METRICAL FEATURES OF THE VENTRAL PART OF THE ALIMENTARY CANAL IN ARCTIC FOX (*Alopex lagopus L.*)

CECHY METRYCZNE CZĘŚCI BRZUSZNEJ PRZEWODU POKARMOWEGO U LISA POLARNEGO (*Alopex lagopus L.*)

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ABSTRACT

The research was carried out on 60 mature individuals of arctic foxes (30 males and 30 females). Not only the length of the intestine was assessed, but also its specific parts. The overall length of the intestine in arctic fox amounted to 3,09 m in males and 3,02 m in females. The ratio of the body's length to the length of the intestine was 1:4,80 in males and 1:4,73 in females. The rate of the large intestine in an overall length of the intestine was 17,26% in males, 17,80% in females.

Keywords: arctic fox, metrical features, alimentary canal

ABSTRAKT

Badania wykonano na 60 osobnikach piesaka (30 samcach i 30 samicach). Określono długość całkowitą jelita oraz jego części składowych i jego pojemność. Średnia długość całkowita jelita piesaka wynosi 3,09 u samców i 3,02 u samic. Stosunek długości tułowia do długości jelita wynosi 1;4,80 u samców i 1;4,73 u samic. Procentowy udział jelita grubego stanowi 17,26% długości całkowitej jelita u samców i 17,80% u samic.

Słowa kluczowe: piesak, cechy metryczne, przewód pokarmowy

DETAILED ABSTRACT

Badania przeprowadzono na 60 dorosłych osobnikach piesaka, w tym 30 samcach i 30 samicach. Zmierzono długość ciała, następnie preparowano brzuszną część przewodu pokarmowego. Wykonano pomiary: całkowitej długości jelita, długości jelita cienkiego, długości dwunastnicy, długości jelita czczego i biodrowego, długości jelita grubego, długości okrężnicy z prostnicą za pomocą taśmy metalowej.

Pojemność jelita wraz ze ścianą określono w zanurzeniu pod wodą pod ciśnieniem 5cm słupa wody. Długość całkowita jelita u samców wynosiła średnio 3,09 m, u samic 3,02 m. Stwierdzono istotnie statystyczną różnicę w wielkości tego parametru. Udział jelita cienkiego samców wynosił 82,42% długości całkowitej jelita, u samic udział ten wynosił - 83,05%. Długość jelita grubego samców wynosiła średnio 0,54m – 17,26% całkowitej długości jelit; u samic 0,54m - 16,80% długości całkowitej jelita. Długość całkowita jelita u samców była 4,8 razy większa od długości ciała, u samic 4,43.

Pojemność względna jelita mierzona w stosunku do masy ciała u samców wynosiła 1:91,55, u samic 1:95,39, była więc nieco większa. Stosunek ciężaru ciała względem pojemności żołądka kształtował się jak 1:51,26 u samców i 1:46,29 u samic. Ciężar wątroby u piesaka wyniósł średnio 420,42g u samców oraz 369,48 g u samic. Różnica ciężaru była statystycznie istotna. Stwierdzono wysoką korelację pomiędzy pojemnością jelita grubego a masą ciała. Długość całkowita jelita i jego poszczególnych odcinków nie wykazuje wysokich korelacji z długością ciała.

INTRODUCTION

The shape and the size of the alimentary canal is investigated, as well as metrical data concerning the length and the absolute capacity and the ratios of the length of intestines to the length of the animal body, of the capacity of intestines to the body weight. Researches also try to define the ratios of respective sections of the intestines to one another.

The dependence between the composition and the kind of food and the morphological features of the alimentary canal was studied. This is crucial in order to consider production effects of the animal husbandry. Metrical features of the alimentary canal in a comparative aspect was presented by Babak [1]. Among publications regarding the parameters of the alimentary canal in Carnivores literature offers data on the size of the alimentary canal in wolf, dingo and jackal - Gill et al. [5]; raccoon dog, silver fox – [2, 4]; common fox that lives in a natural habitat [3]. Szymeczko et al. [6] presented the general information on the length of the arctic fox.

Yet literature seems to offer no data on the intestine length and its respective sections in arctic fox, as well as the capacity of intestines. All that makes it justifiable to research metrical features of intestine, stomach and liver and to compare the data obtained with the other reports which concerned other Carnivores species.

MATERIAL AND METHODS

Animals were obtained from animal farm situated in Łachowo, in the district of Szubin. It has been slaughtered in December 2009. The research investigated 60 adult individuals of arctic fox, including 30 males and 30 females. The length of the body 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. Having removed mesentery, there were taken measurements of the respective sections of the intestine: the total length of intestine, length of small intestine, length of duodenum, length of jejunum and ileum, length of large intestine, the length of colon and rectum. The length of intestines, without chime, was taken once they were spread on a moist non-adhesive surface with a metal band.

The capacity of intestine along with the wall was defined when submerged in water at the pressure of 5cm of the column of water applying a special dish set and scale cylinders. To make a comparison, there was measured the ratio of the length of the intestine to the length of the trunk 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 length was assessed according to methods used by Brudnicki [2,3,4]. The results obtained were analysed statistically; arithmetic mean, standard deviation, correlation coefficient between the length of the trunk, the weight of the body and sections of the intestine. Statistically significant differences were assessed with t-Student test. The computer program Statistica was used in calculating difference with values of $p < 0.05$ considered to be statistically significant

RESULTS

The data defining body size in the individuals researched are presented in Table 1 which shows that arctic fox male body length and body weight exceeded the respective values in females. However, in both cases these differences were insignificant. The data presented were used to calculate relative values of parameters researched.

Table 2 offers information on the total length and its respective parts. The total length of intestine in males was on average 3,09m, in females 3,02m. Statistically significant difference was found ($p<0.05$) concerning the size of this parameter. The total length of the intestine in males was 4,8 times bigger than the body length, in females 4,4.

Table 3 presents data on the total capacity of the intestine and its respective parts as well as on the capacity of stomach in arctic fox. The total stomach capacity in arctic fox was on average 411,60 ml; in females 354,1. The difference was statistically significant ($p<0,05$). The capacity of the small intestine accounted for 75,26% of the total intestine capacity. The capacity of the large intestine accounted for 20,34% of the total capacity of intestine in males and 20,23% in females. The ratio of the body weight to the capacity of stomach amounted to 1:51,26 in males and 1:46,29 in

females. The weight of liver in arctic fox was 420,42 g on average in males and 369,48 g in females. The difference in weight was statistically significant ($p<0.05$). Table 4 offers the correlation between the body length and its weight and the parameters of the alimentary canal in arctic fox. The correlation coefficient was calculated as a combined value for individuals of both sexes.

Table 1. Body length, trunk length and body weight in arctic fox.
Tabela 1. Długość ciała, długość tułowia i masa ciała u lisa polarnego.

Measurements	n		Body length [m]	Body weight [kg]
♂ Males	30	Range	0.60-0.68	6.10-9.40
		x-bar	0.65	8.03
		SD	4.27	4.67
♀ Females	30	Range	0.54-0.66	6.00-8.72
		x-bar	0.64	7.65
		SD	3.87	4.21

x-bar - arithmetic mean, SD – standard deviation

DISCUSSION

The research of the selected metrical features of the alimentary canal in arctic fox allowed to define absolute length and capacity of intestine as a whole as of its respective parts, as well as the capacity of stomach and the liver weight in arctic fox. The results show that differences in the values of both sexes observed in the animal body weight and the body length are also true for alimentary canal parameters. Relative length of intestine as its respective sections calculated against the body length and the relative capacity of the intestine and stomach calculated against the body weight in both sexes doesn't show differences. It 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 ratio of the body length to the intestine length amounted to 1:4,80 in males and 1:4,73 in females. The same parameter in other representatives of Canidae scores lower [5]. In dog the length of the intestine exceeds the length of body about five times, herbivorous bear has an eight-time longer intestine than the body length, while the wild boar living in its natural habitat – sixteen times longer than its body length. The small intestine in arctic fox accounted for 82,42% of the total length of intestine in males, in females 83,05%. The contribution of the small intestine to the total length of intestine in arctic fox is smaller than in common fox (84,6% in males and 83,7% in

females) and it is comparable with the similarily-bred raccoon dog [2, 3, 4]. The small intestine accounted for 75,26% of the total capacity of intestine, the rest (24,34%) accounted for the large intestine. In arctic fox 1 kg of the body weight accounts for, on average, 91,55 ml in males and 95,38 ml in females of the total intestine capacity. The ratio of the relative capacity to the body weight, both for small intestine and for the large intestine as well as duodenum and caecum, is higher in females, while the relative capacity of stomach is higher in males.

Table 2. The length of intestine and its segments in arctic fox
Tabela 2. Długość jelita i jego części u lisa polarnego.

Intestine		Males n = 30			Females n = 30		
		Absolute length [m]	Relative length%	Ratio of the body length to the intestine length	Absolute length [m]	Rel. length%	Ratio of the body length to the intestine length.
DCJ	min-max	2.84 -3.23	100%	1:4.80	2.71-3.18	100%	1:4.73
	x-bar	3.09			3.02*		
	SD	10.76			13.88		
DJC	min-max	229.20-268.30	82.42%	1:3.95	231.60-273.90	83.05%	1:3.93
	x-bar	2.55			2.51		
	SD	9.48			9.78		
DD	min-max	0.31-0.38	11.46%	1:0.69	0.28-0.40	11.31%	1:0.54
	x-bar	0.35			0.34		
	SD	1.85			3.19		
DJCz iB	min-max	198.20-235.20	70.50%	1:3.38	198.50-231.20	70.38%	1:3.33
	x-bar	2.18			2.12*		
	SD	9.54			8.21		
DJG	min-max	0.50-0.59	17.26	1: 0.84	0.5.-0.58	16.80%	1:0.84
	x-bar	0.54			0.54		
	SD	2.42			9.85		
DJŚ	min-max	0.05-0.08	2.03%	1:0.1	0.05-0.07	1.99%	1:0.09
	x-bar	0.06			0.06		
	SD	0.42			0.75		
DO i JP	min-max	0.44-0.53	15.54%	1:0.74	0.40-0.51	15.35%	1:0.73
	x-bar	0.48			0.46*		
	SD	2.27			3.76		

Notes:
x-bar -mean, SD – standard deviation,, DCJ – total intestine length, DJC-small intestine length, DD – duodenum length, DJCz and B – length of the jejunum, DJB – length of the ileum, DJG – large intestine length, DO - caecum length, DJP – colon and rectum length.

Comparing the parameters of the alimentary canal in arctic fox 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.

Table 3. Volume of stomach, intestine and weight of liver in arctic fox.
Tabela 3. Pojemność żołądka, jelita i masa wątroby u lisa polarnego.

Variable		Males n = 30			Females n = 30		
		Absolute capacity [ml]	Relative capacity %	Ratio of the body weight to the intestine capacity kg/ml	Absolute capacity [ml]	Relative capacity %	Ratio of the body weight to the intestine capacity kg/ml
PŻ [ml]	min.-max. x-bar SD	385.00-430.00 411.60 10.84	-	1:51.26	349.00-359.00 354.10* 3.18	-	1:46.29
PCJ [ml]	min.-max. x-bar SD	718.00-751.00 735.17 11.64	100%	1:91.55	715.00-751.00 729.70 12.21	100%	1:95.38
PJC [ml]	min.-max. x-bar SD	537.00-575.00 553.30 8.49	75.26%	1:66.41	525.00-598.00 551.33 13.75	75.56	!:72.07
PD [ml]	min.-max. x-bar SD	78.00-84.00 81.40 7.06	11.07%	1:10.14	78.00-82.00 81.10* 3.18	11.11	1:10.60
PJG [ml]	min.-max. x-bar SD	138.00-165.00 149.60 1.72	24.34%	1:18.63	130.00-173.00 147.53 12.36	20.22	1:19.28
PJŚ [ml]	min.-max. x-bar SD	28.00-35.00 32.27 1.38	4.39%	1:4.02	26.00-36.00 31.60 2.94	4.33	1:4.09
MW [g]	min.-max. x-bar SD	307.00-458.00 420.42 27.15	-	1:52.36	294.00-432.00 369.48* 35.40	-	1:48.30

Legend:
x-bar - mean, Sx – standard deviation, PŻ – stomach capacity, PCJ – total capacity of intestine, PJC – capacity of small intestine, PD – duodenum capacity; PJG – large intestine capacity, PJS – capacity of caecum, MW – weight of liver
*Correlation coefficient between males and females significant at p<0,05

Table 4. Correlation matrix
Tabela 4. Macierz korelacji.

	MC	DC	DCJ	DJC	DJG	PCJ	PJC
MC							
DC	0.27						
DCJ	0.29	0.34					
DJC	0.36	0.23	0.94				
DJG	0.34	0.23	0.46	0.33			
PCJ	0.37	0.32	0.72	0.67	0.47		
PJC	0.27	0.26	0.26	0.33	0.15	0.45	
PJG	0.51	0.34	0.55	0.47	0.29	0.66	-0.28

Correlation: very weak or uncorrelated 0,0-0,1; weak 0,1>3; average 0,3.0,5; high 0,5>0,7; very high 0,7>0,9.

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