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Dressing Percentage, Gross Body Composition and Caloric Value of the Roe-Deer*

[With 8 Tables & 1 Fig.]

The dressing percentage, body composition and caloric value of 8 individuals of *Capreolus capreolus*, killed in winter 1971 and 1972 in Southern Poland, were investigated. The dressing percentage amounted to 65.1% in adult individuals, and to 58.7% in young ones. The content of soft tissue in half-carcass was equal to 88% on the average. Water contents in the whole body is around 64.3% and is strongly correlated with a rather high fat content ranging from 13.1 to 26.8% of dry weight. The remaining part of dry weight (mean 65.5%) consists of proteins and carbohydrates. The mean caloric value of the whole body of roe-deer amounts to 6065.4 cal/g of dry weight, or to 6937.4 cal/g ash-free dry weight. After computation for the biomass this value is equal to 2161.1 cal/g. The accumulated fat constitutes energetic reserve, which can reach 10,000 kcal in the average individual of roe-deer.

I. INTRODUCTION

The roe-deer, *Capreolus capreolus* (Linnaeus, 1758), belongs to the animals of high economic value, both as the game providing trophies and valuable meat, as well as an important component of forest ecosystems in Europe. For obtaining the full picture of utility of roe-deer carcasses the data are required on dressing percentage, carcass jointing and energetic value of the meat. In the hunting literature such parameters are scattered, rarely given and difficult to compare on account of non-uniform and not precisely defined methods (Prior, 1968; Mitchell, 1971, and others).

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Studies on the productivity of roe-deer populations, important for hunting and forest economy, require among others the data on the gross body composition and caloric value of carcasses of the animals. The present study was aimed at the collection of such data on the utility and bioenergetic values of roe-deer bodies.

II. MATERIAL AND METHODS

Eight individuals of roe-deer (4 bucks, 2 does and 2 fawns), were subjected to the analysis of dressing percentage, body composition and caloric value (Table 1). The buck No 6 was examined only in respect of dressing percentage. The roe-deer were weighed without eviscerating immediately after killing with the accuracy up to 0.5 kg (live weight). The bodies were paunched and flayed, heads were separated, extremities cut off in the ankle or wrist joints. Then the carcasses

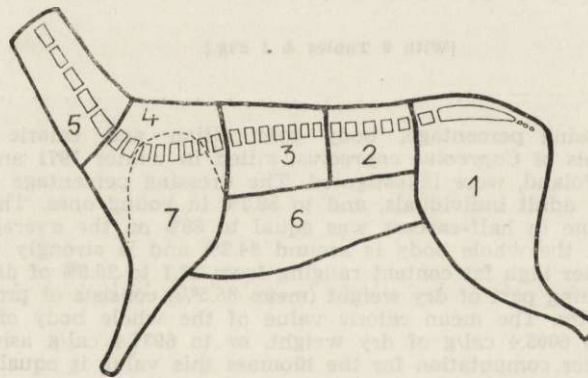


Fig. 1. Division of half-carcass into joint in roe deer.
1 — haunch, 2 — saddle, 3 — entrecote, 4 — chuck, 5 — neck, 6 — brisket with fillet, 7 — shoulder with shin.

were cut into halves along the sagittal plane and divided according to Pálsson (1939) method (Fig. 1). All parts of the half-carcass, head, skin and viscera were weighed with the accuracy up to 0.01 kg. The empty body weight, used in all further calculations, corresponded to the weight of the whole body with skin, head, viscera and legs, but without intestinal tract and antlers. The ratio of dressed body weight (= the weight of carcass = venison) to body weight, expressed in per cents, was defined as dressing percentage (Szulc *et al.*, 1971). All parts of the right half-carcass were dissected in order to separate soft tissues (muscles, connective tissue and fat) from bones. The loss of water caused by drying during carcass jointing and dissection was corrected after control weighing. All soft parts and bones of each half-carcass were homogenized separately by several passages through electric mills. Similar procedures were employed for the head, legs and intestines. To the »viscera« were reckoned not only the alimentary tract but also all internal organs with mesenteric and perinephric fat.

Water and ash content, as well as caloric value, were determined in representative samples of soft tissues, bones, legs, head and intestines as well as in

samples of skin, antlers, muscles of the saddle (*m. longissimus dorsi*) and of haunch (*m. quadriceps femoris*). The water content was determined by drying in a vacuum oven at 60°C, or in a conventional laboratory oven at 105°C. The caloric value and ash content were estimated by combustion of samples in an adiabatic bomb calorimeter KL-3, adopting the procedure described by Górecki (1968). All samples were combusted in 2 or 3 replications.

The samples of all homogenates of each roe-deer were mixed in proportion to their share in dry body weight and then fat content was determined. For this purpose the pooled homogenate was extracted with ethyl ether in a Soxhlet apparatus (Sawicka-Kapusta, 1968). A similar procedure was employed for skin samples.

Knowing the share of particular elements of soft tissues, bones, intestines, head, legs and skin in roe-deer body the total content of water, fat and ash, as well as caloric value for the whole body were calculated. For the obtained mean values standard deviations are given; significance of correlation was estimated by Student *t*-test.

Table 1

Material on outline.

Animal No.	Date of slaughter	Sex	Age	Live weight kg
1	24.01.1971	♀	ad.	26.5
2	5.02.1971	♂	ad.	26.0
3	7.02.1971	♀	ad.	20.0
4	26.02.1971	♂	ad.	25.5
5	8.01.1972	♂	ad.	27.0
6	8.02.1972	♂	ad.	30.5
7	28.12.1971	♂	imm.	18.5
8	11.02.1972	♂	imm.	12.5

III. RESULTS

1. Carcass Jointing and Dressing Percentage

The relative share of particular joints in the half-carcass, and relative share of two half-carcasses in empty body weight (dressing percentage) are given in Table 2. In adult individuals the dressing percentage ranges from 62.6 to 68.0% (mean: $65.1 \pm 1.8\%$) and is by 6.4% higher from the dressing percentage fawns, which amounts to 58.7%. The most valuable joints, *i.e.* haunch and saddle, reach on the average 39.6 and 10.4% of the half-carcass weight. The percentage share of particular joints is similar in individuals differing in size.

2. Dissection

The percentage share of edible soft part (muscles, connective tissue and intramuscular fat) and bones in particular joints is compared in Table 3

Table 2
Yield of joints and dressing percentage of carcasses.

Animal No.	Total body weight, kg	Dressing percentage	Yield of parts to halfcarcass in per cent						
			Haunch	Saddle	Entrecote	Chuck	Neck	Brisket with fillet	Shoulder with shin
1	25.2	65.4	40.6	8.7	7.8	7.4	6.4	11.4	17.7
2	21.7	64.0	38.8	10.8	6.9	8.1	5.2	12.4	17.9
3	17.9	66.2	38.9	10.8	7.4	8.6	5.4	11.5	17.4
4	21.6	68.0	39.2	11.4	7.5	7.9	7.1	9.5	17.3
5	23.1	62.6	38.1	11.0	7.7	9.1	7.5	9.9	16.6
6	25.8	64.6	37.9	10.3	7.1	9.1	6.2	12.0	17.3
7	16.2	59.2	40.9	10.9	7.9	8.1	5.6	10.0	16.5
8	11.0	58.2	42.2	9.4	7.2	7.5	4.7	10.3	18.7
Mean		63.5	39.6	10.4	7.4	8.2	6.0	10.9	17.4
±SD		±3.4	±1.5	±0.9	±0.4	±0.6	±0.9	±1.0	±0.7

Table 3
Contents of main tissues in joints of carcasses.

Joints	Soft tissues content in % \pm SD	Bones content in % \pm SD
Haunch	88.2 \pm 1.6	11.8 \pm 1.6
Saddle	89.4 \pm 2.9	10.7 \pm 2.8
Entrecote	89.1 \pm 3.8	10.9 \pm 3.8
Chuck	86.1 \pm 4.2	13.6 \pm 3.9
Neck	83.5 \pm 5.4	15.6 \pm 5.6
Brisket with fillet	91.6 \pm 2.9	9.0 \pm 2.5
Shoulder with shin	84.4 \pm 1.8	15.6 \pm 1.8
Mean content in halfcarcass, \pm SD	87.9 \pm 0.99	11.8 \pm 1.2

Table 4
Water content, ash content and caloric value of particular samples of the body
of roe deer (means for 7 animals).

Material	Water content in per cent of fresh weight	Ash content in per cent of dry weight	Caloric value	
			Dry weight cal/g	Ash-free dry weight cal/g
1	2	3	4	5
Meat tissue	68.6	4.9	5904.8	6194.6
Bones	27.5	45.8	3321.5	5841.0
Skin	47.5	2.7	5425.4	5543.4
Legs	35.9	24.8	4102.5	5128.1
Heads	72.9	17.1	5704.6	6674.3
Intestines	69.7	3.5	6603.3	6679.5
Muscles of saddle	69.3	5.0	5527.7	5734.8
Muscles of haunch	72.0	4.3	5644.6	5945.6
Antlers	—*	39.4	1695.3	4281.8

* Not measured

It appears that almost 88% of the half-carcass weight fall for soft tissues. They represent on the average $56.7 \pm 3.0\%$ of total body weight, with the mean equal to 57.3% for adult individuals and to 51.7% for fawns.

3. Body Composition

On the basis of individual determinations of water content in particular homogenates (Table 4, column 2) the amount of water in the whole body is calculated (Table 5, column 2). Water constitutes on the average $64.3 \pm 4.3\%$ of the total body weight. Fat represents the most variable constituent of body dry weight. The share of ether extract in dry mass ranges from 13.1 to 26.8% (Table 5, column 4). Changes in the content

Table 5

Computed gross body composition of the whole roe deer, in per cent.

Animal No.	Fresh weight composition, in %%		Dry weight composition, in %%		
	Water content	Dry mass content	Fat	Ash	Rest
1	2	3	4	5	6
1	64.2	35.8	21.3	14.2	64.5
2	60.0	40.0	26.8	12.6	60.6
3	62.6	37.4	23.8	13.0	63.2
4	70.6	29.4	13.1	13.9	74.0
5	62.9	37.1	23.5	11.3	65.2
7	66.9	33.1	18.4	11.2	70.4
8	63.2	36.8	21.8	10.4	67.8
Average ±SD	64.3±3.4	35.7±3.4	21.2±4.4	12.4±1.4	66.5±4.6

Table 6

Computed caloric values of the whole roe deer body.

Animal No.	Dry weight cal/g	Ash-free dry weight cal/g	Fresh weight cal/g
1	5926.2	7032.8	2081.5
2	5953.9	6810.5	2384.3
3	5928.1	6811.9	2215.6
4	5809.2	6743.3	1710.5
5	6574.3	7410.4	2441.9
7	6055.4	6822.9	2007.3
8	6211.1	6929.7	2286.8
Average±SD	6065.4±180.0	6937.4±229.3	2161.1±248.0

of water and fat are mutually correlated ($r = -0.98$, $P < 0.001$), and the relationship corresponds to the rectilinear regression: $Y = 102.83 - 1.268 X$ (where Y = per cent of fat in dry mass, X = per cent of water in biomass).

The ash content in the whole body dry mass, calculated also on the basis of single determinations in particular homogenates (Table 4, column 3) reaches on the average $12.4 \pm 1.4\%$ (Table 5, column 5). The remaining constituents of body dry weight (mainly proteins with a small admixture of carbohydrates) represent on the average 66.5% (Table 5, column 6).

4. Caloric Value

The mean caloric values of particular homogenates are compared in Table 4, column 4 and 5. The highest caloric value was found for the

homogenate of viscera (6603.3 cal/g dry weight). The energetic value of the soft parts homogenate of half-carcass amounts on the average to 5904.8 cal/g dry weight. The caloric values of dry mass in particular homogenates (Table 4, column 4) show considerable differences on account of variable contents of mineral constituents (ash content). After computing for ash-free dry wt. the caloric values are more similar, since depend only on the proportion of fat to protein and carbohydrates. A relatively high caloric value of the ash-free dry wt. was found for bones (5841.0 cal/g). This is caused by a high fat content in the long bone marrow.

Single data on the caloric values of samples from different body parts of particular roe-deer were used for calculation of the mean energy value of the whole body (Table 6). The energy equivalent of dry weight amounts of the average to 6065.4 cal/g. The caloric value of biomass is well correlated with the content of ether extract in the body dry weight ($r=0.92$, $0.001 < P < 0.01$). The determined caloric values of the saddle and haunch meat reach respectively 5527.7 and 5644.6 cal/g dry wt. The caloric value of antlers amounts to 1695.3 cal/g dry wt. After taking into account a rather high content of mineral salts (ash) present in the antlers the remaining part correspond mainly to proteins of a low caloric value. The caloric value of ash-free dry wt. for antlers amounts to 4281.8 cal/g.

IV. DISCUSSION

1. Dressing Percentage and Dissection

The dressing percentage of roe-deer, defined as the relative ratio of dressed body weight (venison) to empty body weight, amounted to 65.1% on the average in eight examined animals. According to Prior (1968) the dressing percentage of roe-deer in England is equal to 55% for bucks in summer and to 58% for does in winter. However, this author does not include neck to dressed body weight. After taking this into account the dressing percentage will increase in bucks to 58.3% and in does to 61.5% i.e. values similar to those obtained in the present study. The dressing percentage of European hare (*Lepus europaeus* Pallas), estimated by Tilgner (1949) as 66.1%, is close to the values reported for roe-deer. Slightly lower values were found by many authors as dressing percentage for different Ungulates used for hunting (Table 7). These data are, however, difficult to be accurately compared on account of variable definitions of dressing percentage and dressed body weight. Among farm animals sheep exhibits a rather similar body size and hence may be used for comparison of dressing percentage. This

Table 7
A comparison of dressing percentage in several species of wild Ungulates.

Animal species (place)	Dressing percentage	Reference
Roe deer, <i>Capreolus capreolus</i> L.	63.5 55.0 (58.3)* 58.0 (61.5)*	This study Prior, 1968
White-tailed deer, <i>Odocoileus virginianus</i> Boddaert	52.5	Hamerstrom & Camburn, 1950
Rocky-mountain deer, <i>Cervus canadensis</i> Erxleben	54.2	Quimby & Johnson, 1951
Red deer, <i>Cervus elaphus</i> L.	67—77 77 ² 69 ²	Baychev, 1967 Dzięciowski, 1970 "
Moose, <i>Alces alces</i> L.	55—60 50.0	Markgren, 1964 Blood <i>et al.</i> , 1967
Pronghorn, <i>Antilocapra americana</i> Ord	54.3	Mitchell, 1971
Uganda kob, <i>Adenota kob</i> (Erxleben)	56.6	Ledger & Smith, 1964

* corrected for the neck involved to carcass (see text), ² venison containing head

value determined on a large material of sheep is very variable, in the range from 42.3 to 52.7%, and depends on both the degree of fatness and the amount of fleece (Jełowicki, 1960). A considerable weight of skin and fleece in a sheep decreases the coefficient of dressing percentage.

Many authors reported the rise in the dressing percentage with age and body weight of killed animals (cf. Mitchell, 1971; Tilgner, 1949, 1950). Among 8 examined roe-deer the youngest and smallest individuals showed also the lowest dressing percentage. However, the material is too scarce for any further analysis of this relationship.

During carcass jointing a standard method used for sheep was employed (Pálsson, 1939). This method is very convenient for practical purposes. The dissection allowed to estimate the total amount of soft edible tissues in the half-carcass and the whole roe-deer body. The mean content of soft tissues in the half-carcass amounting to 88% was very similar in animals of different size, but after expressing as percentage of total body weight it appears to be slightly higher in large animals (57.9%) than in young ones (55.9%). The mean content of soft tissues in the whole body amounted to 56.7%. Hakonson & Whickler (1971) investigated the content of muscles and bones in the body of mule deer, *Odocoileus hemionus* (Rafinesque, 1817). The content of muscles in the whole body weight of this animal amounted to barely 46.9%, since the muscles were cleared of connective and fat tissues. Also in this species the content of muscles increased with age and total body weight.

2. Body Composition and Energetic Reserves

In the present study the roe-deer body was divided into fractions, which were analysed separately in respect of gross body composition and caloric value. The homogenization of the whole carcass employed commonly in the studies of small animals would be very cumbersome in the case of roe-deer. It would be also difficult to obtain sufficiently uniform homogenate and representative samples for analysis. This is associated among others with different mechanical properties of individual tissues. For this reason soft tissues should be homogenized in an electric mincer, while for hard tissues (bones) a grind mill is required.

In comparison with the gross body composition of wild free-living mammals, e.g. small rodents or European hare, the bodies of roe-deer are characterized by more variable content of water and fat. For example the mean content of fat in the bank vole body, *Clethrionomys glareolus* (Schreber), ranges only between 10.4 and 14.0% (Sawicka-Ka-

pusta, 1972), while in European hare it amounts on average to $19.41 \pm 1.7\%$ (Myrcha, 1968). The content of fat in the roe-deer body amounts on average to $21.2 \pm 4.4\%$, ranging between 13.1 and 26.8 per cent of dry wt. A considerable individual variability in the fat content of roe-deer body is related to different state of examined animals. Roe-deer may accumulate fat as energetic reserve and utilize it in a period of food scarcity. Comparing the individuals with the lowest and the highest fat content (26.8 and 13.1% dry wt., respectively), it can be concluded that the amount of fat corresponding to at least 13.7% of body dry weight (i.e. nearly 5% of biomass) may constitute a considerable reservoir of energy. In the average roe-deer weighing approximately 20 kg such amount of fat corresponds to approximately 10,000 kcal. Drożdż & Osiecki (1973) studied in roe-deer the consumption and digestibility of natural food in the winter period and found a poor digestibility of browse in this period. Assuming that no other food is then available, the daily deficit of energy consumption may reach 400 kcal. Hence the mean fat reserve may cover such deficit for as much as 25 days. Øristland (1970) found in the reindeer (*Rangifer tarandus platyrhynchus*, Vrolik) an even higher fat reserve, amounting to 14% of its biomass.

Ash content in the weight of roe-deer body (12.4% on the average) is rather similar to that found in different species of small mammals (10.2–13.7%, Górecki, 1965), and in European hare (12.38%, Myrcha, 1968).

3. Caloric Value

The caloric value of roe-deer body is on the average slightly higher from the corresponding values of different small rodents (1502 cal/g of biomass; Górecki, 1968) and of European hare (1873.9 cal/g of biomass; Myrcha, 1968). The high caloric value of roe-deer body, reaching 2161.1 cal/g of biomass, results from its considerable fatness. All the examined animals were shot in winter when they can achieve the maximum fatness. The energetic values for the whole body of roe-deer cannot be compared with analogous data for farm animals since the data available in the literature refer to edible parts only. In the examined roe-deer edible parts are represented in principle by the soft tissue homogenate (Table 4). This can be compared with the values in food composition tables for game and farm animals (Table 8). The comparison indicates that both water content and caloric values of edible parts of a roe-deer shot in winter in a good state are very close to lean sheep carcass or fat veal. Hence apart from original taste the roe-deer meat

is of good quality in respect of fatness. In Table 8 also the data for roe-deer meat are given after Szczygieł (1972). The low caloric value and high water content allow to suppose that the values refer to animals killed in summer, when their fatness is much smaller.

The results of this study can be useful in the investigations of productivity of roe-deer population. The body caloric value is an essential parameter for calculating the net production which is included in the balance of energy flow through a population (Petrides *et al.*, 1968). For such computations the energetic value of roe-deer biomass in the winter period, equal to 2.16 kcal/g, is recommended. In summer one can expect a lower mean fatness, hence the mean year caloric value of biomass will be also lower. Assuming that roe-deer fatness in summer is similar to the minimum fatness observed in winter, then the figure of 1.9 kcal/g can be used for the mean year caloric value of the biomass.

Table 8

A comparison of water content, ash content and caloric value of the meat of roe deer and some domestic animals.

Meat	Water content (per cent of fresh weight)	Ash content (per cent of fresh weight)	Caloric value of fresh weight (cal/g)
Roe deer venison ¹	68.6	1.5	1854.1
Roe deer venison ²	75.8	1.1	1080.0
Mutton ² : lean	69.0	1.0	1910.0
medium fat	56.3	0.8	3080.0
fat	46.4	0.7	4070.0
Veal ² : lean	74.0	1.0	1230.0
medium fat	71.0	1.0	1560.0
fat	68.0	1.1	2080.0

¹ calculated from the Table 4, ² after Szczygieł *et al.*, 1972.

The whole energetic value of the adult roe-deer body depends on the animal body size and condition and may be compared within 30—60 thousand kcal, while that of half-year-old fawn—around 20—35 thousand kcal. In Southern Poland (Niepołomicka Forest), the mean weight of adult roe-deer amounts in winter to 23 kg, and half-year-old fawn to 15 kg (Bobek B., unpubl. data). Hence the mean energetic values reach 49.5 and 32.4 thousand kcal., respectively. The antlers rebuilt every year by the bucks are equivalent to 170—850 kcal, depending on their size (100 to 500 g). The caloric value of edible tissues to roe-deer constitutes on the average approximately 47% of total energy value of the body (in small animals 42.8%, in large ones—51.0%). The energy reserves accumulated under the form of fat may hence reach 23—25% of the total caloric value of the roe-deer body.

Both the fatness and caloric value of the roe-deer body undergo changes in the year cycle, similarly to other deers (e.g. in red deer, *Cervus elaphus* L.; Mitchell *et al.*, 1970). Such seasonal changes in the roe-deer are not sufficiently known as yet.

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WYDAJNOŚĆ POUBOJOWA, SKŁAD CIAŁA I WARTOŚĆ KALORYCZNA SARNY

Streszczenie

Zbadano wydajność poubojową, skład ciała i wartość energetyczną 8 osobników sarn, *Capreolus capreolus* (L.), ubitych w ciągu zimy 1971 i 1972 na terenie woj. krakowskiego (Tabela 1). Tusze sarn rozbiegano metodą Pálssona (1939) (Fig. 1). Wydajność poubojowa (stosunek ciężaru obu półtuszy do całkowitego ciężaru ciała, wyrażony w %) osiąga u osobników dorosłych 65,1%, zaś u młodych 58,7% (Tabela 2). Zawartość jadalnych, miękkich tkanek (mięśnie, tkanka łączna i tłuszcz śródmięśniowy) w półtuszy osiągała średnio prawie 88%. Zawartość wody w całym ciele wahała się wokół 64,3% (Tabela 3, kolumna 2). Jest ona silnie skorelowana

ujemnie ($r = -0,98$, $P < 0,001$) z zawartością tłuszczu, która jest stosunkowo wysoka i średnio osiąga 21,2% suchej masy ciała (Tabela 5, kolumna 4). Popiół przeciętnie stanowi 12,4% suchej masy (Tabela 5, kolumna 5), białko i niewielka ilość węglowodanów składają się na pozostałe 65,6% suchej masy ciała (Tabela 5, kolumna 6). Wartość kaloryczna suchej masy ciała wynosiła przeciętnie 6065,4 cal/g, zaś suchej masy bez popiołu 6937,4 cal/g. Wartość kaloryczna biomasy w zimie osiąga 2161,1 cal/g, jest więc wyższa niż u drobnych ssaków i u zająca (Tabela 6). Latem wartość kaloryczna ciała sarny jest zapewne nieco niższa, ze względu na mniejsze otłuszczenie. Średnia wartość kaloryczna wszystkich części jadalnych ciała sarny osiąga 1854,1 cal/g biomasy, co odpowiada kaloryczności tłustego mięsa cielęcego lub chudej baraniny. Wartość energetyczna całego ciała sarny w warunkach Polski Południowej osiąga przeciętnie zimą 49,5 tys. kcal, zaś u kozłat półrocznych 32,4 tys. kcal. Rezerwy energetyczne zgromadzone u sarny w postaci tłuszczu mogą osiągać u dorosłego osobnika około 10 tys. kcal, co pozwala na pokrycie zimowego deficytu pokarmowego w ciągu około 25 dni.