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METRICAL FEATURES OF SAME PARTS OF THE ALIMENTARY CANAL AND LIVER IN RACOON DOG (*NYCTEREUTES PROCYONOIDES* GRAY)

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ABSTRACT

The research investigated 56 adult individuals of racoon dog, including 27 males and 29 females. The research of the selected features of same parts of the alimentary canal and liver in racoon dog allowed to define absolute length and capacity of intestine as a whole as well as of its respective sections, as well as the capacity of stomach and the liver weight. The parameters of relative length of intestine at its respective sections calculated against the body length as well as the relative capacity of the intestine and stomach calculated against the body weight of

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animals show similar values and there were observed no significant differences between them, which means that the proportions of the length and capacity in both sexes are similar, while the differences in absolute parameters result from animal body size differences. The present research shows the racoon dog intestine's metrical features point to some adaptation to the intake of considerable amounts of plant feed.

Key words: metrical features, alimentary canal, liver, dog

INTRODUCTION

Studies into the anatomy of alimentary canal in mammals concern, among others, the shape and size of the alimentary canal as a whole as well as its respective sections. Literature covers most frequently metrical data concerning the length and capacity of the alimentary canal. A majority of research covers the abdominal section, especially stomach and intestine.

Researching the length and capacity of intestines in mammals, often researchers try to define the ratios of the length of intestines to the length of the animal body, of the capacity of intestines to the body weight as well as the ratios of respective sections of the intestine to one another.

Literature mentions the size of alimentary canal in different animal species. Most numerous are the studies into the size of intestine in *Suidae,* Brudnicki [2], Roskosz et al. [10,11,12,13] .

However few publications regard the size of the alimentary canal in Carnivores. General information on the size of intestine and its respective sections in dog are presented by Krysiak, Świeżyński (1983) who also report proportions of the body length to the length of intestine in representatives of different mammalian groups. Sizes of alimentary canal in wolf, dingo and jackal are reported by Gill et al. [5].

Yet literature seems to offer no data on the intestine size in racoon dog. What we know is that the species, much more than other Carnivores, intakes plant food, Reig, Jędrzejewski [9].

All that makes it justifiable to research metrical features of alimentary canal in racoon dog and to compare the data obtained with the other reports which concerned other Carnivores species.

MATERIAL AND METHODS

The research investigated 56 adult individuals of racoon dog, including 27 males and 29 females. The corpses were weighed and their length was measured starting from the upper edge of rostral and labial plate to the tail root. Then the abdominal part of the alimentary canal was being prepared.

The intestine, taken out of the abdominal cavity, was separated from the stomach, and then the end of duodenum was defined. Having removed mesentery, there were taken measurements of the length and the capacity following Kwaśnicki [6]. The following were measured: the total length of intestine, length of small intestine, length of duodenum, length of large intestine, length of caecum, capacity of stomach, total capacity of intestine, capacity of small intestine, capacity of duodenum, capacity of large intestine and the capacity of caecum.

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Similarly there was weighed the animal liver. The measurements were carried out on non-fixed material exclusively. The capacity of intestine along with the wall was defined when submerged in water at the pressure of 5 cm of the column of water applying a special dish set and scale cylinders.

The length of intestines was taken once they were spread on a moist non-adhesive surface with a metal band.

The time since the death of animal to the moment the measurements were taken amounted to twenty -four hours.

To make a comparison, there was measured the ratio of the length of body to the length of intestine as well as of the capacity to the corpse weight. Similarly there was defined also the percentage of respective intestine sections to the intestine as a whole. The results obtained were analysed statistically; arithmetic mean, standard deviation, coefficient of variability. Additionally there was made a comparison between respective parameters in both sexes.

There was applied the t – Student test, while the significance of differences between means was studied at the significance of P = 0.95.

RESULTS

The data defining body size in the individuals researched are presented in Table 1 which shows that racoon dog male body length and body weight exceeded the respective values in females: in both cases the differences were significant. The data presented were used to calculate relative values of the parameters researched.

Table 1. Racoon dog body measurements

Measurements		Males	Females	Total
Body length (m)	range $\bar{x}$	0.53 – 0.76 0.59	0.47 – 0,.58 0.51 *	0.47 – 0.76 0.55
Body weight (kg)	range $\bar{x}$	4.60 – 6.70 5.67	3.80 – 6.30 4.85 *	3.80 –6.70 5.26

*** significant differences between means for males and females as $\alpha = 0,05$**

Intestine length

As shown in Table 2, the total length of intestine in racoon dog ranged from 2.36 m to 3.03 m, on average 2.90 m in males and from 2.31 m to 2.95 m, on average 2.60 m, in females. An average total length of intestine in both sexes amounted to 2.75 m. The ratio of the length of body to the mean length of the total intestine amounted to 1 : 5.0.

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Table 2. Intestine length in racoon dog

		Males			Females			Total		
Intestine		Absolute length (m)	Relative length (%)	Ratio of the body length to the intestine length	Absolute length (m)	Relative length (%)	Ratio of the body length to the intestine length	Absolute length (m)	Relative length (%)	Ratio of the body length to the intestine length
Total	range $\bar{x}$ Sx Vx(%)	2.36 - 3.03 2.90 0.16 5.52	100	1 : 4.9	2.31 – 2.95 2.60 * 0.18 6.92	100	1 : 5.1	2.31 – 3.03 2.75 0.18 6.54	100	1 : 5.0
Small	range $\bar{x}$ Sx Vx (%)	196 – 2.55 2.41 0.14 5.81	83.1	1 : 4.1	1.86 – 2.46 2.19 * 0.16 7.30	82.9	1 : 4.3	1.86 – 2.55 2.30 0.16 6.95	83.0	1 : 423
Large	range $\bar{x}$ Sx Vx (%)	0.39 – 0.56 0.49 0.03 6.12	16.8	1 : 0.8	0.37 – 0.53 0.39 * 0.04 10.25	17.1	1 : 0.8	0.37 – 0.56 0.44 0.04 9.10	17.0	1 : 0.8
Duodenum	range $\bar{x}$ Sx Vx (%)	0.32 – 0.38 0.34 0.02 5.88	11.7	1 : 0.6	0.30 – 0.36 0.30 0.02	11.5	1 : 0.8	0.30 – 0.38 0.34 0.02 5.88	11.6	1 : 0.7
Caecum	range $\bar{x}$ Sx Vx (%)	0.06 – 0.09 0.07 0.01 14.28	2.5	1 : 0.1	0.05 – 0.07 0.06 0.01 16.66	2.3	1 : 0.1	0.05 – 0.09 0.07 0.01 14.28	2.6	1 : 0.1

*** significant differences between means at P = 0.95, α = 0,05**

Small intestine, whose length in males reached 2.41 m, on average, and in females - 2.19 m, accounted for 83.1% of the whole intestine. The ratio of the length of the body to the length of the small intestine amounted to 1 : 4.3. The length of the large intestine in males amounted to 0.49 m, in females 0.39 m., which accounted for 15.7 % of the whole intestine.

Mean length of duodenum in males amounted to 0.34 m, while in females – 0.30 m., which accounted for, on average, 11.7% of the total length of the intestine.

Absolute length of the caecum in racoon dog amounted to 0.07 m and it accounted for 2.6% of the total length of the intestine.

Out of the comparisons made, it seems that the differences in the absolute length of intestine between individuals of both sexes are significant. The values of the relative length measured against the body length are similar and there were observed no significant differences between them.

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Intestine capacity

Table 3 presents data on the total capacity of the intestine and its respective sections as well as on the capacity of stomach in racoon dog.

The total intestine capacity in racoon dog in males ranged from 865 to 1370 cm^3, on average 945 cm^3, in females from 710 to 1040 cm^3, on average 850 cm^3. The capacity of small intestine ranged from 565 - 920 cm^3, on average 634 cm^3 in males, and from 500 to 680 cm^3, on average 570 cm^3 in females. The capacity of small intestine accounted for 67% of the total intestine capacity. The capacity of large intestine ranged from 250 to 450 cm^3, on average 312 cm^3 in males and from 210 to 360 cm^3, on average 290 cm^3 in females; its capacity accounted for 33.0% of the total intestine capacity.

Table 3. Capacity of intestine in racoon dog

		Males			Females			Total		
Intestine		Absolute capacity (cm^3)	Relative capacity (%)	Ratio of the body weight to the intestine capacity (kg / cm^3)	Absolute capacity (cm^3)	Relative capacity (%)	Ratio of the body weight to the intestine capacity (kg/cm^3)	Absolute capacity (cm^3)	Relative capacity (%)	Ratio of the body weight to the intestine capacity (kg/cm^3)
Total	range $\bar{x}$ Sx Vx(%)	865 – 1370 945 94.77 10.02	100	1 : 167	710 – 1040 850 * 79.52 9.35	100	1 : 175	710 – 1370 898 87.84 9.78	100	1 : 171
Small	range $\bar{x}$ Sx Vx (%)	565 – 920 634 67.53 10.67	67	1 : 112	500 – 680 570 * 41.88 7.34	67	1 : 118	500 – 920 602 56.84 9.44	67	1 : 115
Large	range $\bar{x}$ Sx Vx (%)	250 – 450 312 43.22 13.85	33	1 : 55	210 – 360 290 * 49.69 17.13	34	1 : 60	210 – 450 301 46.29 15.37	33	1 : 58
Duodenum	range $\bar{x}$ Sx Vx (%)	83 – 130 107 8.67 8.19	11	1 : 19	70 – 110 95 7.32 7.70	10	1 : 20	70 –130 101 7.93 7.85	11	1 : 19
Caecum	range $\bar{x}$ Sx Vx (%)	70– 90 78 6.25 8.01	8	1 : 14	60 – 85 72 7.07 9.82	8	1 : 15	60 – 90 75 7.07 9.42	8	1 : 14
Stomach	range $\bar{x}$ Sx Vx (%)	290 - 670 396 72.34 18.26	-	1 : 70	170 - 510 315 * 63.66 20.20	-	1 : 67	170 - 670 354 78.62 22.21	-	1 : 68

***significant differences between means at P = 0,95 , α = 0,05**

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The relative capacity of intestine measured against the body weight in males amounted to 1 : 167, which makes 1 kg of body weight per 167 cm^3 of the total intestine capacity, in females it amounted to 1 : 175, so the value was slightly higher.

The ratio of the body weight to the capacity of small intestine and large intestine was also slightly higher in females. The relative capacity of duodenum and caecum were similar.

In racoon dog, the capacity of abdomen ranged from 290 to 670 cm^3, on average 396 cm^3, in males, from 170 to 510 cm^3, on average 315 cm^3, in females. The difference in the capacity between males and females was significant.

The ratio of the body weight to the capacity of stomach amounted to 1 : 70 in males, and 1 : 67 in females, on average 1 : 68, which means 1 kg of the body weight, on average, per 68 cm^3, of the stomach capacity.

The weight of liver in racoon dog ranged from 196 to 285 g in males, on average 242.67 g and from 185 to 285 g, on average 245.55 g in females. The difference in weight was non-significant.

Table 4 offers the correlation between respective parameters of the alimentary canal in racoon dog. The correlation coefficient was calculated as a combined value for individuals of both sexes. The present data show that the body weight is correlated with the total length of intestine, length of large intestine, as well as the total capacity of the small intestine and of the large intestine. The body weight is also correlated with the weight of liver. The highest value of the correlation coefficient with the body weight is shown for the total capacity of intestine. The body length is most correlated with the length of large intestine and length and the total capacity of intestine as well as the capacity of large intestine. The length of intestine depends mostly on the length of the small intestine, which is also significantly correlated with the length of large intestine and the capacity of the main sections of the intestine. The length of duodenum is correlated with the length of large intestine and the total capacity as well as the capacity of small intestine. The length of the large intestine is highly correlated with the total capacity of the large intestine. The length of the caecum is correlated only with its capacity. The total capacity of the intestine is correlated with the capacity of small intestine and large intestine, and less with the capacity of caecum. This parameter is also correlated with the capacity of stomach. The capacity of small intestine shows correlation with the capacity of large intestine and the capacity of caecum as well as of abdomen. The measurements show that most parameters researched are correlated with the length of large intestine and animal body weight as well with as the capacity of large intestine. The weight of liver is least considerably correlated with other parameters A significant coefficient of correlation is observed only for the animal body weight.

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Table 4. Correlation coefficient of alimentary canal parameters, weight of liver,body weight and body length in racoon dog

Variable	M C	D T	DCJ	DJC	DD	DJG	DJS	PC	PJC	PD	PJG	PJS	PŻ	MW
M C	1.00	0.31	0.33	0.23	0.04	0.32	0.16	0.55*	0.44*	0.25	0.53*	0.33	0.13	0.37
D T		1.00	0.18	0.06	0.14	0.34	0.24	0.34	0.27	0.17	0.33	0.17	0.25	0.11
DCJ			1.00	0.92*	0.46*	0.56*	0.27	0.60*	0.53*	0.14	0.53*	0.34	0.14	0.06
DJC				1.00	0.39	0.46*	0.21	0.55*	0.47*	0.21	0.46*	0.32	0.12	0.01
DD					1.00	0.22	0.16	0.39	0.39	0.46*	0.28	0.13	0.26	- 0.08
DJG						1.00	0.42*	0.58*	0.47*	0.08	0.59*	0.39	0.14	- 0.07
DJS							1.00	.0.10	0.18	0.06	0.16	0.37	0.21	0.05
PC								1.00	0.88*	0.16	0.82*	0.32	0.35	0.14
PJC									1.00	0.21	0.32	0.45*	0.49*	0.17
PD										1.00	0.19	0.09	0.34	0.04
PJG											1.00	0.44*	0.08	0.15
PJS												1.00	0.28	0.17
PŻ													1.00	0.08
MW														1.00

*** correlation coefficient significant at P = 0.95, α = 0,05**

0.91 – 1.00	0.81 – 0.90	0.71 – 0.80	0.61 – 0.70	0.51 – 0.60	0.41 – 0.50	to 0.41

MC – body weight
DT - body length
DCJ – total length of intestine
DJC – length of small intestine
DD – length of duodenum
DJG – length of large intestine
DJS – length of caecum
PC - total capacity of intestine
PJC - capacity of small intestine
PD – duodenum capacity
PJG – large intestine capacity
PJS – capacity of caecum
PZ – capacity of stomach
MW – weight of liver

DISCUSSION

The research of the selected features of the alimentary canal in racoon dog allowed to define absolute length and capacity of intestine as a whole as well as of its respective sections, as well as the capacity of stomach and the liver weight. The results show that significant differences in the values of both sexes are observed in the animal body weight and the body length are also true for alimentary canal parameters. The parameters of relative length of intestine at its respective sections calculated against the body length as well as the relative capacity of the intestine and stomach calculated against the body weight of animals show similar values and there were observed no significant differences between them, which means that the proportions of the length and capacity in both sexes are similar, while the differences in absolute parameters result from animal body size differences. Racoon dog, as reported by Czyżewska [4] and Reig, Jędrzejewski [9] is a species whose diet consists mainly of plant food, which is reflected in intestine parameters. The absolute total length of intestine in males of racoon dog amounts to 2.80 m, while in females to 2.70. As compared with the body length, the total length of intestine in males amounts to 1 : 4.75, in females - 1 : 5.09, on

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average in both sexes 1 : 4.92. The same parameter in other representatives of Canidae scores lower; in wolf from 1 : 3.01 to 1 : 4.25, in dingo. 1 : 1.41 to 2.90 and in jackal 1 : 2.50 Gill et.al.[5]. In dog the length of intestine exceeds the length of body about five times, herbivorous bear has an eight-time longer intestine than the body length, while in pig - fifteen times, and wild pig living in its natural habitat - sixteen times longer than its body length. In ruminants the ratio is even larger, in cattle – twenty times and in sheep twenty- five, Krysiak, Świeżyński [7].

The small intestine in wolf accounted for 87.94 – 89.87% of the total length of intestine, in dingo for 86.60 – 90.36%, and in jackal for 90.69%. In racoon dog the small intestine accounts for, on average, 83.5% of the total intestine length.

The ratio of the capacity of both these sections of the alimentary canal remains as follows: small intestine accounts for 67% of the total capacity, the other 33% - the large intestine. In racoon dog 1kg of the body weight accounts for, on average, 178 ml of the total intestine capacity. The ratio of the relative capacity to the body weight, both for the small intestine and for the large intestine as well as duodenum and caecum, is higher in females, while the relative capacity of stomach in both sexes is similar. The capacity of stomach, as reported by Gill et al. [5], in Carnivores species was higher in dingo and in wolf, while in jackal it was similar to the one in racoon dog.

The ratio of the body weight to the capacity of intestine in racoon dog was much higher than in the representatives of the species of Canidae studied. Comparing the parameters of the alimentary canal in racoon dog and in other representatives of Canidae, one make conclude that the relative length of intestine against the body length is longer than in the species of this family being described. Higher values are also observed for relative capacity of the intestine measured against the body weight.

The research conducted showed that racoon dog’s intestine, as compared against the body length, remains longer than in other wild Canidae researched. It is worth highlighting that this species shows a greater share of the large intestine, both in its length and capacity. In wolf, dingo and jackal, Gill et al. [5], the large intestine accounted for 12% of the total intestine length, while in racoon dog - 17%

It has been commonly regarded since the reports of Babak [1], that the size of alimentary canal is the one of the symptoms of morphological changes due to a specific diet – it is shorter in carnivorous and longer in herbivorous, which is also confirmed by Radzikowska [8].

The present research shows the racoon dog intestine’s metrical features point to some adaptation to the intake of considerable amounts of plant feed, which confirms the views of Czyżewska [4], Reiga, Jędrzejewski [9], that this species, much more than other Canidae, feeds on plant feed.

CONCLUSIONS

1. The research conducted showed that racoon dog's intestine, as compared with the body length, was longer than in other *Canidae* researched.
2. The large intestine of racoon dog accounted for 17% of total intestine length.
3. The metrical features of racoon dog indicate adaptation of the species to intake of considerable amount to plant feed.

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REFERENCES

1. Babak E., 1903, The effect of diet on the length of alimentary tract. J. Biol. Centr. 23 /12/ :477-483. [in German]
2. Brudnicki W., 1985, Diet-related changes in some morphological characteristics of organs in pig *Sus scrofa f. domestica L* and in wild boar. *Sussc rofa L.* Ph.D. thesis, [in Polish]
3. Czyżewska T., 1973, On the origin and distribution of the Racoon Dog, *Nyctereutes* Temminck,1839 (*Canidae)* Przegl. Zool. XVII, 4 :459-464. [in Polish]
4. Dorożyńska N., Cymborowski B., Radzikowska M., 1971, The influence of diet on the histological structure and functioning of alimentary tract in representatives of different groups of animals. Przegl. Zool. ,15: 40 -45. [in Polish]
5. Gill J., Hoffmannowa H., Piekarz R., 1964, Studies on digestive physiology in the wolf, dingo, and jackal. II. Digestive ability of the pancreas, duodenum and salivary glands and size of the alimentary tract and weight of internal organs. Acta Physiol. Pol. 15.1: 137-148. [in Polish]
6. Kwasnicki A.W., 1951, Digestion physiology in pig. Sielchozgiz. Moscow. [in Russian]
7. Krysiak K., Świerzyński K.,1983, Animal Anatomy T.2 PWN [in Polish]
8. Radzikowska M. 1981, The effect of diet on the structure and function of digestive tract in the rats *(Rattus rattus* L.) Przegl. Zool. 25.1: 83-92. [in Polish]
9. Reig S., Jędrzejewski W., 1988, Winter and early spring food of some carnivores in the Białowieża National Park, Eastern Poland. Acta Theriol. 33.5: 57-65.
10. Roskosz T., Kobryńczuk F., Brudnicki W., 1988, The effect of different diets on the correlation of the intestine measurements in pig, *Sus scrofa* f. dom. L. Ann. Warsaw Agricult.Univ. -SGGW-AR Vet. Med. 14: 3-11.
11. Roskosz T., Kobryńczuk F., Brudnicki W., 1990, The type of diet and the length of intestine in wild pig, *Sus scrofa L.* Ann. Warsaw. Agricult. Univ. SGGW -AR. Vet. Med. 16: 13-17.
12. Roskosz T., Kobryńczuk F., Brudnicki W., 1992, The analysis of the lumen diameter of the intestine in wild pig, *Sus scrofa L.* Ann. Warsaw. Agricult. Univ. SGGW - AR. Vet. Med. 17: 19-21.
13. Roskosz T., Kobryńczuk, F., Brudnicki W., 1993, Correlation between the intestine measurements in the European representatives of the Suidae family. Ann. Warsaw. Agricult.Univ. SGGW - A R. Vet. Med. 18: 3-12.

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