.1	83.0
Backfat, mm		5.4	5.8	3.9
Loin eye, cm ²		7.5	8.5	8.0

backfat but also more fat distributed in the cuts, thus making them the better finished ones than the young ewes. The "best" carcasses were those from ewes slaughtered between two and four years old. Any older ewe than that will yield less valuable mutton. Increase in weight would be very little, yet quality reduced.

Carcass Composition

From ten carcasses (seven ewes and three rams) the six wholesale cuts were separated into bone, muscle, fat and tendons. Their composition is shown in Table 9, in which fat and tendons were put together.

The quality of a carcass is determined by the amount of muscle (red meat) in the primal cuts, combined with some fat in the form of a narrow trim and streaks to enhance taste, juiciness and palatability.

Muscle content in these carcasses ranged from 59 to 73% by cut and varied very little from cut to cut (C.V. 3.6 to 8.7%). Bone content was quite high ranging from 21 to 32% and varying considerably (C.V. 9 to 21%). Although there was not much fat (from 3 to 11%) its content varied the most because in each group there was at least one cut with no fat at all, with the exception of shanks and breast. A certain amount of fat is desirable, but the cuts of the sheep in this study were very lean.

The most valuable cuts were legs, shoulder and loin in that order as judged by a greater amount of red meat, less bone and more fat than the other three cuts. They contained 70% muscle, 21.5% bone and 7.0% fat (Table 10).

The rack ranked only fifth while the shoulder was second. This contrasts with carcasses of other breeds where usually

TABLE 9
Composition of Six Retail Cuts of West African Dwarf Sheep

Cut	Statistic	% Muscle	% Bone	% Fat
Leg	Mean	72.8	21.0	6.2
	S.D.	2.63	3.66	2.22
	C.V. %	3.6	17.4	35.6
	Range	66.8—75.8	16.5—27.2	0.93
Shoulder	Mean	68.9	22.6	8.5
	S.D.	2.80	2.32	3.30
	C.V. %	4.1	10.3	39.1
	Range	64.4—74.1	19.5—27.0	0—14.1
Loin + Flanks	Mean	68.3	20.8	10.9
	S.D.	4.15	4.40	5.90
	C.V. %	6.1	21.2	54.2
	Range	61.9—73.5	13.8—26.0	0.5—23.6
Neck	Mean	66.3	31.0	2.7
	S.D.	2.98	2.86	1.34
	C.V. %	4.5	9.2	49.6
	Range	60.9—68.2	27.8—36.9	0—5.4
Rack	Mean	63.4	32.0	4.6
	S.D.	5.45	4.82	2.57
	C.V. %	8.6	15.1	55.7
	Range	54.0—70.8	24.5—38.6	0—8.4
Shanks + Breast	Mean	59.3	31.5	9.2
	S.D.	5.15	4.02	5.07
	C.V. %	8.7	12.8	55.0
	Range	49.7—68.4	25.5—39.5	2.2—20.9
Overall average		66.5	26.5	7.0

the rack is ranked higher (hotel rack).

Sex Differences.

Eight young ewes and 13 young rams were compared with regard to carcass quality in terms of dressing percent (Table 11, upper part). The younger and lighter ewes yielded higher by 4% than the rams, indicating a better finish (fat

part). The younger ewes had also more fat than all the ewes in the group (Table 9). One would expect that older ewes put on fat with age; but this was not the case.

Underlined in the table are values of single cuts which deviate from the above statement. The neck of ewes had more bones and less fat than the rams. Their shanks and breast contained more fat and correspondingly less muscle.

TABLE 10
Composition of Retail Cuts Ranked by Merit

Cut	% Muscle	C.V.%	% Bone	% Fat	% Tendon
Leg	72.8	3.6	21.0	6.2	3.1
Shoulder	68.9	4.1	22.6	8.5	3.3
Loin	68.3	6.1	20.8	10.9	5.0
Average	70.0		21.5	8.5	
Neck	66.3	4.5	31.0	2.7	2.7
Rack	63.4	8.6	32.0	4.6	3.9
Shanks	59.3	8.7	31.5	9.2	4.6
Overall Average	66.5		26.5	7.0	

*) Percent tendon within % fat

content). The rams had no internal fat as mentioned earlier and less fat distributed in retail cuts. Of the seven ewes and three rams separated into tissues the ewes had more muscle, less bone and more fat in general than rams (Table 11, lower

All cuts taken together (which is the dressed carcass) and averaged over sex by weighting with the number of animals in each group the composition of the carcass of young West African Dwarf sheep was 65.9% muscle (lean), 27.2% bone

TABLE 11
Comparison of Ewes and Rams in Carcass Quality

Trait	18 Ewes			13 Rams		
Age, months	13 (10-17)			15 (10-18)		
Live weight, kg	13.3			15.7		
Cold Carcass, kg	6.5			6.2		
Yield, %	44.1			39.9		
Composition % *)	M	B	F	M	B	F
Leg	73.3	20.2	6.5	71.7	22.8	5.5
Shoulder	69.1	22.1	8.8	68.5	23.8	7.7
Loin + Flank	68.7	19.1	12.2	67.5	24.3	8.2
Neck	66.8	<u>31.1</u>	<u>2.1</u>	64.5	30.8	4.7
Rack	65.8	30.5	3.7	57.9	35.4	6.7
Shanks + Breast	<u>58.2</u>	31.4	<u>10.4</u>	61.7	31.7	6.6
Overall average	67.0	25.7	7.3	65.3	28.1	6.6

*) M=Muscle, B=Bone, F=Fat.

and 6.9% fat including tendons, based on 21 young sheep averaging 14.2 months of age. When these figures are compared with values given by Schultz (1965) for 42 Merino Landrace sheep from a feeding trial, for which the corresponding proportions were 57.2% lean, 15.2% bone and 23.8% fat (plus 3.8% unclassified). When they were slaughtered between nine and ten months of age, the red meat content of the West African Dwarf carcass is 8.7% higher, they have 12% more bone, but 16.9% less fat. Higher bone content may be partially due to a little higher age at slaughter. The extremely small amount of fat accounts for the higher proportion of lean in the carcass of the West African Dwarf sheep.

Numbers of animals for sex and age comparisons were relatively small. They provide nonetheless some idea about carcass composition and quality.

Chemical Composition of Tissues

Mean content of moisture, protein, either extract and ash for the four tissues lean, fat, tendon, bone on fresh basis is given in Table 12. Ash percent in fatty tissue was not measured because of the fat's negligible mineral content.

Moisture was highest in lean and tendon and lowest in fat. Compared with a study by Ziegler (1968) the moisture content of the West African Dwarf sheep was in line with prime and choice grades of leg in the United States. Highest protein percentage was contained in

tendon and only 3% in fat with lean in between. Chemical fat of fatty tissue was naturally the highest with 68%. Bone had 14%, followed by low amounts in tendon and lean. The mineral content in lean and tendon was very small. Besides 14% fat (oil) in the bones there was 26% ash, 45% moisture and 15% protein.

The dry matter content varied by retail cut from 62% for leg, 61% for shanks and breast, 54% in the shoulder, 53% for the rack, 50% in loin and flanks to 48% in the neck, on fresh basis. On dry matter basis tendons were higher in protein than lean (75 compared to 68%) while bone with 28% was double that based on fresh weight. Either extract for tendon and bone was about the same, for lean slightly less and fat over 90%. Ash was almost half in bone and between 2 and 3% in lean (Table 13).

CONCLUSION

The West African Dwarf sheep yield a good to medium carcass. It appears that cull ewes should not be slaughtered later than four years old. At that age they do not gain any more weight, nor do they put on fat. However, their yield and the proportion of primal cuts decrease with advanced age.

No statement regarding mutton quality of rams in relation to age can be made as only young rams were included in this study. It would be desirable to expand these investigations and to include a group of older (market) rams.

TABLE 12

Average Chemical Composition (%) of Lean, Fat, Tendon and Bone on Fresh Weight Basis from Retail Cuts of West African Dwarf Sheep.

Tissue	Moisture	Protein	Ether extract	Ash
Lean				
S.D.	73.18 4.59	17.77 0.69	4.65 1.15	0.55 0.10
Fat				
S.D.	27.71 4.67	3.03 0.72	68.41 6.03	— —
Tendon				
S.D.	63.16 2.52	27.84 1.70	7.87 1.92	0.28 0.22
Bone				
S.D.	44.85 1.87	14.98 0.99	14.05 1.56	26.11 1.57

TABLE 13

Average chemical composition (%) of lean, fat, tendon and bone on drymatter basis

<i>Tissue</i>	<i>Protein</i>	<i>Ether extract</i>	<i>Ash</i>
Lean	67.90	17.71	2.37
S.D.	9.91	2.45	0.50
Fat	4.03	92.72	—
S.D.	1.25	4.57	—
Tendon	75.54	20.65	0.83
S.D.	5.30	5.23	0.53
Bone	28.42	21.45	49.85
S.D.	2.40	6.43	4.80

REFERENCES

- A.O.A.C. (1970.) Official Methods of Analysis of the Association of the Official Analytical Chemists. 11th ed. Washington, D.C.
- BAKER, R. L., CHAPMAN, A. B. and A. L. POPE (1971.) Evaluation of the seven thrib probe and body weight as predictors of carcass traits in Hampshire lambs. *J. Anim. Sci.* **33**: 568-573.
- DEITMERS, ALMUT, IGOCHÉ, C. A. and KIKELOMO H. AKINKUOLIE. (1976.) The West African Dwarf Sheep. I. Reproductive performance and growth. *Niger. J. Anim. Prod.* In press.
- DOEHNER, H. (1961.) Merino-Schafraßen. in: *Deutschland (Merino breeds in Germany)*. In: *Handbuch der Tierzucht*, Vol. IIIb 229-246. Parey, Hamburg.
- Interstate, Danville, Illinois.
- HARING, F. (1975.) *Schafzucht (Sheep Science)*. 4th ed. Ulmer, Stuttgart. pp. 207-227.
- HILL, D. H. 1960. West African Dwarf sheep. Third Ann. Conf. Sci. Assoc. Nig., Ibadan
- LEROY, A. M., CHARLET, P. and K. LINNENKOHL. 1961. Fleischschafraßen (Mutton sheep breeds). In: *Handbuch der Tierzucht* Vol. IIIb: 247-278. Parey, Hamburg.
- NATIONAL LIVE STOCK and MEAT BOARD. (1969) *Meat Evaluation Handbook*. Chicago.
- SCHULTZ, R. (1965.) Jahresbericht der Bundesanstalt für Fleischforschung (Annual Report of the German Federal Institute for Meat Research) G. 34. Quoted by Haring, 1975.
- ZIEGLER, P.T. (1968.) *The Meat We Eat*. Interstate, Danville, Illinois. pp. 359-374.