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THE USE OF CARCASS ANALSIS TECHNIQUES FOR INVESTIGATING THE MEAT PRODUCTION POTENTIAL OF GAME AND DOMESTICATED ANIMALS IN SEMI-ARID AREAS

by

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INTRODUCTION

At this meeting we have been asked to consider whether or not game animals can play any part in increasing the production of animal protein.

Clearly, there are many ways to tackle such a problem. Consideration can be given to the extermination of all game and an estimate made of the increase in animal protein which would be likely to result from the use of domesticated stock alone, alternatively it may be considered that the differential grazing habits of some of the game animals would improve the grazing for the benefit of the domestic stock to the extent of increasing their meat yield per acre, or the meat production potential of the game animals themselves might be a profitable field of investigation. It is this latter facet of the problem to which I refer in this paper. It is assumed that the environment in which the majority of the animals under consideration will be living is that of those large tracts of land, amounting to about ⅓ of East Africa's land mass which, because of its low or erratic rainfall, is marginal or sub-marginal for crops but eminently suited for meat production.

These semi-arid areas, situated in the tropics, present problems the answers to which are sometimes obscured rather than enlightened by lessons learned in the temperate zones. For example it is not always appreciated that the increases in animal productivity in the temperate zones have largely resulted from an economy which has enabled producers steadily to raise the plane of nutrition of their stock and select those animals best able to respond to it.

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Here the problem is different. To be objective about any scheme aimed at increasing the yield of meat per acre in country similar to that in which we are meeting to-day it must be accepted that it is economically impossible to raise the level of animal nutrition by any appreciable extent. Those methods that can be economically justified such as increasing the number of watering points, controlling the bush by fire and regulating the grazing can, at their very best, bring in a gross return of 10 shillings per acre. Such is the productivity of Kenya's most developed and best run ranches. This return surely precludes the spending of large sums of money on grassland improvement schemes.

This does not mean that such areas are unproductive or that such productivity cannot be materially increased. It does mean however that as major improvements cannot be attained by raising the level of nutrition they must largely result from the selection of those families species or strains of animals best able to achieve, either singly or in combination, an efficient, sustained, conversion of the existing fodder into meat within this environment.

To many people the suggestion that animals other than the known domesticated ones can seriously be considered as commercial meat producers is laughable. These same people however would consider it only right for a farmer in a predominantly grain growing area to keep pigs, the owner of moorland to keep sheep, the beef producer Aberdeen Angus or Herefords according to the food and terrain available and the dairyman Ayrshires or Jerseys according as to whether he lived in the North of Scotland or the Channel Isles. Indeed they would go even further and point out that certain breeds of sheep are essential for hill grazing whilst others do better in the lowlands. Yet what is this but a selection of species or strains within a species best suited to particular environmental and feed conditions.

/Objective ....

Objective consideration of the problems of meat production in these semi-arid areas is dependant upon bearing in mind that whilst it is generally agreed that zebu (Bos indicus) cattle are better suited to the environment than exotic stock (Bos taurus) they themselves are exotics, having only arrived in the country a matter of some 250-300 years ago. During this time they have adapted themselves to the local environment but with our present knowledge it is surely illogical to preclude the possibility that some game animals, indigenous to the country may be as well or better suited to produce meat in their own environment than domesticated stock or alternatively that they may profitably live in peaceful co-existence with them.

Fundamentally the problem is one of relative efficiency in a given environment and efficiency in meat production can mean many things such as the rate of growth, reproduction and maturity, resistance of susceptability to disease, high conversion ratios in terms of pounds of stock feed eaten per pound of edible meat produced, variety of fodder plants eaten, ability to withstand periods of food shortage and water deprivation etc. In addition to all of these criteria there is the efficiency with which the animal deposits lean and fat within its carcass and the amount of wastage, in the form of inedible products that occurs at slaughter.

It is when estimations of individual or species efficiency are being made that a knowledge of an animals composition is so important, because merely to compare liveweights or growth rates can be misleading. For example if one considers the production of 100 lbs. of boneless meat taken from the carcasses of three animals of the same weight but which have a carcass fat percentage of 9, 28 and 36 respectively, it can be calculated, using hay of a Starch Equivalent of 20 (which approximates the general nutritional level of the grazing available in these semi-arid areas) that the fattest animal will require the equivalent of 146 lb. more hay to produce 100 lbs. of boneless meat than the leaner animal and 72 lbs. more than

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the medium fat animal. In a country where feed is more often than not inferior or in short supply such differences are important.

Another aspect is the effect that growth rate has upon the final composition of the animal. It has been shown by Watson (1943) that steers gaining at the rate of 2 lbs. per day throughout their life will after reaching 1,200 lbs.liveweight depend almost entirely on fat deposition for any increase in weight; on the other hand steers growing at the rate of 0.6 lbs. per day will reach this stage at 850 lbs. liveweight. Fat being the most uneconomical of animal products to produce it is of practical importance to know at what weight animals under a given set of conditions reach an economic slaughter level, for as can be seen by the above example, to try to carry the 850 lbs animal on until it was 1,000 lbs would be gross waste of food unless of course the object was to produce fat in quantity.

It is to record the relative efficiency of animals in terms of their composition that a standard system of carcass analysis has been developed at Muguga.

Originally designed to investigate the production potential of Boran zebu steers the work has been extended to cover other species of cattle, sheep, goats and game animals.

The basis of such meat investigations is the dressed carcass, which is the same for any species of animal. In fact the underlying principle of the records taken is to ensure that a direct comparison can be made between all carcasses of all species of animals.

The dressed carcass is one from which the hide has been removed, the head severed at the Atlas joint, the legs removed at the knee and hock joints (Tarsals and Metatarsals) and the tail at the first Cocygeal Vertebra. With the exception of the kidneys and kidney fat, which ramains in the carcass, all the viscera is removed and the diaphragm is trimmed off close to the rib wall.

/Quality ....

Quality considerations excluded, two indices give an indication as to the value of the carcass. The first is the 'Killing' or 'Dressing Out' percentage. This is the total weight of the dressed carcass expressed as a percentage of the live-weight taken immediately before slaughter. It should always be recorded whether the carcass was weighed hot (H.D.W.) i.e. as soon as dressed, or cold (C.D.W.) twenty four hours after slaughter. There is usually some 2½ to 3% difference between the hot and cold weights.

A lean steer will usually kill out at 45% whilst a very fat one may well reach as high as 63% Clearly, in terms of yield the latter is the more productive but by no means is it necessarily the most profitable.

The second index of carcass worth is its balance. The hindquarter contains a much higher meat to bone ration than does the forequarter and it is from the hindquarter that the more succulent joints come, so that any animal with a preponderance of hindquarter is a superior meat producer. The degree of such suitability is measured by cutting the carcass in half between the tenth and eleventh ribs, the first rib being the one nearest the head, and then weighing both fore and hind quarter. A steer with 51% hindquarter can be considered satisfactory and Boran steers have been recorded with up to 55% hindquarter.

The carcass analysis is carried a stage further by sub-dividing the quarters into anatomical joints and recording the weights and percentages of fat, lean, bone and inedible material in each joint. This is recorded on a standard analysis sheet as shown (Fig.1) and this provides information as to the deposition of the components throughout the carcass. By studying the analysis of a series of animals of different weights, ages and growth rates it is possible to build up the growth pattern of a species.

So much for a brief introduction to the mechanism of carcass analysis, now what use can be made of any results so far obtained?

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For 'side balance' the relative figures for sample groups of cattle, goats and game animals are given in Figure 2 (Table 2a).

Relative killing out percentages for these animals are given in Figure 2 (Table 3a) and these are important because the information they provide has opened up what promises to be profitable lines of research.

It has already been shown (Callow et al) 1944 that for cattle there is a correlation between the killing out percentage and the amount of fat in the carcass. As the animal becomes progressively fatter so does the killing out percentage rise. It was somewhat surprising therefore to find from the carcass analyses of game animals that these animals containing as they did less than 5% carcass fat (and this meagre figure has yet to be improved upon) were giving killing out percentages of well over 50% and some were over 60% (See Fig.4). From our knowledge of cattle none of these animals should have a killing out percentage higher than 45%

Such a wide deviation from the accepted rule calls for some explanation.

The only other factor likely to have a major effect on the killing out percentage is the amount of digestive tract complete with its contents, usually referred to as 'fill', which in cattle varies inversely with the degree of fatness. For example as a steer with nine percent carcass fat will have a full digestive tract content amounting to about 28% of its liveweight whereas one with 36% carcass fat will have a digestive tract percentage of approximately 17%.

The implication of a low fat content combined with a high killing out percentage is that these game animals have a much smaller full digestive tract relative to their size than do cattle and this in turn would seem to indicate a more efficient digestive system relative to the environment in which they live.

It has therefore been necessary to extend the carcass analysis studies to include records of the viscera and visceral

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contents and of the external offal (head, hide fat and tail).

It is usual to standardise carcass analysis by working on a fat free basis or by making comparisons between animals of the same degree of fatness and the preliminary results from the extended carcass studies have confirmed the theory that game animals do, in fact, have a lower percentage of full digestive tract than do cattle of a similar fat content.

For example the lean steer mentioned earlier, which had a carcass fat percentage of nine, - (which approximates the minimum amount of fat found in cattle however thin they may appear) - will have a full digestive tract content amounting to some 28% of its liveweight whilst some game animals only have 19% (11 Wildebeeste 21.3%, 5 Thomson's Gazelle 19.2%, 1 Impala 15.2% and 2 Eland 17.9%)

Because the most unusual fat distribution in these game animals puts them so far outside the range of that normally to be found in domesticated stock the relative killing out percentages have been used as an alternative means for standardising the analyses for further direct comparison rather than the 'fat free' or 'similar fat' methods normally adopted. Comparisons made on this basis (Fig.5) Table 5a also confirm that game animals tend to have a smaller percentage of full digestive tract than do their domesticated counterparts. This suggests that they are better able to use the available fodder and there would appear to be at least four possible explanations as to why this is so.

It may be that these animals are very selective grazers or browsers and that they are capable of finding food of a very much higher nutritive value than any chemist, working in similar flora has so far been able to collect. Considerable care has been taken by research workers collecting fodder samples for chemical analysis to observe the grazing habits of stock and, to

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the best of their ability, collect only such fodder as the animals are known to eat. It is therefore difficult to believe such major differences in the pattern of killing out percentage as have been recorded can entirely result from selective grazing practices. It must also be remembered that for much of the year there are very small quantities of any of the possible feeds showing these superior feeding values. Viz seed pods, dried leaves from leguminous trees, shrubs etc.

Another possible explanation could be that the food passes through the digestive tract faster in some animals than in others and that they obtain their nutrients, not from a more efficient digestive system, but by having a greater throughput of food. In this way they might obtain a greater total quantity of nutrients per day. There are several objections to this theory. If the daily throughput of food is greater it is hardly logical to associate such a state of affairs with a reduction in the relative size of the digestive tract, rather the converse is to be expected. Also Blaxter et al have shown experimentally that it is the highly nutritive concentrate rations which pass rapidly through the digestive tract of the ruminant and that as the feed becomes coarser and longer so does the rate of passage fall in order to give a longer time for the digestive processes to work.

It is equally valid to suggest the converse of the above i.e. that more efficient digestion occurs because the rate of passage is slower through the tract thus enabling the fodder to be more completely digested. It is known however that, chemically, the level of nutrition of the fodder in these areas is so lew that even if the passage of food is slower and digestion almost complete it would still require a greater bulk of food within the tract at any one time and this does not accord with the known facts.

Finally there remains the possibility that there is some physiological difference in the digestive system which

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permits either a higher degree of digestibility in the game animals or ensures that the products of digestion are more effectively used within the body i.e. less are lost by excretion etc. (Livingston). The evidence so far available seems to suggest such an explanation and it may be that part of the answer can be arrived at by following up an observation made by Professor D.M.S. Watson to Dr. Callow at Cambridge in 1943 when he drew attention to the remarkable fact that, in beef animals the muscular tissues is about one-third of the liveweight irrespective of the degree of fatness.

Using the carcass analysis of 14 head of Bos taurus cattle Callow (Table 1) showed that this was indeed so and that the constant was in fact 31.7 precent $\pm$ 1.8. Following this observation with a similar one on Bos indicus (zebu) cattle (Table 2) it can be seen that they too have a constant which is 1% higher than that of Bos taurus. This is interesting because it has been shown by workers both in the States and in Australia, and Muguga figures confirm this, that zebus or zebu carcass kill out some 2 per cent higher than do exotic cattle having a similar fat content.

Applying these findings to other species viz goats and game animals Table 3 and 4 has producted some startling results.

As can be seen from Table 5 Wildebeest have a lean constant of 41.6% whilst Thomsons Gazelle is as high as 45.6% which means that they can carry, respectively, some 9 to 13 pounds more lean meat per 100 lbs of liveweight than can zebu steers. This would seem to indicate that they are likely to be more economical converters of fodder into meat than cattle.

Evaluation of the merits of the carcasses of the varying species as meat producers is dependant upon knowing their relative compositions. The relative composition for goat, cattle and game carcasses is shown in Figure 6 (Table 6a). From this figure can be seen the effect of growth, from a lower to a higher carcass yield, on the composition of the carcasses of the different species. In the steer carcasses

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there is a steady rise in the proportion of fat whilst the composition of the game carcasses remains almost constant.

This is important because it shows that similar carcass yields will have widely differing food values. The composition and number of pounds of edible meat produced from these carcasses per 100 lbs liveweight is shown in Figure 7. From these weights the relative calorific values of the edible meat yields has been calculated and these are shown in Figure 8.

Reference to the relative composition of the edible meat (Fig. 7) will show that the steer carcasses depend upon fat deposits for their superior calorific values. The production of carbohydrates in the form of animal fat is however very expensive and an alternative evaluation of the relative worth of this edible meat, based on the amount of animal protein produced per 100 lbs of the live animal, is shown in Figure 9. From this it can be seen that <u>for protein production</u> the game animal is superior.

TABLE I

Carcass lean as a percentage of liveweight in Bos taurus cattle

No.	Breed	Sex	Carcass Lean as % of Liveweight	Age in mths.	Liveweight lb.	(kg.)	Killing Out %	Carcass fat as % of Live-weight
15	Shorthorn	Steer	28.5	42	1484	(673.1)	56.2	19.3
19	A.Angus	Steer	29.1	33	1428	(647.7)	58.0	21.6
17	Hereford	Steer	29.3	48	1540	(698.5)	60.4	23.4
18	A.Angus	Steer	30.0	33	1372	(627.3)	59.9	21.3
23	Shorthorn	Heifer	31.0	39	1232	(558.8)	57.5	18.6
7	Red Poll	Steer	31.9	12	791	(358.8)	53.0	11.2
5	Shorthorn	Steer	32.0	24	945	(428.6)	56.5	15.5
8	Shorthorn	Steer	32.4	24	1036	(469.9)	56.3	15.1
3	Shorthorn	Steer	32.4	24	742	(336.6)	50.1	6.8
12	Shorthorn	Heifer	32.6	24	924	(419.1)	55.3	14.3
10	Shorthorn	Steer	32.7	20	1064	(482.6)	61.7	21.2
16	Welsh	Steer	33.6	48	1512	(685.8)	59.4	17.4
22	H x Welsh	Steer	33.8	24	812	(368.3)	53.2	10.6
25	Shorthorn	Heifer	34.1	39	1022	(463.6)	54.1	11.1
		Mean	31.7 ± 1.8					

TABLE 2

Carcass lean as a percentage of liveweight in Bos indicus cattle

No.	Breed	Sex	Carcass Lean as % of Liveweight	Age in mths	Liveweight lb.	(kg.)	Killing Out %	Carcass fat as % of Live-weight
757	Boran Zebu	Steer	29.7	18	640	(290.3)	48.0	7.9
722	" "	"	29.9	18	602	(273.1)	48.1	7.1
749	" "	"	32.1	18	560	(254.0)	49.0	5.5
733	" "	"	32.2	18	508	(230.4)	51.2	8.1
743	" "	"	32.6	18	618	(280.3)	52.2	9.4
728	" "	"	33.3	18	444	(201.4)	50.1	6.1
788	" "	"	33.5	18	536	(243.1)	51.4	7.6
738	" "	"	33.8	18	554	(251.3)	51.7	7.0
764	" "	"	34.9	18	598	(271.3)	53.4	7.3
763	" "	"	35.2	18	436	(197.8)	51.3	4.2
		Mean	32.7 ± 1.8					
726	Boran Zebu	Steer	29.4	30	825	(374.2)	47.0	7.6
736	" "	"	31.0	30	772	(350.2)	49.7	7.4
734	" "	"	31.1	30	788	(357.4)	50.6	8.9
746	" "	"	31.3	30	746	(338.4)	49.7	6.8
759	" "	"	32.3	30	792	(359.2)	49.3	7.8
742	" "	"	32.8	30	798	(362.0)	51.3	7.7
752	" "	"	33.2	30	788	(339.3)	50.2	6.7
768	" "	"	34.7	30	724	(328.4)	52.4	6.9
755	" "	"	35.8	30	706	(320.2)	53.1	6.8
720	" "	"	37.1	30	762	(345.6)	53.5	6.2
		Mean	32.9 ± 2.4					
43N	Boran Zebu	Steer	29.1	40	1176	(533.4)	58.4	19.5
434	" "	"	30.0	54	1124	(509.8)	58.9	19.3
103N	" "	"	30.6	44	1174	(532.5)	60.1	20.3
443	" "	"	31.2	42	1120	(508.0)	57.4	16.9
442	" "	"	31.7	42	1145	(519.4)	58.9	17.4
504	" "	"	32.1	66	1144	(518.9)	59.8	18.1
27N	" "	"	32.6	40	1148	(520.7)	59.2	17.7
107N	" "	"	33.0	44	1178	(534.3)	56.1	13.9
424	" "	"	34.0	48	977	(443.2)	58.7	15.1
479	" "	"	34.7	66	1014	(459.9)	62.1	17.3
		Mean	31.9 ± 1.8					
Overall lean %		Mean =	32.5 ± 2.0					

TABLE 3

Carcass lean as a percentage of liveweight in Goats.
Data supplied by Hutchinson(1960)

No.	Breed	Sex	Carcass Lean as % of Liveweight	Age in mths	Liveweight lb. (kg.)	Killing Out %	Carcass fat as % of Live - weight
1	Tanganyika	Female	27.1	31	49.0 (22.2)	42.7	8.4
2	3/4 Boer	Castrate	29.4	25	79.9 (36.2)	45.4	7.2
3	Tanganyika	Female	29.6	84	68.9 (31.3)	42.3	6.2
4	Kamorai	Female	30.0	39	81.9 (37.1)	47.7	11.2
5	3/4 Boer	Castrate	30.2	25	98.9 (44.9)	46.5	7.5
6	Tanganyika	Female	31.1	36	63.9 (30.0)	43.5	4.9
7	Tanganyika	Female	31.3	31	45.0 (20.4)	44.7	6.2
8	3/4 Boer	Female	31.3	25	96.9 (44.0)	48.4	8.7
9	3/4 Boer	Male	31.4	25	98.9 (44.9)	46.9	6.7
10	3/4 Boer	Castrate	31.8	25	104.9 (47.6)	47.9	7.8
11	3/4 Boer	Male	32.1	25	78.9 (35.8)	45.2	3.8
12	3/4 Boer	Male	34.0	25	103.9 (47.1)	47.6	5.7
13	3/4 Boer	Male	38.0	25	90.9 (41.2)	50.4	3.5
		Mean	31.3 ± 2.6				

TABLE 4

Carcass lean expressed as a percentage of liveweight in
Wildebeest and Thomson's gazelle

No.	Breed	Sex	Carcass Lean as % of Liveweight	Age in mths	Liveweight lb. (kg.)	Killing Out %	Carcass fat as % of Live - weight
196	Wildebeest	Male	39.0	Mature	362.3 (164.3)	51.1	2.4
201	"	"	40.5	30	378.0 (171.5)	50.5	1.8
203	"	Female	40.5	Mature	298.0 (135.2)	51.1	1.0
202	"	Male	41.9	96	197.0 (89.4)	54.7	2.5
199	"	Male	45.9	96	475.5 (215.7)	56.2	1.0
		Mean	41.6 ± 2.6				
200	Thomson's gazelle	Female	41.2	60	42.6 (19.3)	54.1	0.3
197	"	Female	45.0	Mature	41.5 (18.8)	54.4	0.5
194	"	Male	45.8	60	51.1 (23.2)	58.8	Trace
205	"	Female	47.5	Mature	37.0 (16.8)	60.1	0.5
195	"	Male	48.5	60	54.1 (24.5)	61.2	0.5
		Mean	45.6 ± 2.8				

N.B. The fat content in the game animals is so small that it has been expressed as a percentage of the carcass rather than as a percentage of the liveweight.

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CARCASS OR BRAND NO. ______ TYPE ______ CARCASS GRADE ______

LIVE WT ______ CDCwt. ______ F.Q.WT ______ H.Q.WT ______ K.O.% C.D.W. ______

JOINT	JOINT WT	JOINT % of S	LEAN WT	LEAN % of J	SUB.FAT WT	SUB.FAT % of J	INTER FAT WT	INTER FAT % of J	COD FAT WT	COD FAT % of J	K. FAT WT	K. FAT % of J	HUMP & KIDNEY		TRUE BONE WT	TRUE BONE % of J	INED.PDS. WT	INED.PDS. % of J	D.LOSSES WT	D.LOSSES % of J	CHECK WT	CHECK % of J	B. BONE WT	B. BONE % of J
HIND LEG																								
LOIN																								
FORE LEG																								
NECK AND THORAX																								
LOSSES																								
CHECK WT																								
TOTALS																								
% OF SIDE																								

	WT	%
EDIBLE		
INEDIBLE		

	WT	%
FAT		
LEAN		
BONE		
KIDNEY		
HUMP		
I.P.		
LOSS		

Animal No:-   Date born:-   Date weaned:-

Birth Wt:-   Weaning Wt:-   Age at slaughter:-

Brief History and Description:-

Pre slaughter treatment:-

LINEAR MEASUREMENTS.

LIVE ANIMAL

Head length
Head width
Fore rib
Hooks
Pins
Length of sacrum
Depth of chest
Height at withers
Height at sacrum
Pins to shoulder
Fore girth
Circ. of canon
Tail base Circumference

FROM FACTORY SHEET

Grade	Grade score
Hot wt.LHS	Cold wt.LHS
____ Hot wt.RHS	____ Cold wt.RHS
Hot side wt.	Cold side wt.
Price paid	

Remarks:-

CARCASS

Length
Circum. of Round
'Blockiness' meat edge
'Blockiness' bone edge
Internal chest Depth 9th Rib
External chest meas.meat edge
External chest meas.bone edge
Length of radius
Circum.of fore leg at ½ lgth.
Length of loin (10/11 rib)

10th RIB MEASUREMENTS

Length of 'Eye' Muscle
Depth of 'Eye' Muscle
Marbling score of Eye Muscle
Colour 'Eye' Muscle

Fat A	Fat B
Max. Fat	Min.Fat
Depth of Fat A.	Thickness of Rib end.

Remarks:-

The Relative yields of Hindquarters and Carcasses

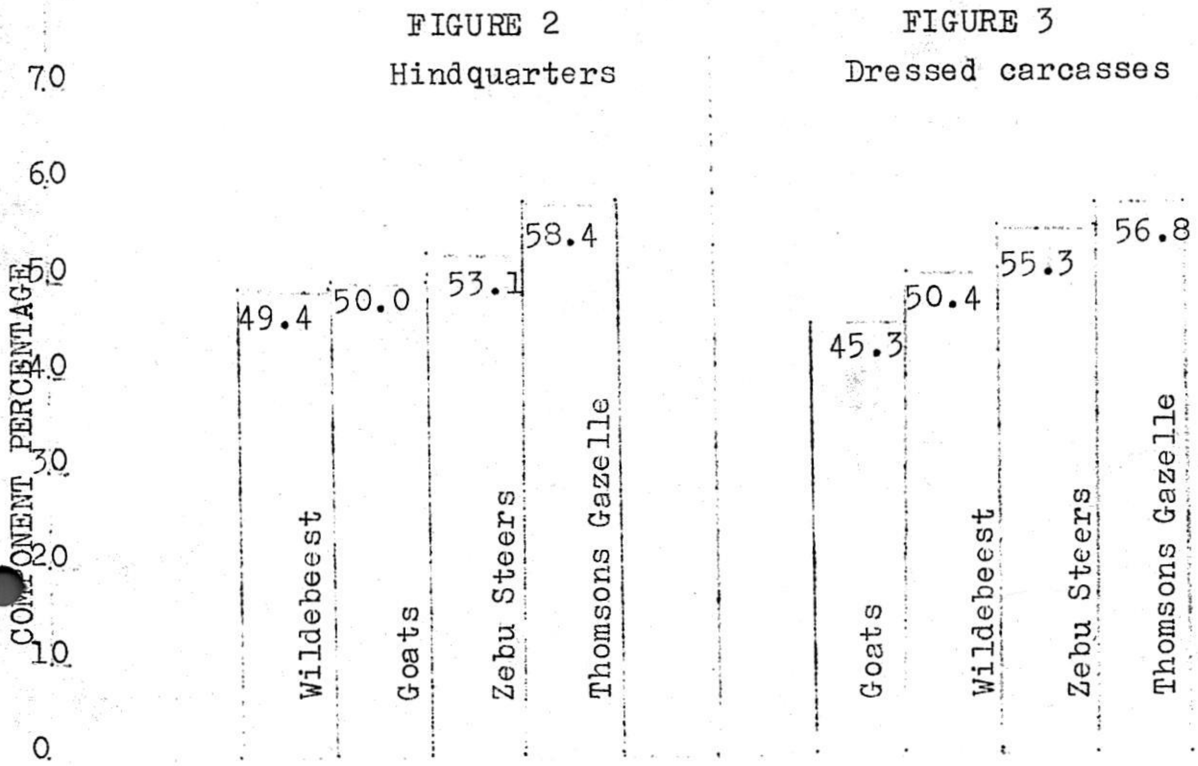

Table 2a & 3a (Fig. 2 & 3)

A comparison of the relative yield of Hindquarters and carcasses in cattle, goats and game animals.

Species	Number	Sex Distribution	Description	Mean H.Q.%	Mean K.O.%
Wildebeeste	9	5 M 4 F	5 Mature 4 Immature	49.4	50.4
Goats	12	4 M 4 F 4 Castrates	12 Mature	50.0	45.3
Zebu Steers	15	15 Castrates	9 Mature 6 Immature	53.1	50.4
Thomsons Gazelle	8	3 M 5 F	8 Mature	58.4	56.8

FIGURE 4

The relationship between the Killing-Out percentage and Far content of the dressed carcass in Goat Cattle and Game Animals.

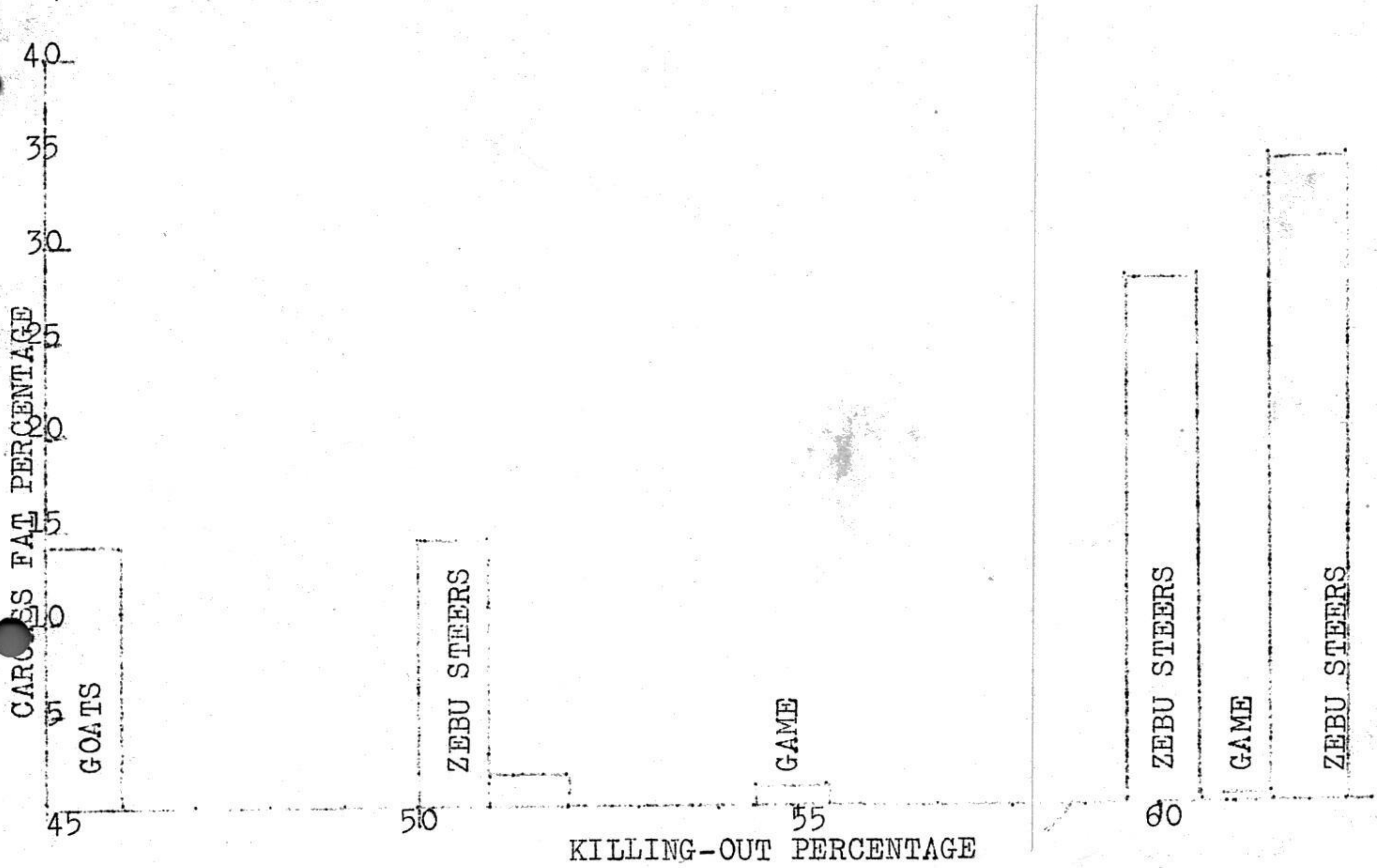

TABLE 4a (Fig.4)

The relationship between carcass yields and the fat content of the carcasses of Cattle, Goats and Game animals.

Species	Number	Sex Distribution	Description	Mean KO %	Mean Fat %
Goats	12	4 M 4 F 4 Castrates	12 Mature	45.3	14.2
Zebu Steers	20	20 Castrates	12 Immature	50.9	14.1
Wildebeest	3	2 M 1 F	3 Mature	51.0	1.8
Wildebeest T. Gazelle	2) 2) 4	1 M 1 F 1 M 1 F	1 Mature) 1 Immature) 2 Mature)	54.9	1.1
Zebu Steers	18	18 Castrates	18 1st Grade K.M.C. Steers	59.6	28.4
T. Gazelle	3	2 M 1 F	Mature	60.0	0.3
Zebu Steers	6	6 Castrates	6 'local' GradeSteers	61.5	34.9

FIGURE 5

The composition of goats, cattle and game animals

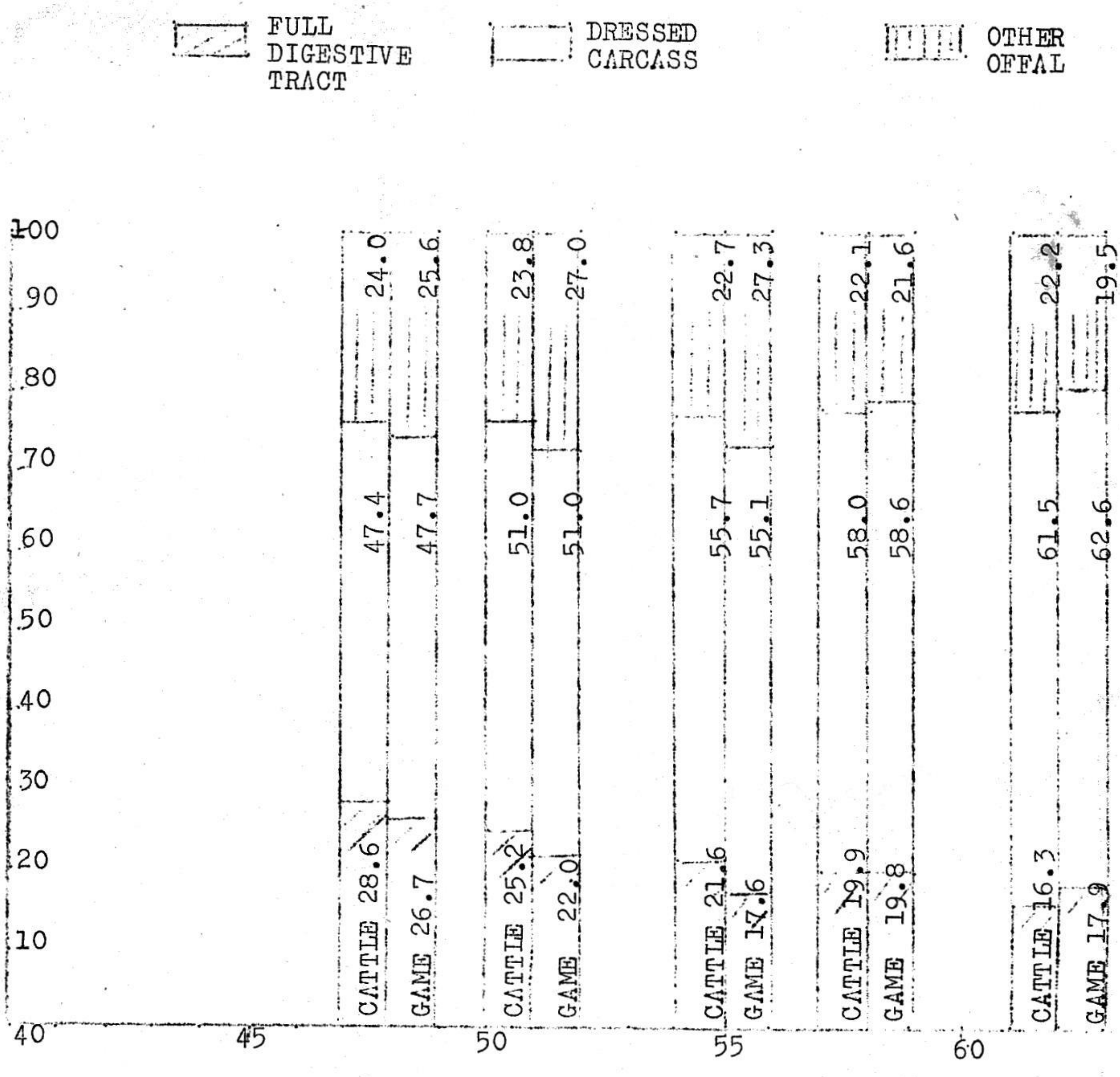

TABLE 5a (Figure 5.)

The relationship between the dressed carcass and the full digestive tract expressed as a percentage of the liveweight in cattle and game animals at given killing-out percentages.

SPECIES	NUMBER	SEX DISTRIBUTION	DESCRIPTION	K.O.%	FULL DIG. TRACT %
	Not Stated	Castrates	McConnels Lean steer analysis	47.4	28.6
Wildebeeste)	4	1 M 3 F	3 Mature) 1 Immature)	47.7	26.7
Kongoni)	1	1 F	1 Mature)		
Steers	calculated from Regression line.			51.0	25.2
Wildebeest	5	3 M 2 F	4 Mature 1 Immature	51.0	22.0
Steers	Not Stated	Castrates	McConnels ½ fat Steer analysis	55.7	21.6
Wildbeeste)	2	2 M	1 Mature) 1 Immature)	55.1	17.6
T. Gaz.)	6	1 M 5 F	6 Mature) 1 Immature)		
Kongoni)	1	1 F	1 Immature)		
Impala)	1	1 M	1 Mature		
Hereford Steers	10	Castrates	Butters analysis	58.8	19.9
Eland)	1	1 F	Mature)	58.6	19.8
Oryx)	1	1 F	Mature)		
Hereford X Brahaman	10	Castrates	Butters analyses	61.5	16.3
Grant)	2	2 M	1 Mature) 1 Immature)		
Eland)	1	1 M	1 Mature)		
T. Gazelle)	2	1 M 1 F	Mature)	62.1	17.0
Impala)	1	1 F	Mature)		

FIGURE 6

The carcass composition of goats, cattle and game animals at different killing-out percentages.

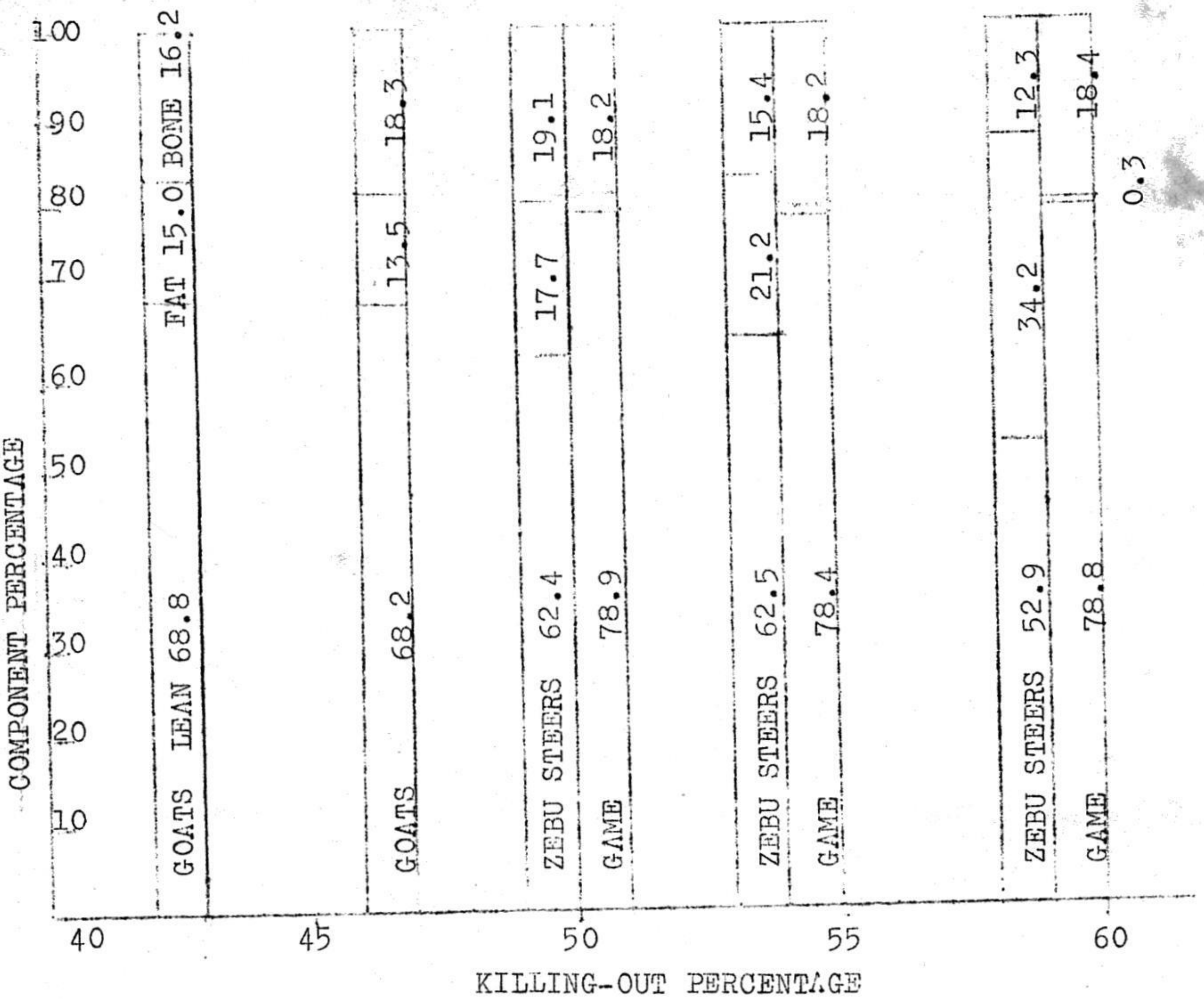

TABLE 6a (Fig. 6)

The carcass composition of Cattle, goats and game animals at killing-out percentages.

Species	No.	Sex Distribution	Description	KO%	Fat %	Lean %	Bone %
Goats	4	4 F	4 Mature	43.3	15.0	68.8	16.2
Goats	8	4 M 4 Castrates	8 Mature	47.4	13.5	68.2	18.3
Z. Steers	4	4Castrates	4 Immature	50.9	17.7	62.4	19.1
Wildebeest	3	2 M 1 F	3 Mature	51.0	1.8	78.9	18.2
Z. Steers	4	4Castrates	2 Mature 2 Immature	55.0	21.2	62.5	15.4
W/beest) T. Gaz.)	1 3	1 M. 1 M 2 F	1 Mature) 3 Mature)	54.9	1.1	48.4	18.2
Z. Steers	4	4Castrates	4 Mature	60.0	34.2	52.9	12.3
T. Gaz.	3	2 M 1 F	3 Mature	60.0	0.3	78.8	18.6

FIGURE 7

The yield and composition of the meat in a dressed carcass per 100 pounds liveweight.

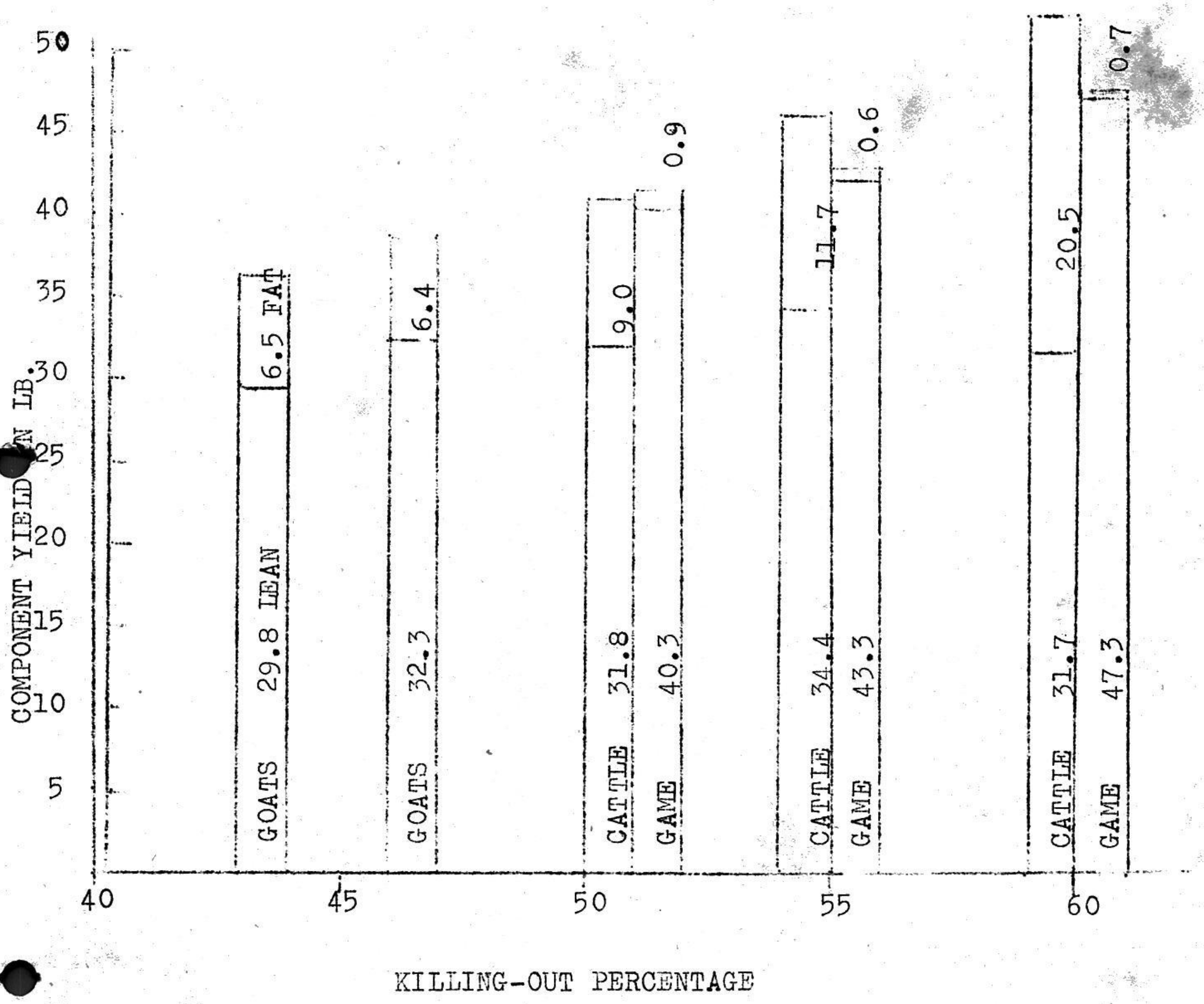

FIGURE 8

The gross calorific value of the boneless meat yield from 100 lb. liveweight.

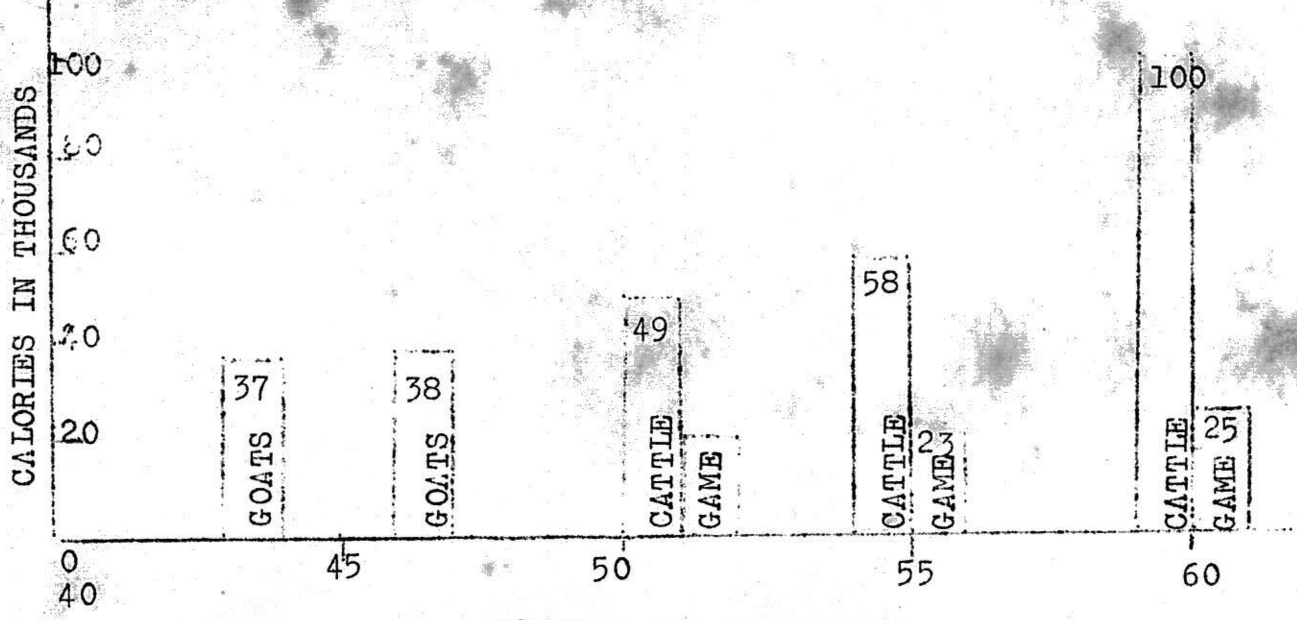

FIGURE 9

The calorific value of the Protein content of the Boneless meat yield from 100 lb liveweight.