5. Meat

In view of the pronounced dairy conformation and the large accumulation of fat in the tail, the Awassi is far from being a mutton sheep. Yet male Awassi lambs and culled ewes and rams now provide approximately one-half of the income of dairy flocks in Israel, and nearly the entire income of mutton flocks.

Awassi fat lamb production has passed several stages since the beginning of improvement of the breed. Until the founding of the State of Israel in 1948, the male lambs in improved flocks had to be done away with as soon as possible after birth as the price relation between milk and lamb rendered it utterly uneconomical to give the lamb any milk after the colostral stage. This situation, which was also true for dairy cattle, continued for several years at the end of the 1940s and the early 1950s in Israel, when meat prices were Government-controlled at a very low level, while the price of milk was relatively high. The lambs were slaughtered at the age of two or three days.

Toward the middle of the 1950s, the Government policy with regard to meat prices underwent a fundamental change. Prices for locally produced lamb and veal were raised to a level that made the feeding of male lambs and calves profitable. Awassi lambs from improved flocks began to reach the market at a live weight of about 12 kg, a weight at which unimproved lambs used to be marketed by the bedouin and fellahin at Eastertime. Lambs of greater weight were rejected by butchers who regarded these as 'mutton'. However, as time went on and consumers did not object to heavier cuts, the marketing weight of male Awassi lambs was raised first to 20 kg and later to 30 kg. The greater weight remained in vogue until the late 1960s when it was again increased to the present level of 45-55 kg.

The large fat tail of heavy lambs has a negative effect on their sales price, especially during the hot summer months when a large part of the accruing animal fat has to be disposed of to soap and candle factories at very low prices. It is only in recent years that the money value of the fat tail has somewhat increased, owing to the replacement (introduced by many restaurant keepers in Israel) of the expensive lamb in the popular oriental dish *shashlik* by the much cheaper breast meat of chicken and .turkey. The addition of a piece of tail fat to every two or three pieces of poultry meat on the spit imparts the flavour of lamb to the roasted meat. Nevertheless, Awassi lambs still fetch a lower market price than German Mutton Merino lambs.

Lamb

In the course of the last three decades, several slaughter tests with male Awassi lambs have been conducted. Examples of some of these are given in Tables 5-1 to 5-12, not in the chronological order of the tests, but in accordance with the increasing weights at which lambs were sold during the period.

In 1951 the author recorded the body composition of ten male two-month-old Awassi lambs (Table 5-1). In a slaughter test with five three-month-old male lambs, slaughtered after a starvation period of 20 hours, Eyal and Goot (1960) recorded the data given in Table 5-2.

In a trial with pure-bred Awassi and Finnish Landrace-Awassi cross-bred lambs, Goot *et al.* (1978) examined the carcass weight and composition of two male Awassi lambs born as singles and fed, without roughage, on unlimited quantities of concentrates until the age of five months when they were slaughtered. The average data for the two lambs are as shown in Table 5-3. On conclusion of a

TABLE 5-1. **Mean weight of carcass, fat tail, head, feet, inner organs and pelt of 10 male Awassi lambs (in kg and as % of mean live weight)**

	Kg	% of live weight
Live weight	17.700	100.0
Carcass weight	8.615	48.7
Forequarters	3.900	22.0
Hindquarters (with kidneys but without fat tail)	3.900	22.0
Fat tail	0.815	4.6
Head	1.100	6.2
Feet	0.600	3.4
Liver	0.285	1.6
Lungs	0.310	1.8
Spleen	0.048	0.3
Heart	0.077	0.4
Alimentary tract	2.600	14.7
Pelt	2.500	14.1

TABLE 5-2. **Live weight and body composition of male Awassi lambs**

	Kg	%
Live weight	32.40	100.0
Slaughter weight including fat tail and edible inner organs	17.72	54.7
Body	14.10	43.5
Fat tail	2.36	7.3
Heart, lungs and liver	1.26	3.9

TABLE 5-3. **Carcass weight and composition of two male Awassi lambs**

Carcass weight (kg) and dressing percentage		*Carcass composition (%)*	
\Slaughter weight	47.75	Muscle	49.75
Hot carcass weight	22.40	Carcass fat	32.95
Cold carcass weight	21.95	Subcutaneous fat	20.50
Dressing percentage	46.90	Intermuscular fat	12.45
		Bone	14.95
		Waste	1.70
		Dissection loss	0.65
Weight of different body parts (g)			
Fat tail	5 250	Liver	765
Head with horns	2 608	Lungs with trachea	689
Unshorn skin	6 350	Spleen	70
Blood	2 400	Heart	170
Full stomach	3 167	Pericardium	71
Empty stomach	1 048	Kidneys	120
Kidney fat	208		
Caul fat	555		
Gut fat	263		

Weight and composition of different carcass joints

Joint	Weight (kg)	Bone (%)	Muscle (%)	Subcutaneous fat (%)	Intermuscular fat (%)	Total fat (%)	Waste and dissection loss (%)
Neck	2.263	18.15	50.10	12.00	14.15	26.15	5.60
Thorax	5.293	19.20	40.20	20.85	17.85	38.70	1.90
Shoulder	2.181	15.45	57.75	14.80	11.30	26.10	0.70
Loin	2.061	13.20	44.05	29.90	12.40	42.30	0.45
Psoas muscles	0.240	0	79.40	0	11.05	11.05	9.55
Pelvis	3.044	10.00	37.55	36.20	13.25	49.45	3.00
Leg	2.463	13.65	62.05	16.95	6.85	23.80	0.50

feeding trial with male Awassi lambs (see Table 3-59), Atzmon and Doron (1951) selected the heaviest 5½ -month-old lamb for an additional slaughter test (Table 5-4).

In 1977, Epstein (unpublished) examined the body composition of male and female Awassi, Awassi-East Friesian cross-bred (see Appendix B, 'Meat (lamb)'), and German Mutton Merino lambs at marketing weights then common in Israel. Before despatch to the slaughterhouse, three male Awassi lambs included in the investigation weighed 54 kg, and two female Awassi lambs 50.5 kg on average. Table 5-5 gives the data recorded.

An extensive investigation into the various factors involved in the slaughter of pure-bred Awassi and cross-bred Awassi-East Friesian and German Mutton Merino-Awassi lambs was conducted by Goot, Folman and Eyal (1967). The results of the test with the Awassi lambs are given in Tables 5-6 and 5-7 and Fig. 5-1. (For those of the cross-breds, see Appendix A, Tables A-40 to A-46 and Fig. A-4; Appendix B, Tables B-28 to B-32 and Fig. B-l.)

The test was conducted in two stages. In the first stage the weight loss of the lambs in transit from farm to slaughterhouse over a distance of 20 km, as well as the carcass weight and the weights of different parts and organs, was recorded, and at the second stage the weight loss of the carcass in transit from slaughterhouse to butcher-shop and the composition of the carcass were recorded.

The lambs used in the test comprised three groups, each raised on a different plane of nutrition from the age of four months. The lambs of group I received 500 g of hay a day in addition to a concentrate mixture sufficient for maintenance and normal growth; group II received 500 g of hay and a 20 percent larger concentrate ration than the lambs of group I; group III received 500 g of hay and free access to concentrates in a self-feeder (see Tables 3-65 and 3-66).

The mean weight loss in transit from farm to slaughterhouse and during 21 hours without water and 35 hours without feed amounted to 4 kg for each lamb, or 5.8 percent. Days of *sharab* (hot desert wind), on which the ambient temperature rose to a maximum of 30°C and the relative humidity fell from 78 to 35 or 24 percent, had no effect on shrinkage during transit and fasting. Goot, Folman and Eyal (1967) commented that the mean shrink of 5.8 percent was considerably lower than the 9.0 and 10.7 percent, respectively, recorded by Epstein (1961) for 12 docked and 12 undocked male Awassi lambs from which feed and water had been withheld for 18 hours prior to slaughter. Obviously, the difference in the percentage of shrink is due to the different weights and ages of the lambs used in the two trials. The lambs tested by Goot, Folman and Eyal (1967) were 306 days old and weighed 69.1 kg on average before shipment, whereas those tested by Epstein were 91 days old and weighed 29.9 (docked) and 30.8 kg (undocked). Indeed, in three male Awassi lambs of an average live weight of 54 kg before dispatch, the author recorded a loss of only 5.2 percent in transit and 24 hours without feed and water (see Table 5-5). As Snapp and Neumann (1960) remarked on the shrinkage in cattle, 'calves may shrink up to 10 percent and more while heavy cattle may not shrink over 4 or 5 percent'.

TABLE 5-4. **Live and slaughter weights of different parts of a male Awassi lamb (kg)**

	Weight
Live weight at $5^1/_2$ months	50.00
Weight after slaughter and bleeding	48.90
Forequarters	10.20
Hindquarters	11.65
Fat tail	4.25
Head	2.30
Liver	0.80
Heart, spleen, lungs and trachea	1.30
Kidneys and kidney fat	0.25
Testicles	0.30
Caul fat	0.60
Viscera	9.80
Pelt and feet	5.90
Total	47.35
Weight loss	1.55

TABLE 5-5. **Mean body composition of three male and two female Awassi lambs (kg)**

			Male	Female
Age (months)			6½	8
Live weight on farm			54.0	50.5
Live weight after 24 hours' starvation at slaughterhouse			48.8	45.0
Weight loss during shipment and 24 hours withholding feed and water			5.2	5.5
		(%)	9.6	10.9
Total carcasses at slaughterhouse			28.400	25.600
	(warm dressed weight)			
	at butcher-shop (cold dressed weight)		27.677	25.200
Weight difference between warm and cold dressed weight			0.723	0.400
		(%)	2.5	1.56
Forequarters			12.270	11.350
Hindquarters			11.377	10.670
Fat tail			4.030	3.180
Carcass, total			27.677	25.200
Killing-out percentage			56.7	56.0
Forequarters	Neck		2.197	1.700
	Leg and shoulder		4.317	3.275
	Chest		5.713	6.365
	Weight loss		0.043	0.010
	Total		12.270	11.350
Hindquarters	Loin and rump		3.850	3.645
	Leg and thigh		7.450	7.010
	Weight loss		0.077	0.015
	Total		11.377	10.670
Fat tail	Tail fat		3.890	3.060
	Tail		0.140	0.120
	Total		4.030	3.180

TABLE 5-5. (cont.)

	Male			Female		
Forequarters	Neck	Leg and shoulder	Chest	Neck	Leg and shoulder	Chest
Bone	0.510	0.765	1.230	0.340	0.610	1.035
Muscle	1.390	2.813	3.043	1.160	2.285	3.425
Fat tissue	0.267	0.707	1.383	0.200	0.370	1.895
Weight loss	0.030	0.032	0.057	—	0.010	0.010
Total	2.197	4.317	5.713	1.700	3.275	6.365
Hindquarters	Loin and rump		Leg and thigh	Loin and rump		Leg and thigh
Bone	0.390		1.273	0.320		1.100
Muscle	2.153		4.543	2.125		4.315
Fat tissue	1.270		1.577	1.210		1.555
Weight loss	0.037		0.057	0.015		0.015
Total	3.850		7.450	3.670		6.985
Forequarters, total						
Bone	2.505			1.985		
Muscle	7.246			6.870		
Fat tissue	2.357			2.465		
Weight loss	0.119			0.020		
Total	12.227			11.340		

		Male	Female
Hindquarters, total	Bone	1.663	1.420
	Muscle	6.696	6.440
	Fat tissue	2.847	2.765
	Weight loss	0.094	0.030
	Total	11.300	10.655

Carcass, total	Kg	% of live weight [48.8 kg]	Kg	% of live weight [45 kg]
Bone	4.168	8.54	3.405	7.57
Muscle	13.942	28.57	13.310	29.58
Fat tissue	5.204	10.66	5.230	11.62
Weight loss	0.213	0.44	0.050	0.11
Total	23.527	48.21	21.995	48.88
Fat tail				
Tail fat	3.890	7.97	3.060	6.80
Tail	0.140	0.29	0.120	0.27
Total	4.030	8.26	3.180	7.07

TABLE 5-5. (cont.)

		Male	Female
	Head, feet and inner organs		
Head (without skin)	Total	2.027	1.675
	Tongue	0.108	0.115
	Brain	0.100	0.115
	Horns	0.382	0.010
Feet (without skin)		0.747	0.725
Inner organs	Liver	0.757	0.645
	Lungs with trachea	0.650	0.410
	Spleen	0.103	0.060
	Heart	0.163	0.130
	Kidneys	0.127	0.110
	Diaphragm	0.153	0.093
	Oesophagus	0.045	0.040
	Oesophagus fat tissue	0.220	0.190
	Thymus	0.020	0.020
	Testes	0.280	—
	Udder	—	0.200
	Skin and intestines		
Weight of wet skin	Body	5.500	6.200
	Head and ears	0.610	0.520
	Legs	0.360	0.340
	Total	6.520	7.060
Length of intestines (m)	Small intestine	32.630	28.650
	Large intestine	6.700	7.850
	Total	39.330	36.500

TABLE 5-6. **Live and carcass weights of male Awassi lambs (kg)**

Group	Number of lambs	Age (days)	Live weight			Warm carcass weight	Carcass yield (%)
			On farm	Before slaughter (in wool)	Before slaughter (shorn)		
I	14	312	65.2	61.3	59.1	28.9	48.0
II	7	303	71.8	67.4	65.5	32.5	48.5
III	10	298	72.8	69.0	66.6	33.1	48.6
Mean	31	306	69.1	65.1	63.0	31.1	48.3

TABLE 5-7. **Mean weights of inner organs, kidney and caul fat, and fat tail in male Awassi lambs (kg)**

Group	Number of lambs	Live weight	Liver, lungs and heart	Kidneys	Kidney fat	Caul fat	Total kidney and caul fat	Fat tail
I	14	61	2.0	0.137	0.6	1.4	2.0	6.3
II	7	67	2.2	0.155	1.0	2.9	3.9	6.9
III	10	69	2.1	0.153	1.1	2.9	4.0	8.0
Mean	31	65	2.1	0.146	0.8	2.2	3.1	7.0

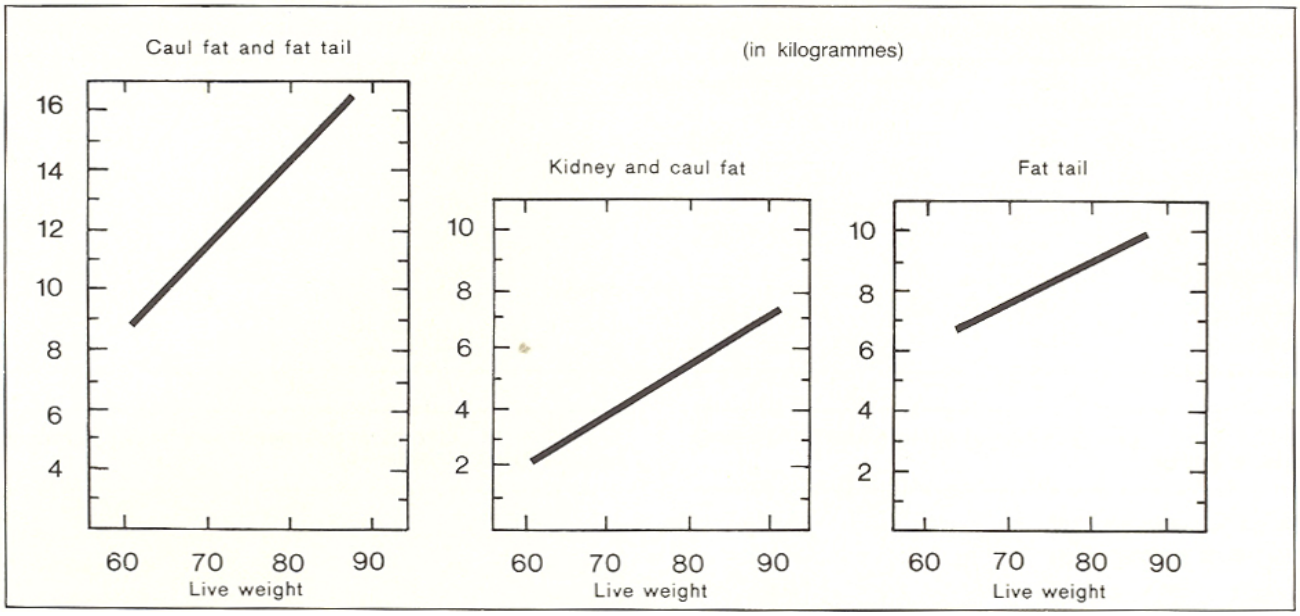

Figure 5-1. Weight of caul and kidney fat and fat tail in relation to live weight. (**Source:** Goot, Folman & Eyal, 1967)

The mean fleece weight of the 31 lambs examined by Goot, Folman and Eyal (1967) was 2.1 kg, or 3.2 percent of the weight of the unshorn lambs. The cold carcass weight was estimated at 2 percent less than the warm carcass weight. The slaughter yield without inner organs and fat tail amounted to 48.3 percent; the addition of the edible inner organs increased it to 51.8 percent, and of the inner organs and fat tail to 62.6 percent.

From among the heavy lambs of group III, the three heaviest ones were selected for an analysis of their carcass composition, for which one-half of each carcass was used. The average live weight of these lambs on the farm was 81.0 kg (see Table 3-60) ; shearing and shrinkage in transit and during the period of abstention from feed and water prior to slaughter reduced it to 73.8 kg. (See Tables 5-8 to 5-11.) The ratio of subcutaneous to intermuscular fat in the trunks of the Awassi lambs was 63:37.

TABLE 5-8. **Mean percentages of bone, muscle and fat tissue in the carcasses of three male Awassi lambs**

Carcass weight (kg)	36.9
Carcass yield	50.0
Bone	11.3
Muscle	45.3
Fat	42.7
Weight loss	0.7

TABLE 5-9 **Mean weight and percentage of various carcass parts of three male Awassi lambs**

	Kg	%
Forequarters	19.70	54.03
Hindquarters	16.76	45.97
Neck	4.32	11.84
Breast	8.52	23.37
Shoulders	6.86	18.82
Loin	5.07	13.91
Psoas muscles	0.40	1.10
Pelvis	4.28	11.74
Thighs	7.01	19.22
Total	36 46	100.00

In addition to the subcutaneous and intermuscular fat, there also exists intramuscular fat, the quantity of which can only be determined by chemical analysis. Table 5-12 gives the composition of the 'eye-muscles' of heavy male Awassi lambs (Goot, Folman & Eyal, 1967).

The effect of docking on the carcass of fat-tailed sheep has been examined in the Awassi, Ausimi, Rahmani and Karakul. Epstein (1957) docked the tail of a three-day-old male Awassi lamb below the first caudal vertebra. The animal was castrated with an emasculator at the age of five months and slaughtered at 11 months when it had reached a live weight of 51 kg. The lamb was shorn before slaughter to show the fat development on the hindquarters of the live animal and the line of

TABLE 5-10. **Distribution of bone, muscle and fat tissue in various parts of the carcass of three male Awassi lambs (%)**

	Bone	Muscle	Subcutaneous fat	Intermuscular fat	Total fat	Weight loss
Neck	12.1	45.5	15.5	24.9	40.4	2.0
Breast	14.3	39.2	19.7	26.0	45.7	0.8
Right shoulder	12.1	52.0	25.5	10.1	35.6	0.3
Loin	6.2	33.8	46.4	13.6	60.0	—
Psoas muscles	—	79.7	—	19.4	19.4	0.9
Pelvis	8.7	38.2	39.8	11.6	51.4	1.7
Thigh	12.1	57.5	22.6	6.8	29.4	1.0

TABLE 5-11. **Energy value of muscle and fat in heavy Awassi lambs**

Weight of carcass (kg)	36.46
Weight of muscle (kg)	16.57
Weight of fat (kg)	15.48
Muscle, calories	25000-40000
Fat, calories	116 000
Energy value of protein content (%)	11-12
Energy value of fat content (%)	88-89

TABLE 5-12. **Chemical composition of 'eye-muscles' of male Awassi lambs** (%)

	Mean	Range
Dried matter	27.8	26.2-30.6
Protein	21.0	20.4-21.6
Fat	4.7	3.2- 6.2
Ash	0.9	0.9- 1.0

amputation which is clearly marked along the border of the woolly and woolless parts of the buttocks (Fig. 5-2). The rump of the live animal and the carcass after removal of the skin showed that the large mass of fat concentrated in the tail of a well-fed Awassi sheep had not moved up to the hindquarters. Only two small fat moieties, each weighing not more than 200 g, remained on the buttocks (Fig. 5-3). When the carcass was halved longitudinally, these fat deposits, which in the undivided carcass appeared very small, expanded outwards and became more prominent (Fig. 5-4). In Awassi sheep in which the fat tail has been docked below the third caudal vertebra or farther down and in which the superior part of the lateral skin folds of the tail has remained on the rump, the fat accumulations are considerably larger than in the present case, their size depending on the extent of the skin folds near the tail butt.

In twelve 91-day-old male fat-tailed Awassi lambs and 12 lambs of the same breed, sex and age, which had been docked on the third day after birth, Epstein (1961) recorded the mean live and carcass weights, the weights of the head, feet, edible inner organs and pelt, and of the bone, muscle and fat

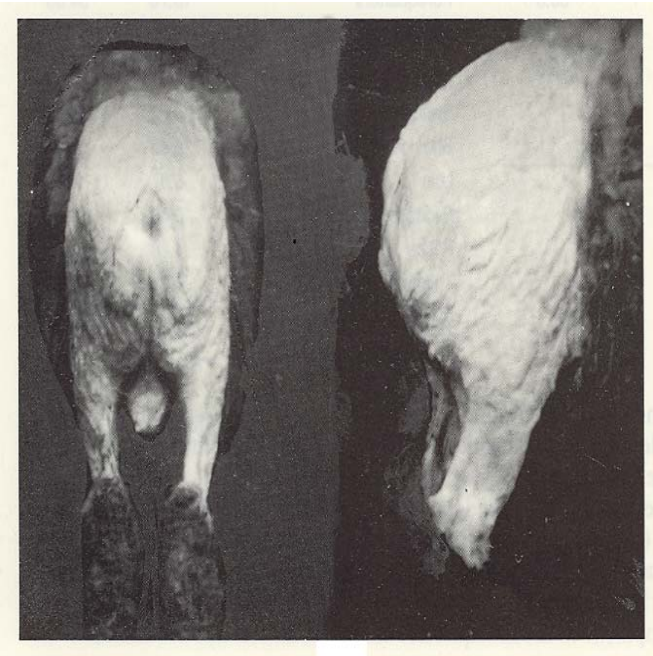

Figure 5-2. Hindquarters of a docked Awassi lamb (live weight 51 kg)

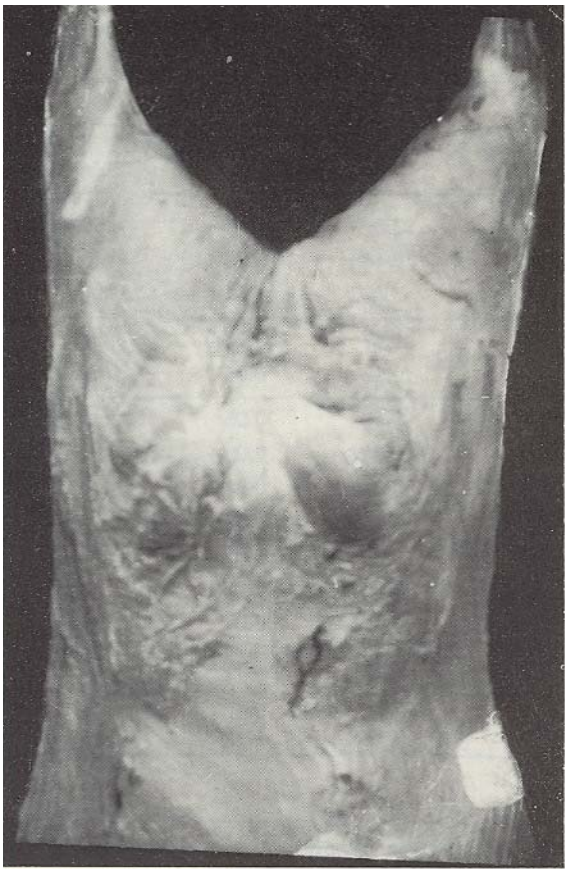

Figure 5-3. Hindquarters of a docked Awassi lamb after removal of the pelt

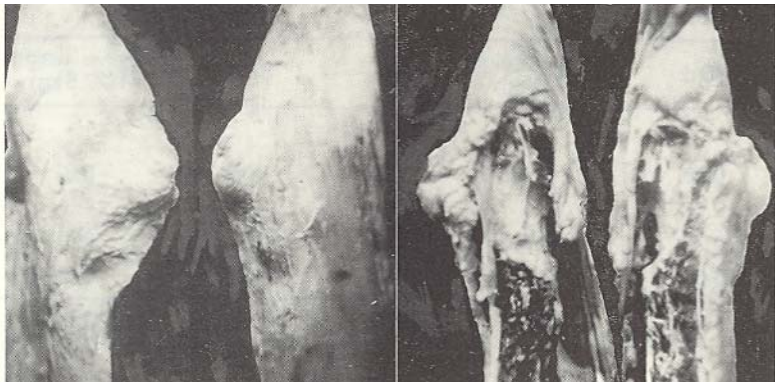

Figure 5-4. Halved hindquarters of a docked Awassi lamb. External and internal views

tissue in the forequarters and hindquarters (Tables 5-13 and 5-14 and Fig. 5-5). Prior to slaughter the lambs had been deprived of feed for 18 hours and were weighed empty (see also Chapter 3, 'Effect of docking', Tables 3-114 and 3-115).

While docking had only a slight negative effect on the weight of the lambs at the age of 91 days, the mutton conformation of the live docked lambs was superior to that of the undocked controls. In particular, the forequarters and hindquarters had a more balanced appearance, approaching the conformation desired in a mutton breed. Outwardly there was little evidence of fat accumulation on either side of the tail butt. During the 18-hour fasting period prior to slaughter, the docked lambs lost 2.7 kg or 9 percent and the undocked controls 3.3 kg or 10.7 percent in live weight.

In the slaughtered lambs there was hardly any difference between those docked and those undocked in the average weight of the head, feet and edible inner organs. The slightly larger weight of the heads of the undocked lambs may have been a result of fortuitous differences in horn weight; there were nine horned and three polled lambs in each of the two groups. The relative weight of the feet was the same in both groups. In the docked lambs, the mean weight of the edible organs was 86 g above

TABLE 5-13. **Mean weights of carcass, head, feet, edible inner organs and pelt of 12 docked and 12 undocked male Awassi lambs (kg and as % of mean live weights)**

	Docked			Undocked		
	Kg	SD±	% of live weight (27.2 kg)	Kg	SD±	% of live weight (27.5 kg)
Total carcass	13.59	3.69	50.0	13.87	2.45	50.4
Forequarters	6.96	1.73	25.6	6.48	0.90	23.6
Hindquarters	6.64	1.97	24.4	7.39	1.61	26.8
Head	1.23	0.18	4.5	1.17	0.08	4.2
Feet	0.58	0.08	2.1	0.58	0.06	2.1
Liver	0.47	0.11	1.7	0.49	0.05	1.8
Lungs	0.36	0.11	1.3	0.32	0.05	1.2
Spleen	0.06	0.01	0.2	0.05	0.01	0.2
Heart	0.12	0.02	0.5	0.12	0.02	0.4
Kidneys	0.10	0.01	0.4	0.10	0.02	0.4
Testicles	0.04	0.02	0.2	0.04	0.02	0.2
Diaphragm, etc.	0.39	0.10	1.4	0.33	0.07	1.2
Total edible inner organs	1.54	0.28	5.7	1.45	0.17	5.4
Pelt	3.63	0.62	13.3	3.76	0.72	13.7

TABLE 5-14. **Mean weights of bone muscle and fat tissue in forequarters, hindquarters and total carcass of 12 docked and 12 undocked male Awassi lambs (kg and as % of mean live weights)**

	Docked			Undocked		
	Kg	SD±	% of live weight (27.2 kg)	Kg	SD±	% of live weight wt (27.5 kg)
Forequarters						
Bone	1.45	0.29	5.3	1.45	0.19	5.3
Muscle	4.10	0.76	15.1	4.01	0.47	14.6
Fat tissue	1.34	0.77	4.9	0.94	0.34	3.4
Weight loss	0.07	0.04	0.3	0.08	0.04	0.3
Total	6.96	1.73	25.6	6.48	0.90	23.6
Hindquarters						
Bone	1.03	0.20	3.8	1.00	0.10	3.6
Muscle	3.51	0.73	12.9	3.35	0.40	12.1
Body fat tissue	2.04	1.12	7.5	1.03	0.35	3.7
Tail fat	—	—	—	1.90	0.90	6.9
Tail	—	—	—	0.07	0.02	0.3
Weight loss	0.06	0.03	0.2	0.04	0.03	0.2
Total	6.64	1.99	24.4	7.39	1.61	26.8
Total carcass						
Bone	2.48	0.47	9.1	2.45	0.29	8.9
Muscle	7.61	1.47	28.0	7.36	0.82	26.7
Body fat tissue	3.37	1.87	12.4	1.97	0.68	7.1
Tail fat	—	—	—	1.90	0.90	6.9
Tail	—	—	—	0.07	0.02	0.3
Weight loss	0.13	0.06	0.5	0.13	0.03	0.5
Total	13.59	3.69	50.0	13.87	2.45	50.4

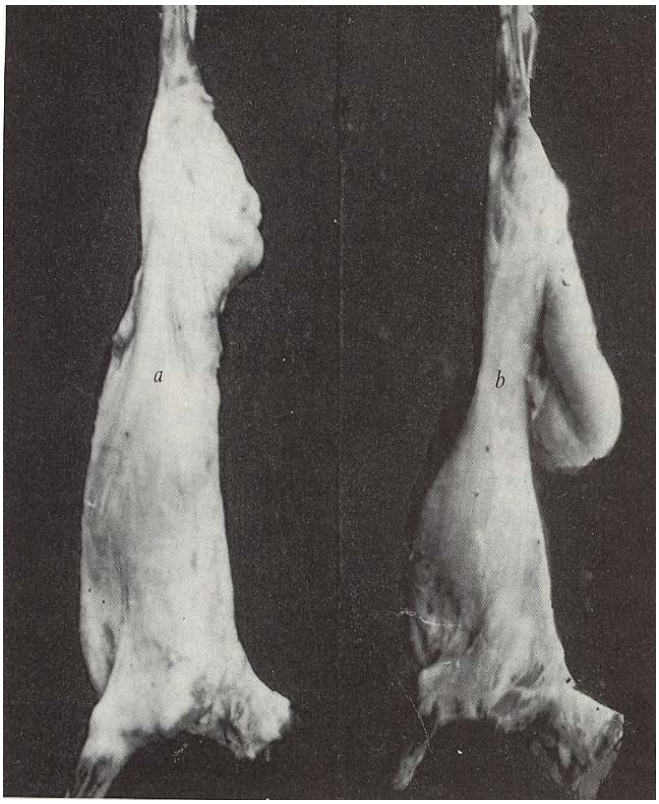

Figure 5-5. a) Carcass of docked fat-tailed lamb (weight 14.650 kg);
b) Carcass of fat-tailed lamb (weight 14.950 kg)

TABLE 5-15. **Ratio of forequarters to hindquarters in docked and undocked fat-tailed Awassi lambs**

	Forequarters	Hindquarters
Docked lambs	100	95.4
Undocked lambs, including fat tail	100	114.1
Undocked lambs, excluding fat tail	100	83.7

that of the control animals. The skin of the docked lambs weighed 133 g less on average than the skin of the undocked lambs, owing to the presence of the tail covering in the latter.

The dressed weight of the docked lambs was 50 percent and that of the undocked lambs 50.4 percent of the live weight. Docking had, however, a marked influence on the weight ratio of forequarters to hindquarters. The forequarters of the docked lambs were absolutely and relatively heavier than the forequarters of the undocked lambs. Similarly, and to a greater extent, the hindquarters of the docked lambs were absolutely and relatively heavier than the hindquarters of the undocked lambs minus the fat tail, though the difference in favour of the docked lambs was less than the weight of the fat tail (1.97 kg).

The forequarters of the docked lambs were 317 g, or 4.8 percent, heavier than the hindquarters. The forequarters of the undocked lambs were 916 g, or 12.4 percent, lighter than the hindquarters including the fat tail; but they were 1 056 g, or 19.5 percent, heavier than the hindquarters minus the fat tail, a very undesirable proportion from the mutton point of view. Taking the weight of the forequarters as 100, the ratio of forequarters to hindquarters was as given in Table 5-15.

The carcasses of the docked lambs had a superior appearance to those of the undocked control animals, although in several of the former accumulation of fat on both sides of the tail butt detracted from their appearance. The superiority of the docked carcasses was due to the better condition and more favourable balance of the forequarters and hindquarters. The hindquarters of the docked lambs, more especially the thighs and buttocks, were fuller and heavier than those of the undocked; they were thus superior in economic usefulness since to the consumer the legs of mutton and the loin chops are the best part of the sheep (Fig. 5-5).

The loss in carcass weight caused by docking was much less than the weight of the fat tail. Additional nutrients in amounts not far short of those normally stored in the tail of fat-tailed lambs were deposited in the docked lambs in both the forequarters and the hindquarters. Dissection demonstrated in which forms these deposits had taken place.

In the forequarters, the proportion of bone to live weight was not affected by the docking of the fat tail. However, muscle tissue in the forequarters of the docked lambs exceeded that of the undocked controls by 94 g and fat tissue by 392 g. In other words, the fat, which would normally have been deposited in the tail, was partly made good by the deposits of extra muscle and fat in the forequarters in the ratio of 1:4.2. In terms of live weight, the percentages of lean meat and fat in the forequarters of the docked lambs exceeded those of the undocked lambs by 0.5 percent (15.1 versus 14.6) and 1.5 percent (4.9 versus 3.4), respectively. However, only about one-fourth of the fat normally deposited in the tail was represented by the extra meat and fat in the forequarters of the docked lambs.

In the hindquarters, bone growth was affected by docking to a negligible extent, the bone in the docked lambs weighing 33 g more than in the undocked. However, the growth of muscle and body fat tissue was markedly increased by docking. In the docked lambs the lean meat weighed 162 g more and the body fat tissue 1 004 g more than in the undocked lambs. In the docked animals the fat that would normally have been deposited in the tail was partly made good by deposits of extra muscle and fat in the hindquarters, in the ratio of 1:6.2. In terms of live weight, the hindquarters of the docked lambs contained 0.8 percent more muscle tissue (12.9 versus 12.1) and 3.8 percent (7.5 versus 3.7) more body fat than the hindquarters of the undocked control animals. Approximately three-fifths of the 'inhibited' tail fat was made good by extra meat and fat in the hindquarters of the docked lambs, the share of the hindquarters as a depository of the extra meat and fat deposited thus being 2.4 times that of the forequarters. Were it possible in docking the fat tail under conditions of ordinary farm management to remove the skin folds on both sides of the tail completely, the two fat cushions near the butt of the tail would be of negligible size in the 91-day-old lamb, and the ratio of extra muscle to extra fat tissue deposited in the hindquarters following docking would probably be as narrow as that for the forequarters.

The ratio of lean meat to total fat was 2.26:1 in the whole carcass of the docked lambs, and 1.91:1 in that of the undocked control animals. As it is the protein of the muscle that gives meat its special nutritional value, the superiority of the docked carcasses to the undocked was to some extent a result of the higher relative share of lean meat (Epstein, 1961).

In a study on the growth and carcass characteristics of 19 docked and 19 normal male Awassi lambs conducted at the experimental farm of the American University of Beirut, the average dressing percentage of the intact lambs was found to exceed that of the docked ones by a statistically significant margin (Table 5-16). Following removal of the fat tail, a tendency was observed for the fat to spread forwards over the loin, shoulder, brisket and sternum, with only a slight indication of increased internal deposits (McLeroy, Ananian & Kurdian, 1959). There was only a limited, if any, increase in marbling owing to docking. The difference in iodine number (grams of iodine absorbed by 100 g of fat) of back fat in favour of docked lambs is representative of a mobile fat similar to that normally deposited in the tail (Table 5-17) (McLeroy & Kurdian, 1958).

TABLE 5-16. **Average live weight, carcass weight (kg) and dressing percentage of docked and undocked male Awassi lambs in Lebanon**

	Docked	Undocked
Live weight	39.70	42.76
Carcass weight	19.05	21.70
Dressing percentage	47.98	50.75

TABLE 5-17. **Average iodine number of fat from different body parts of docked and undocked male Awassi slaughter lambs in Lebanon**

Location	Docked	Undocked	Difference
Back	46.9	43.6	3.3
Caul	38.5	37.6	0.9
Kidney	38.4	37.1	1.3
Tail	51.5	51.4	0.1

In Iraq, Asker, El-Khalsy and Juma (1964) examined the carcasses often male Awassi lambs that had been docked by the rubber ring method during the second week of their lives and had been slaughtered at 13 months when they had reached an average live weight of 38.9 kg (Table 5-18) (see also pp. 132-3 and Table 3-116 and Fig. 3-17). The average dressing percentage was 38.6-2.6 percent less than that of the ten undocked control animals that weighed 43.6 kg at the same age. The carcasses of the docked lambs had a larger fat accumulation around the tail root and thicker subcutaneous fat

deposits on the brisket, back, loins, neck and legs than the control lambs. All cuts of the docked lambs showed thicker layers of fat, and the kidney, heart and caul fat was also more copious. Owing to the marked development of the subcutaneous fat, the carcasses of the docked animals had a whiter appearance than those of the control group.

TABLE 5-18. **Average weights of carcasses and carcass cuts of 10 docked and 10 undocked male Awassi lambs in Iraq (kg)**

	Docked lambs	Undocked lambs
Live weight	38.90	43.60
Carcass weight	15.00	18.00
(Killing-out percentage	38.6	41.2)
Shoulders	3.67	4.24
Breast and shank	2.00	2.19
Loins	1.96	2.21
Ribs	1.66	1.91
Legs	4.59	5.13
Fat tail	—	1.32

TABLE 5-19. **Mean weights of carcass, head, feet, tail, stomach, intestines, edible inner organs, and pelt of 5 docked and 6 undocked male Awassi lambs in Iraq (in kg and as % of mean live weights)**

	Docked		Undocked	
	Kg	% of live wgt(37.4kg)	Kg	% of live wgt(40.5kg)
Carcass	20.600	55.10	23.100	57.00
Fat tail	0.724	1.94	2.715	6.70
Head	3.01	8.05	3.23	7.98
Feet	1.10	2.94	1.12	2.77
Liver	0.666	1.78	0.728	1.80
Lungs	0.592	1.58	0.714	1.76
Spleen	0.081	0.22	0.145	0.36
Heart	0.170	0.45	0.162	0.40
Kidneys	0.112	0.30	0.119	0.29
Testicles	0.277	0.74	0.339	0.84
Stomach	1.47	3.93	1.44	3.56
Intestines	1.47	3.93	1.56	3.85
Pelt	5.23	14.00	5.67	14.00

Source: Farhan, Al-Khalisi & Hameed, 1969

The carcasses of the docked lambs had an average length of 46.4 cm and a heart girth of 64.0 cm, versus 49.9 and 68.4 cm, respectively, in the undocked lambs (Asker, El-Khalsy & Juma, 1964).

In another experiment at Abu-Ghraib, Farhan, Al-Khalisi and Hameed (1969) compared the carcass characteristics of five male Awassi lambs that had been docked with rubber rings during the first week of age with six undocked control lambs (Table 5-19). The lambs were slaughtered at 7½-8½ months, ten days after completion of a feeding trial of 81 days. Before slaughter they were deprived of feed and water for 16 hours.

The docked lambs had an average live weight of 45.8 kg before fasting and 37.4 kg after fasting, losing 8.4 kg (or 18.3 percent) weight during this period. The undocked control animals weighed

48.7 kg before fasting and 40.5 kg after, losing 8.2 kg (or 16.8 percent) by fasting. The dressed weight of the docked lambs was 44.1 percent, and that of the fat-tailed control lambs 46.0 percent of the live weights recorded before the fasting period. After slaughter the stomach and intestinal contents of the docked lambs weighed 5.93 and 2.49 kg, and of the undocked controls 6.17 and 2.03 kg, respectively. The average length of the small intestine was 9.5 m in the docked lambs and 10.5 m in the undocked animals. The composition of the carcasses was recorded after 48 hours of chilling.

Docking reduced the fat content of the carcass and the killing-out percentage, but increased the percentages of kidney fat and muscle and the depth of fat tissue over the *Musculus longissimus dorsi.* In the docked sheep the fat tissue amounted to 15.9 percent and the muscle tissue to 52.1 percent of the total carcass weight excluding the fat tail, and in the undocked animals to 17.5 and 51.1 percent, respectively. The kidney fat in the docked lambs weighed 244 g, or 1.21 percent of the carcass weight without the fat tail, versus 204 g, or 0.91 percent of the carcass weight of the undocked sheep. The fat cover over the seventh-rib section of the *M. longissimus dorsi* on the right loin side measured 5.1 mm in thickness in the docked lambs and 4.6 mm in the fat-tailed control animals.

Mutton

The killing-out percentage of fat adult Awassi sheep of unimproved type in the summer was estimated by Hirsch (1933) at 52 percent, ranging from 50 to 54 percent. The dressed carcass yield of rams was somewhat higher. However, adult slaughter ewes from bedouin flocks, of an average live weight of 40 kg and in rather poor condition, had a warm dressed weight of only 15.6 kg, or 39 percent of the live weight. Adult Awassi slaughter sheep, purchased by the Mandatory Government of Palestine in Syria and Iraq during the Second World War, were graded according to the dressed weights and dressing percentages, including the fat tail, given in Table 5-20.

TABLE 5-20. **Grading of unimproved Awassi slaughter sheep**

Grade	Carcass weight (kg)	Carcass yield (%)
Choice	25.0	50
Extra	18.0	45
A	16.8	42
B	15.6	39
C	14.8	37

TABLE 5-21. **Mean weights of carcass and inner organs of low-grade adult Awassi slaughter sheep (kg)**

	Weight
Live weight	32.75
Dressed weight	12.70
Liver	0.45
Lungs	0.65
Spleen	0.10
Heart	0.15

The mean live and slaughter weights and the weights of the edible inner organs of 20 unshorn sheep of grade B (carcass yield 38.8 percent) were as given in Table 5-21.

In 1951, five unimproved Awassi ewes of an average live weight of 40.2 kg were kept at a slaughterhouse for four days without adequate feed. Normally such ewes kill out at 42 percent, but in this instance, owing to the emptiness of the alimentary tract, the mean dressing percentage was 44.3. Table 5-22 gives the mean weights of the different parts and organs of the carcasses.

In 1970 the author recorded the body composition of five six- to eight-year-old Awassi ewes in good condition and of an adult stud ram in rather lean condition, culled from a highly improved flock (Tables 5-23 and 5-24). The shrinkage in transit and during the fasting period prior to slaughter was 3.68 percent in the ewes and 4.32 percent in the ram.

TABLE 5-22. **Mean weights of carcass parts and inner organs of adult, unimproved Awassi ewes (in kg and as % of mean live weight)**

	Weight	
	Kg	% of live weight
Live weight on delivery to slaughterhouse	42.4	—
Live weight before slaughter	40.2	100.0
Forequarters	9.2	22.9
Hindquarters (with kidneys and fat tail)	8.6	21.4
Total carcass	17.8	44.3
Head	0.960	2.39
Brain	0.106	0.26
Tongue	0.366	0.91
Liver	0.570	1.42
Lungs and trachea	1.010	2.51
Spleen	0.112	0.28
Heart	0.192	0.48
Udder	0.150	0.37
Fat tail	0.660	1.64
Alimentary tract	1.340	3.33

TABLE 5-23. **Mean weights of carcass, head, feet, inner organs, and pelt of 5 adult Awassi ewes and 1 ram (in kg and as % of mean live weights)**

	Ewes			Ram	
	Kg	SD ±	% of live weight	Kg	% of live weight
Live weight on farm before fasting	70.600	5.12	—	81.000	—
Live weight before slaughter	68.000	4.85	—	77.500	—
Carcass weight	34.050	2.39	50.10	44.410	57.40
Forequarters	15.716	2.23	23.10	22.820	29.50
Hindquarters with fat tail	18.334	1.89	27.00	21.590	27.90
Head	2.326	0.21	3.42	3.330	4.30
Brain	0.124	0.02	0.18	0.240	0.31
Tongue	0.142	0.03	0.21	0.310	0.40
Feet	0.926	0.12	1.36	1.330	1.72
Liver	1.208	0.15	1.78	0.700	0.90
Lungs and trachea	0.718	0.16	1.06	0.910	1.17
Spleen	0.156	0.06	0.23	0.150	0.19
Heart	0.280	0.06	0.41	0.270	0.35
Kidneys	0.196	0.06	0.29	0.180	0.23
Udder	1.072	0.43	1.58	—	—
Testicles	—	—	—	0.510	0.66
Oesophagus and thymus	0.182	0.09	0.27	0.240	0.31
Diaphragm	0.284	0.09	0.42	0.320	0.41
Pelt	7.146	1.27	10.50	10.150	13.10

TABLE 5-24. **Mean weights of bone, muscle and fat tissue in forequarters, hindquarters and total carcass of 5 adult Awassi ewes and 1 ram (in kg and as % of mean live weights)**

	Ewes			Ram	
	Kg	SD ±	% of live weight	Kg	% of live weight
Forequarters					
Bone	3.103	0.44	4.56	6.050	7.81
Muscle	8.574	1.34	12.61	13.720	17.70
Fat tissue	3.902	0.71	5.74	2.570	3.32
Weight loss	0.137	0.27	0.20	0.480	0.62
Total	15.716	2.23	23.10	22.820	29.50
Hindquarters					
Bone	1.778	0.26	2.61	2.600	3.35
Muscle	7.216	0.68	10.61	9.910	12.79
Body fat tissue	5.580	0.88	8.21	3.850	4.97
Tail fat	3.382	0.75	4.97	4.820	6.22
Tail	0.220	0.07	0.32	0.210	0.27
Weight loss	0.158	0.10	0.23	0.200	0.26
Total	18.334	1.89	27.00	21.590	27.90
Total carcass					
Bone	4.880	0.78	7.18	8.650	11.16
Muscle	15.790	1.23	23.22	23.630	30.49
Body fat tissue	9.482	1.16	13.94	6.420	8.28
Tail fat	3.382	0.75	4.97	4.820	6.22
Tail	0.220	0.07	0.32	0.210	0.27
Weight loss	0.296	0.22	0.44	0.680	0.88
Total	34.050	2.39	50.10	44.410	57.40