

Meat Production in Peruvian Goats: Body and Carcass Composition

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1. INTRODUCTION

In Peru as well as in other countries with an important goat industry (France, Mexico) kids not required for the replacement of breeding stock are usually slaughtered at ages under 3 months and live weights below 6-7 kg. If these kids could be raised economically to heavier weights, an increase in meat production would be obtained without having to increase the number of breeding animals.

As part of a trial on the possibility of fattening kids in confinement, slaughter data were collected and are presented in this paper. The results should be of interest in all those regions where the question of the most appropriate slaughter age or weight arises.

2. MATERIALS AND METHODS

The trial was carried out at the station of the Peruvian Ministry of Agriculture located near the city of Lambayeque on the northern coast.

One hundred and four male, uncastrated kids of the Peruvian Criollo breed were slaughtered at ages between 90 and 550 days. Eighty-nine were slaughtered at the age of 90, 150, 180, 210, 240 or 270 days. These kids had been born at the station. Their actual age ranged \pm 5 days from the group mean. The other 15 animals in the age groups 360 and 550 days were purchased from a commercial herd. Their age was estimated on

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the basis of their dentition (Bartels, 1968) and information provided by the farmer, and is thought to range within 45 days from the assigned ones.

The kids born at the station received milk in buckets (63 kg in 9 weeks), concentrates, green sorghum and alfalfa. After weaning the feeding consisted of green sorghum and alfalfa, and a mixture of molasses, cotton-seed cake and ground corn-spindles. The purchased animals had been reared with their mothers and grazed on dry-land pastures (250 mm of rain). At the station they received the same diet as those born at the station for 120 days prior to slaughter.

Food but not water was withheld for 12 hours before slaughter. Live weight before slaughter was recorded to the nearest 0.1 kg. The weight of carcass and body tissues was made to the nearest 5 grams. All weights were recorded warm. The carcass was cut according to the diagram shown in Figure 1. All relative weights are expressed as a percentage of empty body weight.

3. RESULTS

Live and empty body weights showed large variations within age groups (Table 1). The regression of age to empty body weight for all animals was $y = 7.286 + 0.025x$ with a correlation of $r = 0.73$.

Subdivision of the animals in two groups, one of those reared at the station and the other of those reared on the range, did not result in a higher age to weight correlation. The dams of the station-born animals had been purchased from various farmers in the area so that both groups were genetically similar. It can be assumed that the variation in weight found represents to a large extent the variation present in the Criollo population in which selection, if any, is done for milk production (Nolte, 1971).

Due to the large variation within age groups, for the further evaluation of the slaughter results it was decided to

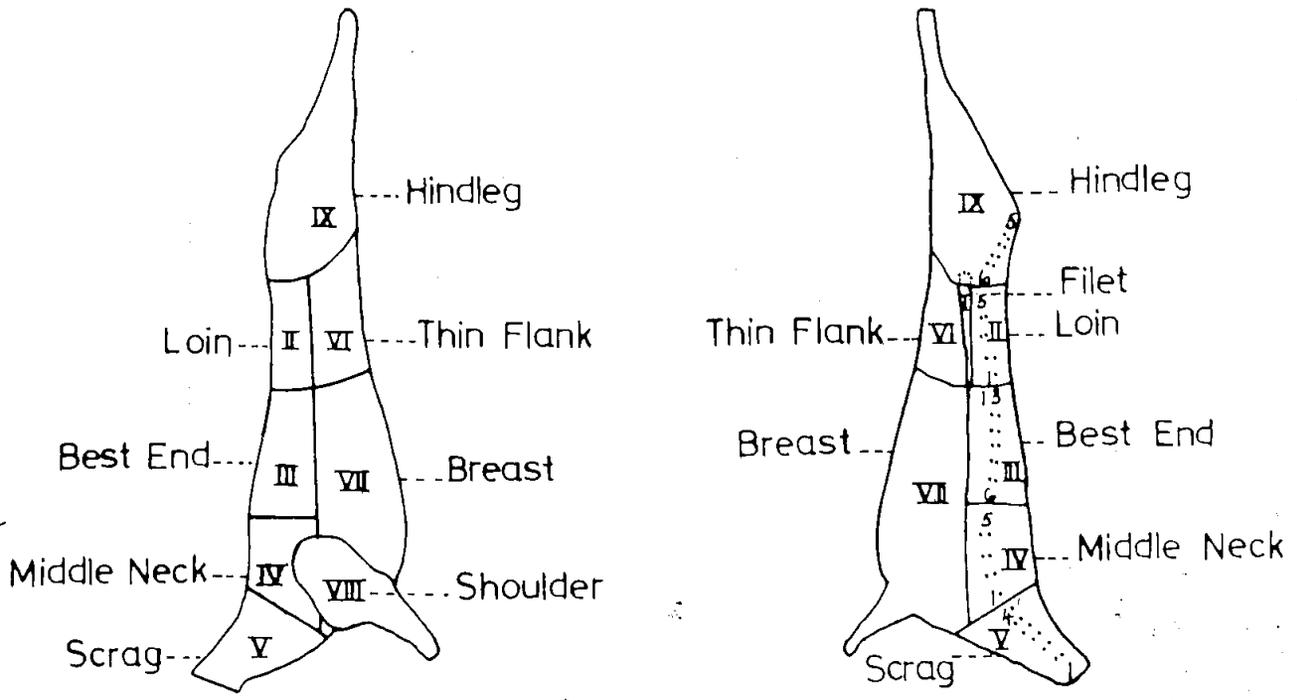


Figure 1. Carcass cuts: left – external view; right – internal view.

regroup the animals according to their empty body weights as shown in Table 2.

Table 1. Average live and empty body weight by age groups.

Age in days	n	live weight		empty body weight	
		kg	o/o s	kg	o/o s
90	23	7.8	20.3	6.2	17.7
150	27	15.3	16.1	12.2	16.4
180	6	18.2	22.6	14.5	21.4
210	7	17.2	10.2	12.7	11.8
240	6	18.6	12.7	14.1	13.5
270	20	22.4	13.4	17.0	14.7
360	4	24.1	22.7	17.5	26.3
550	11	23.9	9.6	18.2	10.1

Table 2. Average empty body weight and age by empty body weight.

empty body weight range in kg	n	average e.b.w.		average age	
		kg	s	days	s
5.01— 7.00	21	6.0	.57	90	0
7.01— 9.00	1	7.7	—	150	0
9.01— 11.00	8	10.3	.63	150	32.0
11.01— 13.00	23	12.0	.53	178.7	49.9
13.01— 15.00	13	14.0	.44	214.6	50.2
15.01— 17.00	16	16.0	.57	315.6	145.8
17.01— 19.00	11	17.9	.62	301.8	135.8
19.01— 21.00	9	20.9	.47	435.5	138.5
greater than 21.01	2	22.5	—	315.0	—

Table 3. Dressing percentage and weight of carcass parts.

	\bar{X}	s	\bar{X}	s	\bar{X}	s	\bar{X}	s	\bar{X}	s	\bar{X}	s	\bar{X}	s	\bar{X}	s	\bar{X}	s
number																		
empty body weight, kg	6.0	.57	7.7	—	10.3	.63	12.0	.53	14.0	.44	16.0	.57	17.9	.67	19.9	.47	22.5	—
carcass, kg	2.93	.39	3.70	—	5.34	.68	6.09	.46	7.38	.52	8.45	.61	9.74	.62	11.0	.53	12.55	—
dressing, o/o live weight	39.2	2.52	37.8	—	39.7	3.52	39.8	2.68	39.5	3.39	40.9	2.91	43.0	4.91	42.5	1.93	42.2	—
dressing, o/o e.b.w.	49.1	3.11	48.1	—	51.9	4.60	50.9	2.64	52.7	2.45	52.9	2.68	54.5	3.00	55.2	3.24	55.8	—
scrag, kg	.31	.04	.38	—	.52	.08	.61	.07	.78	.07	.87	.10	1.01	.16	1.30	.13	1.32	—
middle neck, kg	.16	.03	.22	—	.29	.06	.35	.05	.42	.05	.50	.06	.58	.06	.65	.08	.80	—
best end, kg	.22	.04	.26	—	.39	.04	.41	.06	.50	.08	.60	.09	.69	.05	.82	.08	.87	—
loin, kg	.16	.03	.20	—	.30	.05	.35	.05	.43	.08	.49	.05	.56	.08	.58	.06	.72	—
filet, kg	.017	.006	.033	—	.032	.006	.041	.011	.047	.011	.059	.015	.080	.014	.091	.030	.099	—
breast, kg	.28	.05	.38	—	.56	.05	.68	.07	.82	.14	.92	.16	1.08	.11	1.14	.13	1.40	—
thin flank, kg	.14	.02	.19	—	.30	.04	.34	.05	.42	.09	.45	.08	.52	.06	.48	.07	.62	—
shoulder, kg	.66	.08	.85	—	1.16	.11	1.35	.12	1.55	.14	1.81	.11	2.06	.10	2.30	.13	2.74	—
kidney, kg	.91	.15	1.05	—	1.61	.19	1.87	.15	2.28	.17	2.62	.21	2.97	.21	3.34	.17	3.85	—

3.1. Dressing percentage and weight of major cuts

The dressing percentage ranged between 39.2 and 43.0o/o on a live weight basis and between 49.1 and 55.8o/o on an empty body weight basis (Table 3). The heavier animals had a higher dressing. On a live weight basis the dressing was lower than that found by Morand-Fehr et al. (1977) in French Alpine Goats, and contrary to our findings in their case the dressing was highest in the middle weight ranges (live weight ranged in their case between 4.0 and 32.6 kg). In Table 4 our findings are compared with those of Morand-Fehr et al. (1977) and some compiled from the literature by Gall (1982). While there are large differences in the dressing as a percentage of live weight they are quite close when expressed as a percentage of empty body weight. This reflects the inadequacy of live weight as a guideline for comparison of animals subjected to different treatments, especially preslaughter treatments.

The weight of the major cuts is given in Table 3, and in Table 5 their relative weight as a percentage of the carcass and of the empty body weight is shown. Disregarding the empty body weight groups 7.01-9 kg and above 21.01 kg which were under-represented, there is a tendency, significant in many cases (Table 6), for a change in their proportion of the whole carcass as follows:

to increase:	scrag, filet, breast,
to decrease:	shoulder,
to remain constant:	middle neck, best end, loin, thin flank, hing leg.

The rather large variation within groups in the weight of the cuts can be attributed partially to the already mentioned variation in the breed, but in the case of the breast and the thin flank also to the absence of an exact anatomically defined cutting line. Our findings agree with those of Morand-Fehr et al. (1977) in the tendency that the hind leg, although representing a larger percentage of the carcass in the Criollos (31.09 - 28.38o/o vs. 26.7-24.9o/o in French Alpine), did not show any significant trend in either case; neither did the scrag nor the middle neck. The shoulder weight showed in both cases a declining trend with increasing animal weight; 24.8 - 20.4o/o and 22.49 - 20.92o/o in the Alpine and Criollo kids respectively.

Table 4. Comparison of the dressing of the Peruvian Criollo with kids of other breeds.

Criollo			French Alpine ¹		Others ²			breed and location
l.w.	dressing		l.w.	dressing	l.w.	dressing		
kg	o/o l.w.	o/o e.b.w.	kg	o/o l.w.	kg	o/o l.w.	o/o e.b.w.	
			4.0	40.0				
7.5	39.2	49.1	8.3	48.2	6.1	49.7	—	Calabrese, Italy
9.8	37.8	48.1			11.5	37.2	48.3	Desi X (Angora X Desi), India
13.4	39.2	51.9	11.9	49.6	14.2	41.3	50.4	Desi X (Angora X Desi), India
15.3	39.8	50.9	16.2	46.2	15.6	44.6	54.2	Jamnapari, India
18.7	39.5	52.7			17.8	36.6	47.9	Desi X (Angora X Desi), India
20.7	40.9	52.9			19.1	40.4	48.7	Local, Botswana
22.7	43.0	54.5	22.3	46.2				
25.9	42.5	55.2	27.6	41.7	24.0	48.2	55.8	Jamnapari, India
29.8	42.2	55.8	32.6	39.6	32.2	45.8	56.1	Boer, Botswana

1 Morand-Fehr et al., 1977

l.w. _____ live weight

2. Gall, 1982

e.b.w. _____ empty body weight

Table 5. Carcass parts as a percentage of carcass and of empty body weight.

number	22	1	8	23	13	16	11	9	2
	\bar{X}								
e.b.w., kg	6.0	7.7	10.3	12.0	14.0	16.0	17.9	19.9	22.5
<i>carcass parts as a percentage of empty body weight</i>									
scrag	5.20	4.93	5.07	5.11	5.58	5.46	5.65	6.52	5.87
middle neck	2.69	2.86	2.83	2.93	3.00	3.14	3.25	3.26	3.56
best end	3.69	3.38	3.80	3.43	3.58	3.76	3.86	4.11	3.87
loin	2.69	2.60	2.92	2.93	3.08	3.07	3.13	2.91	3.20
filet	.29	.43	.31	.34	.34	.37	.45	.46	.44
breast	4.70	4.94	5.46	5.69	5.87	5.77	6.04	5.72	6.22
thin flank	2.35	2.47	2.92	2.85	3.00	2.82	2.91	2.41	2.76
shoulder	11.08	11.04	11.31	11.30	11.09	11.35	11.53	11.54	12.18
hind leg	15.27	13.64	15.69	15.65	16.31	16.43	16.62	16.76	17.12
<i>carcass parts as a percentage of whole carcass</i>									
scrag	10.45	10.27	9.72	10.05	10.58	10.28	10.35	11.83	10.48
middle neck	5.54	5.95	5.41	5.73	5.66	5.87	5.96	5.91	6.37
best end	7.41	7.03	7.40	6.78	6.81	7.12	7.12	7.52	6.93
loin	5.57	5.41	5.63	5.65	5.78	5.77	5.77	5.27	5.70
filet	.55	.89	.61	.67	.64	.70	.82	.83	.79
breast	9.54	10.27	10.65	11.17	11.08	10.84	11.11	10.38	11.12
thin flank	4.90	5.13	5.53	5.58	5.71	5.31	5.32	4.36	4.94
shoulder	22.49	22.97	21.79	22.13	21.07	21.47	21.21	20.92	21.79
hind leg	31.09	28.38	30.24	30.67	30.85	30.98	30.48	30.36	30.67

Table 6. Significance of the difference between empty body weight groups in the weight of major cuts as a percentage of whole carcass. (1)

Mean e.b.w., kg	6.0	10.3	12.0	14.0	16.0	17.9	19.9
Cut							
scrag	ab	abcdef	bg	ch	dj	ek	bfg hjk
middle neck	—	—	—	—	—	—	—
best end	a	—	ab	—	—	—	b
loin	—	—	—	—	—	—	—
filet	abcd	ef	a	g	b	ceg	df
breast	abcd	a	—	b	c	—	d
thin flank	abc	ad	b	ce	f	g	defg
shoulder	abcd	—	—	a	b	c	d
hind leg	—	—	—	—	—	—	—
Dressing o/o e.b.w.	abcd	—	ef	a	b	ce	df

(1) Within a single row, means with the same letter differ significantly ($P = 0.05$).

Table 7. Correlations between carcass components, weight, and age.

	age	live weight	e.b.w.	carcass weight	dressing o/o l.w.	dressing o/o e.b.w.
live weight	.75	-	.99	.98	.25	.60
empty body weight	.73	.99	—	.99	.37	.60
carcass weight	.70	.98	.99	—	.44	.57
dressing o/o l.w.	.03	.25	.60	.44	—	.68
dressing o/o e.b.w.	.31	.60	.60	.69	.68	—
scrag o/o carcass	.49	.55	.53	.58	.30	.57
middle neck o/o carcass	.12	-.10	-.12	-.15	-.23	-.23
best end o/o carcass	.15	-.07	-.09	-.13	-.22	-.22
loin o/o carcass	.04	.27	.30	.35	.51	.58
filet o/o carcass	.29	.53	.55	.56	.34	.40
breast o/o carcass	.25	.54	.54	.57	.35	.60
thin flank o/o carcass	-.04	.22	.21	.24	.16	.34
shoulder o/o carcass	.12	.28	.27	.33	.39	.60
hind leg o/o carcass	.23	.49	.49	.57	.57	.82

Correlations between the different parameters were also estimated (Table 7). The positive correlations between empty body weight and dressing percentage as well as between empty body weight and filet, scrag, and breast as a percentage of the carcass support the results thus far. The correlation between empty body weight and hind leg as a percentage of the carcass was moderately positive (0.49) indicating a tendency to increase relative to the carcass in heavier animals. This fact is not evident in the comparison of the group means, probably due to the large variation mentioned and the uneven number of animals in the groups. The correlations between empty body weight and shoulder, middle neck, best end, loin, and thin flank as a percentage of the carcass were too low to indicate any consistent trend.

3.2. *Organs and offals*

The weight of the inner organs and non-edible offals as well as their weight as a percentage of empty body weight is given in Table 8. In Table 9 correlations between their percentage of empty body weight and age, live weight, empty body weight, carcass weight, dressing as a percentage of live weight and of empty body weight are given. The tendencies for the various tissues to change with increasing empty body weight are as follows:

- to increase: genital tract, kidney and pelvic fat,
- to decrease: head, feet, heart, respiratory tract, liver,
kidneys, digestive tract,
- to remain constant: skin, blood, spleen.

4. DISCUSSION

The results indicate that the changes in body composition with increasing weight result in a more valuable meat animal not only in absolute value, but also in terms of the body composition. Parts with a low value like head, feet, heart, respiratory and digestive tract decrease (blood and spleen remain constant) in their contribution to the empty body weight, while the percentage represented by the carcass increases.

In the carcass the higher priced cuts like filet, best end, loin, and hind leg either increase or remain constant. The amount of fat, although still low, also increases.

It can be concluded that further studies aimed at making better use of available animal resources are warranted. They would include studies over an even higher age/weight range to determine the optimal slaughter time, studies on the composition of the female body (which in other species become fatter at a lower weight), and the effects of castration on growth and body composition. Selection in the breed for better meat producing qualities should also be possible, considering the large variation found in Peruvian Criollo goats.

5. SUMMARY

The weight of the carcass and its parts, as well as that of the inner organs and offal, was determined in 104 male,

Table 8. Weight of organs and offals and percentage of empty body weight.

	\bar{X}	s	\bar{X}	s	\bar{X}	s	\bar{X}	s	\bar{X}	s	\bar{X}	s	\bar{X}	s	\bar{X}	s		
empty body weight, kg	6.0	.57	7.7	—	10.3	.63	12.0	.53	14.0	.44	16.0	.57	17.9	.67	19.9	.47	22.5	—
number	21		1		8		23		13		16		11		9		2	
head, kg	.57	.09	.57	—	.74	.14	.82	.09	1.04	.12	1.16	.19	1.28	.23	1.59	.15	1.53	—
o/o e.b.w.	8.92	.97	7.40	—	7.16	1.09	6.80	.74	7.42	.90	7.25	1.18	7.16	1.27	7.95	.71	6.77	—
skin, kg	.52	.08	.60	—	.88	.14	1.18	.27	1.21	.13	1.45	.17	1.65	.22	1.71	.20	2.15	—
o/o e.b.w.	8.86	1.71	7.79	—	8.59	.99	9.88	2.29	8.65	.79	9.09	1.03	9.24	1.18	8.55	.97	9.59	—
feet, kg	.31	.04	.40	—	.44	.05	.47	.08	.56	.07	.63	.06	.70	.03	.77	.07	.81	—
o/o e.b.w.	5.16	.72	5.19	—	4.13	.30	3.93	.66	3.97	.53	3.94	.43	3.94	.18	3.86	.34	3.59	—
blood, kg	.32	.05	.51	—	.61	.03	.70	.09	.88	.28	.99	.11	1.00	.09	1.10	.11	1.07	—
o/o e.b.w.	5.40	.72	6.62	—	5.93	.51	5.86	.72	6.86	.24	5.62	.65	5.61	.56	5.53	.52	4.78	—
heart, kg	.038	.005	.041	—	.059	.010	.072	.026	.074	.013	.093	.016	.089	.018	.103	.020	.120	—
o/o e.b.w.	.64	.10	.53	—	.57	.12	.60	.20	.53	.11	.58	.10	.50	.11	.54	.05	.53	—
respiratory kg	.14	.03	.17	—	.20	.03	.23	.04	.23	.02	.26	.04	.29	.04	.31	.03	.47	—
tract, o/o e.b.w.	2.34	.33	2.21	—	1.98	.25	1.90	.28	1.65	.19	1.60	.26	1.63	.22	1.56	.13	2.07	—
liver, kg	.16	.04	.24	—	.31	.05	.33	.05	.36	.07	.39	.05	.41	.07	.43	.05	.46	—
o/o e.b.w.	2.69	.43	3.11	—	3.05	.68	2.79	.41	2.59	.52	2.46	.37	2.30	.38	2.18	.24	2.05	—
spleen, kg	.015	.004	.014	—	.024	.006	.024	.005	.028	.008	.030	.007	.031	.004	.033	.006	.044	—
o/o e.b.w.	.25	.05	.18	—	.23	.05	.20	.04	.20	.05	.19	.04	.18	.02	.17	.03	.19	—
kidneys, kg	.042	.008	.051	—	.070	.014	.070	.013	.070	.013	.081	.007	.085	.013	.091	.011	.103	—
o/o e.b.w.	.70	.09	.66	—	.69	.17	.58	.11	.50	.10	.50	.05	.47	.07	.46	.05	.46	—
kidney and kg	.018	.009	.024	—	.053	.025	.067	.033	.073	.047	.078	.043	.110	.067	.108	.037	.285	—
pelvic fat, o/o e.b.w.	.30	.14	.31	—	.52	.26	.56	.25	.52	.29	.49	.22	.62	.31	.54	.20	1.27	—
genital tract, kg	.03	.007	.08	—	.11	.035	.15	.061	.18	.069	.27	.183	.27	.081	.29	.038	.38	—
o/o e.b.w.	.56	.09	1.08	—	1.04	.32	1.24	.51	1.26	.48	1.70	.20	1.53	.18	1.43	.19	1.69	—
digestive tract kg	.81	.13	1.01	—	1.50	.15	1.55	.19	1.92	.30	2.07	.33	2.03	.29	2.25	.38	2.38	—
(empty), o/o e.b.w.	13.53	1.52	13.12	—	14.74	1.92	13.01	1.68	13.77	2.29	12.99	2.21	11.37	1.65	11.28	2.03	10.57	—
rumen capacity, kg (water)	3.74	.68	6.00	—	6.68	1.15	7.52	1.28	9.03	1.39	9.02	1.52	9.32	1.43	12.90	1.18	11.10	—

Table 9. Correlations between organs, offals, age, weight, and dressing.

	age	live weight	e.b.w.	carcass weight	dressing o/o l.w.	dressing o/o e.b.w.
head, kg	.84	.92	.91	.89	.19	.48
o/o e.b.w.	.08	-.31	-.36	-.37	-.39	-.29
skin, kg	.60	.90	.91	.91	.34	.58
o/o e.b.w.	-.11	.01	0	0	-.07	-.04
feet, kg	.71	.91	.93	.91	.29	.47
o/o e.b.w.	-.40	-.60	-.61	-.61	-.28	-.51
blood, kg	—	—	—	—	—	—
o/o e.b.w.	-.05	-.03	-.03	-.07	-.22	-.23
heart, kg	.60	.81	.81	.81	.26	.50
o/o e.b.w.	-.20	-.27	-.29	-.28	-.17	-.19
respiratory kg	.53	.86	.87	.86	.32	.55
tract, o/o e.b.w.	-.57	-.65	-.67	-.64	-.22	-.32
liver, kg	.63	.83	.85	.81	.22	.40
o/o e.b.w.	-.29	-.40	-.40	-.43	-.29	-.43
spleen, kg	.16	.29	.29	.29	.10	.19
o/o e.b.w.	-.09	-.05	-.05	-.05	-.02	0
kidneys, kg	.60	.80	.82	.78	.20	.33
o/o e.b.w.	-.48	-.69	-.69	-.71	-.33	-.60
kidney and kg	.18	.57	.59	.60	.36	.46
pelvic fat, o/o e.b.w.	-.06	.28	.30	.32	.30	.32
genital tract, kg	.47	.71	.74	.73	.33	.40
o/o e.b.w.	.27	.47	.51	.48	.22	.23
digestive tract kg	.66	.94	.87	.86	.17	.40
(empty), o/o e.b.w.	-.22	-.37	-.37	-.44	-.43	-.61

uncastrated Peruvian Criollo kids. Their ages ranged from 90 to 550 days and they had empty body weights between 6.0 and 22.5 kg. The dressing percentage (empty body weight basis) increased from 49.1 to 55.8o/o with increasing empty body weight. Similarly, as a percentage of the carcass, scrag increased from 10.45 to 11.83o/o, filet from 0.55 to 0.83o/o, and breast from 9.54 to 10.38o/o. Shoulder decreased from 22.49 to 20.92o/o. Middle neck, best end, loin, thin flank and hind leg remained constant making up on the average 3.01, 3.75, 2.96, 2.75 and 16.10o/o respectively of the carcass.

Of the inner organs and offals, as a percentage of the empty body weight, the genital tract increased from 0.56 to 1.43o/o, and kidney and pelvic fat from 0.30 to 0.54o/o. Head decreased from 8.92 to 7.95o/o, feet from 5.16 to 3.86o/o, heart from 0.64 to 0.54o/o, respiratory tract from 2.34 to 1.56o/o, liver from 2.96 to 2.18o/o, kidneys from 0.70 to 0.46o/o and digestive tract from 13.52 to 11.28o/o. Skin, blood and spleen remained constant with an average of 8.98, 5.76 and 0.20o/o respectively.

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