Effects of Age and Sex on Liveweight and Body Composition of the West African Dwarf Sheep

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SUMMARY

SIXTEEN animals selected from the sheep flock of the University were divided into four age-groups [4, 30, 150-180 and 360-420 days] with each group consisting of two males and two females. They were weighed just before slaughter to obtain their live-weights. Weights of drainable blood, head, hot carcass, trotters, intestinal and stomach contents, liver, kidney, heart, spleen and lungs were recorded and expressed as percentage of the ingesta-free body or empty body weight [E.B.W.].

All body components measured increased in weight with increasing age, but when expressed as percentage of the E.B.W., showed a progressive decrease with advancing age, except the stomach and intestinal contents. The percent moisture content of the visceral organs decreased with advancing age while the percent crude protein and ether extracts increased with age.

Sex effects on live-weight and weights of some body components were not apparent at the early age-groups. At maturity however, the males generally had higher values for the various body components. Similarly, the chemical composition of the visceral organs showed very little sex differences before maturity; after this stage the males consistently had higher moisture and crude protein values and lower ether extracts values than the females.

INTRODUCTION

THE growth and development of the sheep have been the subject of a number of studies (Hammond and Appleton, 1932; Wallace, 1948; Palsson and Verge, 1952). A basic understanding of the nature of growth processes is necessary in order to be able to improve the efficiency of meat production. Growth involves not only the rate of mass increase but also the other aspects such as sex, feed efficiency, body composition, metabolic rate (Bailey

kitts and Wood, 1960). The concept of differential growth has been shown to apply to the growth of various anatomical parts, tissues and organs (McMeekan, 1940). The exact composition of the gain at various stages of growth depends on the relative priority of the various tissues for available nutrients. The dietary protein concentration for instance has been shown to affect the gain in weight and the composition of the gain (Walker and Cook, 1967); while the chemical nature and the absolute amount of the gain depend on the stage of growth as well as the plane of nutrition (Jagusich, Norton and Walker, 1970).

Most of the studies so far reported on body composition and carcass quality have been on exotic breeds of sheep. There is little known of the chemical composition of the West African dwarf sheep from birth to maturity. In the experiment now reported, results are given on changes in body components and visceral organs of the West African dwarf sheep as affected by age and sex at four different stages of development (4, 30, 150-180 and 360-420 days of age). The first two age-groups fall into the pre-weaning stage when the animal depends mostly on the dam's milk, and the last two age-groups fall into the post-weaning stage when the animal is able to feed on its own (Wallace, 1948)

MATERIALS AND METHODS

Sixteen West African dwarf sheep from the flock of the University Teaching and Research Farm were divided into four age-groups (4, 30, 150-180 and 360-420 days) each consisting of two males and two females. Until the time of slaughtering, the animals in the pre-weaning stage of development (4 and 30 days of age) were still with their dams. The other animals including the dams of the unweaned lambs, were group-fed freshly-cut giant star grass (*Cynodon nlemfuensis*) *ad libitum* and approximately 0.5 kg concentrate per head daily. Weaning of the young ones is usually at three months of age, with an average weaning weight of about 8.0 kg. Following weaning the lambs are separated into age-groups with the sexes apart.

All the animals were weighed just before slaughter to obtain their liveweight. They were slaughtered by severance of the jugular blood vessels and simultaneous dislocation of the neck. Slaughtering

and other operations were carried out as rapidly as possible to minimize moisture losses from the carcass. Weights of drainable blood, head, hot carcass, skin trotters, stomach and intestinal contents were obtained. Chemical analysis of this whole carcass was not possible because of lack of facility for high capacity meat grinders. However, five important visceral organs, viz., liver, kidney, heart spleen and lungs, were chemically analyzed for moisture, ash, crude protein (N x 6.25) and ether extracts (fats) using A.O.A.C. (1970) method of analysis. The data were subjected to analysis of variance (Steel and Torrie, 1960) and the treatment means compared, using the Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The pattern of growth of the West African dwarf sheep at the four stages studied can be seen from Table 1. Apart from being small in size as compared with other breeds (Williamson and Payne,

TABLE 1

Liveweight and Weights of certain Body Components of the West African Dwarf Sheep as affected by Age.

Parameters	Age			
	4 days	30 days	150-180 days	360-420 days
Live weight (kg)	2.44	3.68	9.58	20.48
Empty Body Weight *(kg)	2.38	3.40	7.50	17.42
E.B.W. as % of live wt.	97.54	92.90	78.28	85.06
Drainable blood (kg)	0.17	0.22	0.46	1.09
As % of E.B.W.	7.35	6.34	6.20	6.26
Head (kg)	0.34	0.45	0.85	1.47
As % of E.B.W.	14.36	13.36	11.58	8.44
Skin (kg)	0.31	0.46	0.85	1.70
As % of E.B.W.	13.00	13.41	11.57	9.76
Trotters (kg)	0.17	0.23	0.40	0.57
As % of E.B.W.	7.34	6.69	5.41	3.72
Hot carcass (kg)	1.15	1.76	3.42	7.72
As % of E.B.W.	48.32	51.76	45.70	44.32
Intestinal contents (kg)	0.06	0.28	2.08	3.06
As % of E.B.W.	2.57	8.37	27.93	17.58

* Empty Body Weight (E.B.W.) = Live weight minus weight of stomach and intestinal contents.

1959), the West African dwarf sheep can be described as slow-growing, reaching only about 20 kg in 12-14 months. The fastest growth period appeared to be between one month and 5-6 months of age. Between 4 days and 30 days of age, the lambs had an average of about 50% increase in weight. Between one month and 5-6 months, the average increase in weight was about 160% and about 100% between 5-6 months and 12-14 months. Sex differences were not apparent in the

early stages, but at 12-14 months, the males were heavier ($p < 0.01$) than the females (Table 2).

All the body components studied viz. drainable blood, head trotters, skin, carcass, stomach and intestinal contents, increased in weight with advancing age. But when the weights of these body components were expressed as the percentage of the ingesta-free body or empty body weight (E.B.W.), the percentage values

TABLE 2

Sex Effects on the Weights of certain Body Components in the West African Dwarf Sheep

Parameters	4 days		30 days		150-180 days		360-420 days	
	Male	Female	Male	Female	Male	Female	Male	Female
Live weight (kg)	2.38	2.49	4.08	3.28	9.41	9.75	24.89	16.06
E.B.W. (kg)	2.32	2.43	3.74	3.06	7.29	7.71	21.49	13.35
E.B.W. as % of live wt.	97.50	97.59	91.66	93.28	77.47	79.09	86.32	83.16
Drainable blood (kg)	0.17	0.18	0.26	0.18	0.46	0.45	1.31	0.88
As % of E.B.W.	7.48	7.25	6.84	5.72	6.25	6.15	6.10	6.59
Head (kg)	0.37	0.32	0.46	0.45	0.91	0.79	1.81	1.31
As % of E.B.W.	15.75	13.10	12.17	14.79	12.44	10.71	8.42	8.47
Skin (kg)	0.31	0.31	0.46	0.45	0.79	0.91	2.04	1.36
As % of E.B.W.	13.16	12.91	12.26	14.80	10.89	12.24	9.50	10.42
Trotters (kg)	0.18	0.17	0.23	0.23	0.45	0.34	0.68	0.45
As % of E.B.W.	7.56	7.17	6.09	7.45	6.23	5.41	3.17	3.33
Hot carcass (kg)	1.33	1.36	1.85	1.47	3.15	3.57	9.76	5.68
As % of E.B.W.	57.33	55.97	49.46	48.04	43.21	48.19	45.41	42.54
Intestinal Contents (kg)	0.06	0.06	0.34	0.23	2.12	2.04	3.40	2.71
As % of E.B.W.	2.62	2.53	9.13	7.44	29.08	27.53	15.82	20.22

TABLE 3

Weight of Visceral Organs of the West African Dwarf Sheep as affected by Age

Parameters	Ages			
	4 days	30 days	150-180 days	360-420 days
E.B.W. (kg)	2.38	3.40	7.50	17.42
Liver (g)	70.98	84.61	198.35	290.95
As % of E.B.W.	2.98	2.49	2.64	1.67
Kidneys (g)	27.18	19.61	49.29	40.41
As % of E.B.W.	1.4	0.58	0.66	0.23
Heart (g)	21.95	26.28	41.89	71.10
As % of E.B.W.	0.92	0.77	0.56	0.41
Spleen (g)	5.85	11.21	16.52	27.38
As % of E.B.W.	0.25	0.33	0.22	0.16
Lung (g)	51.24	66.55	120.10	192.20
As % of E.B.W.	2.15	1.96	1.60	1.10

for drainable blood, head, skin, trotters and hot carcass showed a progressive decrease with advancing age. Expressed as the percent of E.B.W., the stomach and intestinal contents showed a progressive increase with age up to 150-180 days of age and then a decrease at 360-420 days. This observation could be due to the rapid development of the rumen as from the time the animal started to eat roughage. At maturity (360-420 days), however, when the rumen capacity becomes more or less constant, the animal is still able to increase in body weight. Similar growth results were obtained when the E.B.W. were expressed as the percentage of liveweight. There were highly significant differences ($P > 0.01$) in both live weight and E.B.W. at the four stages of growth studied.

Generally, the males consistently had heavier ($P > 0.05$) head, trotters, and stomach and intestinal contents at the four stages of development studied. But sex differences in the weight of other body components including live weight, hot carcass, drainable blood and skin were

not apparent until mature age (360-420 days) when the males had higher ($P < 0.01$) values (Table 2).

Data on visceral organ weights at the four different stages of growth are presented in Table 3. All the organs studied except the kidneys showed a progressive increase in weight with advancing age. When the weights of the different organs were expressed as the percentage of the E.B.W., there was a progressive decrease with age, indicating that the E.B.W. was increasing at a much faster rate than the visceral organs. This observation is explained by the fact that the visceral organs are early maturing (Hammond and Appleton, 1932), reaching their maximum size before the other body parts.

Differences due to sex in the weights of the different visceral organs are shown in Table 4. The variability of the data is such that it does not allow for any meaningful explanation of the overall pattern of the changes in the organs in relation to sex. At maturity however, the males had slightly but not significantly ($P < 0.05$) heavier liver, kidney

TABLE 4
Sex effects on the Visceral Organs Weights in the West African Dwarf Sheep

Parameters	Ages							
	4 days		30 days		150-180 days		360-420 days	
	Male	Female	Male	Female	Male	Female	Male	Female
E.B.W. (kg)	2.38	2.49	3.74	3.06	7.29	7.71	21.44	13.39
Liver (g)	60.38	81.57	91.90	73.135	192.75	203.95	326.15	255.7
As % of E.B.W.	2.54	3.28	2.46	2.5	2.64	2.64	1.52	5.91
Kidneys (g)	23.75	30.61	21.79	17.43	51.23	47.35	46.73	34.91
As % of E.B.W.	1.00	1.23	0.58	0.57	0.70	0.62	0.22	0.25
Heart (g)	17.63	26.26	26.50	25.85	40.38	43.40	87.21	55.98
As % of E.B.W.	0.74	1.05	0.71	0.85	0.55	0.56	0.41	0.42
Spleen (g)	6.48	5.18	13.30	9.12	14.10	18.93	26.58	28.18
As % of E.B.W.	0.27	0.21	0.36	0.29	0.19	0.25	0.12	0.21
Lungs (g)	47.08	55.39	76.85	56.85	105.35	134.84	192.75	191.65
As % of E.B.W.	1.98	2.23	2.03	1.86	1.45	1.75	0.90	1.43

TABLE 5

Chemical Composition of the Visceral Organs of the West African Dwarf Sheep as affected by Age

Parameters	Ages			
	4 days	30 days	150-180 days	360-420 days
Weight of liver (g)	70.98	84.61	198.35	290.95
Moisture (%)	73.90	71.49	71.12	70.15
Ash (%)	5.94	7.87	4.18	1.34
Crude protein (%)	16.56	17.74	20.42	22.61
Ether extract (%)	3.17	3.18	3.95	5.53
Weight of kidney (g)	27.18	19.61	49.24	40.41
Moisture (%)	81.92	79.14	76.85	75.53
Ash (%)	3.56	4.52	2.66	1.10
Crude protein (%)	12.94	14.04	17.52	16.47
Ether extract (%)	1.79	2.52	2.58	7.16
Weight of Heart (g)	21.95	26.28	41.89	71.10
Moisture (%)	78.09	75.32	73.64	67.02
Ash (%)	4.01	4.82	2.67	0.75
Crude protein (%)	14.04	15.85	19.25	21.34
Ether extract (%)	3.13	3.84	4.01	10.30
Weight of Spleen (g)	5.83	11.21	16.52	27.38
Moisture (%)	78.95	74.87	73.70	72.68
Ash (%)	4.21	9.62	3.05	1.42
Crude protein (%)	14.84	14.02	20.98	21.24
Ether extract (%)	1.76	1.81	1.84	3.83
Weight of Lungs (g)	51.24	66.55	120.10	192.20
Moisture	80.06	78.23	72.90	72.74
Ash (%)	4.41	4.53	5.60	3.19
Crude protein (%)	12.93	14.45	19.38	20.89
Ether extract (%)	2.04	2.58	2.62	2.72

TABLE 6

Sex Effects on the Chemical Composition of the Visceral Organs

Parameters	Ages							
	4 days		30 days		150-180 days		360-420 days	
	Male	Female	Male	Female	Male	Female	Male	Female
Weight of Liver (g)	60.38	81.57	91.90	78.13	192.75	203.95	326.15	255.75
Moisture (%)	72.20	75.00	69.36	73.62	72.31	69.93	71.48	68.82
Ash (%)	3.75	8.13	8.36	7.38	4.40	3.96	1.36	1.3
Crude protein (%)	16.55	16.57	19.81	15.67	19.54	21.29	23.45	21.77
Ether extract (%)	3.00	3.34	2.89	3.47	3.02	3.88	3.61	7.45
Weight of kidney (g)	23.75	30.61	21.79	17.43	51.23	47.35	46.73	34.09
Moisture (%)	83.60	80.24	76.78	81.50	77.36	76.34	76.89	73.77
Ash (%)	1.84	5.28	5.64	3.40	2.39	2.93	1.12	1.08
Crude protein (%)	12.56	13.31	14.60	13.48	16.71	18.32	16.36	16.57
Ether extract (%)	1.38	2.20	2.48	2.56	2.61	2.55	5.71	8.61
Weight of heart (g)	17.63	26.26	26.50	25.85	40.38	43.40	87.20	55.98
Moisture (%)	79.04	77.14	74.93	75.71	73.72	73.56	67.05	66.99
Ash (%)	2.65	5.37	6.10	3.54	2.56	2.78	0.98	0.52
Crude protein (%)	14.33	13.75	15.43	16.23	19.74	18.76	22.45	20.22
Ether extract (%)	2.83	3.43	3.06	4.62	3.30	4.72	8.93	11.67
Weight of spleen (g)	6.48	5.18	13.30	9.12	14.10	18.93	26.58	28.18
Moisture (%)	79.31	77.59	77.76	71.98	74.60	72.80	72.85	72.51
Ash (%)	3.05	5.37	6.42	12.82	3.38	2.72	1.25	1.58
Crude protein (%)	14.60	15.08	14.36	13.68	19.86	22.11	22.33	20.15
Ether extract	1.66	1.86	1.74	1.88	1.72	1.96	3M03	4.63
Weight of lungs (g)	47.08	55.39	76.25	56.85	105.35	134.84	192.75	191.56
Moisture (%)	82.10	78.02	76.50	79.96	72.93	72.87	72.81	72.67
Ash (%)	2.98	5.84	5.63	3.43	6.76	4.43	3.44	2.9
Crude protein (%)	12.32	13.54	15.40	13.29	12.93	13.83	21.20	20.57
Ether extract (%)	2.00	2.08	2.49	2.67	1.78	3.46	2.38	3.16

and heart than the females, while spleen and lungs did not show any sex differences

Chemical composition of the viscera organs are presented in Tables 5 and 6. The percentage moisture content of the organs decreased progressively from the early age to maturity. The percentage as content generally increased from 4 days to 30 days of age, after which it decreased with age. Both the crude protein ($N \times 6.25$) and ether extracts (fats) increased progressively with age. At maturity (360-420 days), the kidneys had the highest moisture content (percentage-wise) followed by the lungs, spleen, heart and liver in that order. Crude protein content was highest in the liver, followed by the heart, spleen, lungs and kidney while the fat content was highest in the heart, followed by the kidney, liver spleen and lungs in descending order. Generally, the chemical composition of the visceral organs showed very little sex differences before mature age. At maturity, the males consistently had slightly but not significantly ($P > 0.05$) higher moisture and crude protein values while the females had significantly ($P < 0.05$) higher ether extracts (fats) values.

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