

CHARACTERISTICS OF FEMUR AND HUMERUS IN SWEDISH LANDRACE AND HYPOR HOGS

SVOJSTVA FEMURA I HUMERUSA ŠVEDSKOG LANDRASA I HYPOR TOVLJENIKA

Đikić Marija, I. Jurić, N. Stipić, R. Božac

SAŽETAK

U ranijim istraživanjima Petričević i sur. (1985) utvrdili su signifikantne razlike između postotaka kostiju u polovicama i butu svinja Švedskog landrasa (ŠL) i Hypor (Hy) tovljenika.

U našim istraživanjima uspoređeni su femur i humerus ŠL ($m=62$) i Hy ($n=53$). Na femuru i humerusu izmjereni su: masa, dužina, opseg dijafize na najtanjem dijelu i promjer na 4 mjesta (1. proximalna epifiza, 2. distalna epifiza, 3. najtanji promjer dijafize, 4. najveći promjer dijafize na mjestu mjerenja obujma).

Obrada podataka obavljena je po Snedecor Cochran (1967) i Stana Barić (1964).

Utvrđena je masa polovica ŠL $\bar{x}=79,16$ kg, $s=4,58$ kg, a Hy $\bar{x}=79,29$ kg, $s=5,24$ kg.

Masa femura i humerusa ŠL=306,79 i 276,81 gr, a Hy 327,68 i 293,11 gr.

Razlike za masu femura i humerusa između ŠL i Hy su signifikantne na 1% razini.

Dužina femura i humerusa iznosila je za ŠL 197,27 i 177,49 mm, a za Hy 199,19 i 176,79 mm i nisu se statistički razlikovale. Promjer proksimalne i distalne epifize razlikovao se samo za proximalnu epifizu femura na 5% razini. Najveća razlika je bila za oba promjera dijafize i opseg. Hypor je imao veći promjer i opseg dijafize na 1% razini signifikantnosti.

Korelacija između mase polovica i mase i dužine femura i humerusa je visoko pozitivno signifikantna.

Koeficijenti korelacije između svojstava dijafize
Correlation coefficients between characteristics of diaphyses

		Švedski landras Swedish Landrace				Hypor Hypor			
		X1	X2	X3	X4	X1	X2	X3	X4
Masa polovica Carcass weight	kg X1		0.302*	0.286*	0.125		0.191	0.244	0.311*
Promjer dijafize (min) Diameter diaphyse (min)	mm X2	0.321*		0.725**	0.413**	0.220		0.879**	0.632**
Promjer dijafize (max) Diameter diaphyse (max)	mm X3	0.299*	0.547**		0.404**	0.265	0.611**		0.701**
Opseg Circumference	mm X4	0.383**	0.504**	0.662		0.210	0.381**	0.693**	
HUMERUS					HUMERUS				

** P<0,01 * P<0,05

ABSTRACT

In earlier investigations Petričević et al. (1985) have ascertained significant differences of the percentage of bones within the carcasses and ham between the Sweden Landrace (SL) and the Hypor (Hy) hogs.

In our researching work the femur and humerus of SL (n=62) and of Hy (n=53) were compared. The following parameters of femur and humerus were measured: the weight, the length, the circumference of diaphysis on the thinnest place, the diameter largest (on the place of measuring the volume) diameter of diaphysis.

The data processing is done after Snedecor and Cochran (1967). The weight of carcasses of SL amounted to 79,16 kg, s=4,58 kg, of Hy to 79,29 kg, s=5,24 kg. The weight of femur and humerus of SL amounted to 306,79 g and 276,81 g respectively, that of Hy to 327,68 g and 293,11 g respectively. The differences of the weights of femur and humerus between SL and Hy were significant on the 1% level.

The length of femur and humerus of SL came to 197,27 mm and 177,49 mm respectively, that of Hy to 199,19 mm and 176,79 mm respectively. There were no statistical differences between them.

As for the diameter of proximal and distal epiphyses, a difference on the 5% level

was ascertained for proximal epiphysis of femur only. Both diameters and the circumference of diaphysis differed most and were in Hy greater on the 1% level of significance.

The correlation between the weight of carcasses and the weight and length of femur and humerus was high - positively significant.

In researching work was ascertained that the weight of femur and humerus in Hy was significantly greater than in SL. The greater diameter and circumference of diaphysis, both of femur and of humerus, in Hy were the ground of the difference.

Key words: hogs, breeds, Swedish Landrace, Hypor, bones, femur, humerus

The work is carried out in the framework of the project No 4-05-038: Heredity and Changing the Relation and Composition of Tissues in Swine. It has been presented on the 43rd Annual Meeting of the EAAP, Madrid 1992.

Correlation coefficients between characteristics of diaphyses
Koeficijenti korelacije između svojstava dijafize

		Swedish Landrace Švedski landras				Hypor Hypor			
		X1	X2	X3	X4	X1	X2	X3	X4
Carcass weight Masa polovica	kg X1		0.302*	0.286*	0.125		0.191	0.244	0.311*
Diameter diaphyse (min) Promjer dijafize (min)	mm X2	0.321*		0.725**	0.413**	0.220		0.879**	0.632**
Diameter diaphyse (max) Promjer dijafize (max)	mm X3	0.299*	0.547**		0.404**	0.265	0.611**		0.701**
Circumference Opseg	mm X4	0.383**	0.504**	0.662**		0.210	0.381**	0.693**	
HUMERUS					HUMERUS				

**P<0.01 *P<0.05

INTRODUCTION

In meat-processing industry a profitable use of the sides of pork depends upon the relation and distribution of muscular, fatty and bony tissues. Bones as well as fat are undesirable in using the sides of pork, and the quantity of tissue most often

is described through the relations meat: fat and meat: bones, after Fortin et al. (1987) determined by racial differences. Petričević et al. (1985) established significant differences between the swine race Swedish Landrace and the hybrid Hypor as for the percentage of bones in the sides of pork and in leg. Bichard M. et al. (1989) regards the relation meat: bone in the future an important element of the selection of pigs in sense of improving the quality of the sides of pork, but he points out that the heritability and the heterosis - effect of that property aren't investigated enough yet.

Jurić et al. (1989) have investigated the relations among muscular, fatty and bony tissues in leg. They showed that the bones have a share in leg with 3,32% and that the coefficient of correlation between the weight of muscles and of bones amounts to 0,433, between the percental share of muscular and of bony tissues to 0,27.

Correlations between muscular and fatty as well as between fatty and bony tissues are negative. Bones have a share in the body of swine with 10-12%, their function is supporting the muscular mass. In that connection, knowing the anatomical properties of length, of the diameters of proximal and distal epiphyses, of the minimal diameter (i.e.thickness), maximal diameter (i.e.widt) and circumference of the femur and humerus diaphyses makes possible to understand the disposition and function of muscles inserted in femur and in humerus respectively as well as to compare the alternations of bones developing as a consequence of the selection of pigs in sense of increasing the fleshiness.

This work aims to establish some anatomical properties of femur and humerus as well as the differences in weight and shape between two races of pigs, the purebred Swedish Landrace and the hybrid Hypor.

MATERIAL AND METHODS

The bones femur and humerus of fattened pigs of Swedish Landrace (n=62) and Hypor (n=53), kept under the same conditions of fattening, were investigated.

After slaughtering and cooling, conformably to the method by Weniger (1967), the right side of pork has been chopped up and femur and humerus separated from leg and bladebone respectively. Then the bones were completely freed from muscular and connective tissues and ligaments, excluding the joint cartilages. Thereafter weight has been weighed, the length of femur and humerus measured by the use of a ruler, the diameters of proximal and distal epiphyses gauged by means of a slide caliper, in the same way the minimal diameter (i.e.width) of diaphysis. The circumference of diaphysis was ascertained with a tape-measure.

The length of femur has been measured from the most proximal point of the trochanter major to the most distal point of the epicondylus lateralis. The diameter of proximal epiphysis was gauged between the trochanter major and the

most medial point on the caput femoris. The diameter of distal epiphysis was gauged from the most lateral point on the epicondylus lateralis to the most medial point on the epicondylus medialis. The diameter of corpus humeri has been gauged on the thinnest part of diaphysis, and that the minimal (i.e. thickness) in dorso-palmar, the maximal (i.e. width) in latero-medial direction, on the same part the circumference also.

Data processing is done after Snedecor and Cochran (1967), Barić Stana (1964).

RESULTS AND DISCUSSION

On Table 1 the results of investigation of the live weight, the weight of cold sides of pork and the weight of femur and humerus in the fattened pigs of Swedish Landrace and Hypor are given.

Table 1 Live weight, weights of carcasses, femur and humerus
Tablica 1 Živa masa, masa hladnih polovica, femura i humerusa

Characteristics Svojstvo		Swedish Landrace Švedski landras n=62		Hypor n=53	
		\bar{x}	s	\bar{x}	s
Live weight Živa masa	kg	103.27	5.028	104.04	5.748
Cold carcasses Hladne polovice	kg	79.16	4.585	79.29	5.239
Femur Femur	gr.	306.79**	24.297	327.68**	31.200
Humerus Humerus	gr.	276.81**	20.826	293.11**	29.327

** P<0.01

Those results show that between the fattened pigs of Swedish Landrace and Hypor there is difference in the weight of femur and humerus on the 1% level of significance. Obtained results are in conformity with the data of Fortin et al. (1987), but contrary to the findings of Richmond et al. (1972), which didn't find out differences in the weight of femur and humerus between the fattened pigs of races included in their investigation.

The length, diameters and circumference of femur in the fattened pigs of Swedish Landrace and Hypor are given in Table 2.

Table 2 Characteristics of femur
Tablica 2 Svojstva femura

Characteristics Svojstvo		Swedish Landrace Švedski landras n=62		Hypor n=53	
		\bar{x}	s	\bar{x}	s
Length of femur Dužina femura	mm	197.23	6.647	199.19	6.743
Diameters Promjer					
- proximal epiphise - gornja epifiza	mm	66.11*	2.948	67.17*	2.540
- distal. epiphise - doljnje epifize	mm	60.23	2.525	61.09	3.027
- diaphysae (min) - diafiza (min)	mm	22.84**	1.439	61.09	3.027
- diaphysae (max) - diafiza (max)	mm	25.55**	1.656	26.55**	2.171
Circumference Opseg	mm	77.81**	3.810	80.23**	4.479

** P<0.01 *P<0.05

The length of femur (Table 3) in the fattened pigs of Swedish Landrace amounts to 197,23 mm, that one of Hypor to 199,19 mm, but statistically significant differences between investigated groups weren't established. The diameter of distal epiphysis of femur, determining the diameter of articulus genus also, isn't statistically different in fattened pigs of Swedish Landrace and Hypor, while the diameter of proximal epiphysis, determining the diameter of articulus coxae also, in the same fattened pigs is found out statistically different on the 5% level of significance. For the thickness, the minimal diameter and the circumference of diaphysis of femur a statistically significant difference on the 1% level between the Swedish Landrace and the Hypor is ascertained. The enlargement of the length of femur in fattened pigs purebred and hybrids after Richmond R. J. and Berg R. T. (1972) is in proportion with the increase of live weight up to 91 kg, then the rate of growth decreases, and with the live weight of 114 kg no differences of the length of femur in different races are ascertained. Differences of the diameter of proximal epiphysis (articulus coxae) as well as of the minimal and maximal diameter and circumference of diaphysis in fattened pigs Hypor are stipulated by the enlargement of the muscular mass of leg, which is supported with femur, and at the same time by stronger tendons which join articulations and enable the flexion and extennsion of extremity. So according to the investigations of Petričević at al. (1985) the muscular mass of leg in the fattened pigs Hypor is found out larger than that one in Swedish Landrace.

The properties of humerus in investigated fattened pigs are given in Table 3.

Table 3 Characteristics of humerus
Tablica 3 Svojstva humerusa

Characteristics Svojstvo	Swedish Landrace Švedski landras n=62		Hypor n=53		
	\bar{x}	s	\bar{x}	s	
Length of humerus Dužina humerusa	mm	177.42	6.718	176.79	7.172
Diameters Promjer					
- proximal epiphise - gornja epifiza	mm	73.06	3.896	72.79	3.376
- distal. epiphise - donje epifize	mm	51.82	3.610	52.92	4.595
- diaphysae (min) - diafiza (min)	mm	19.34*	1.200	19.93*	1.328
- diaphysae (max) - diafiza (max)	mm	27.68**	1.667	28.66**	1.839
Circumference Opseg	mm	77.81**	3.810	80.23**	4.479

**P<0.01 *P<0.05

From the results of investigation (Table 3) is visible that for the length and the diameter of distal (articulus cubiti) and proximal (articulus humeri) epiphysis no statistically significant difference between investigated groups is ascertained. But according to the investigations of Richmond R. J. et al. (1979), which to a large degree are renewed researching carried out in 1972 by Richmond R. J. and Berg R. T., there are significant differences among the properties of femur and humerus in the fattened pigs weighing from 68 to 114 kg, but no differences between the fattened pigs of pure breed and hybrids. However, in our investigations a difference on the 5% level of statistical significance for the minimal diameter (i.e. thickness) as well as a difference on the 1% level of statistical significance for the maximal diameter (i. e. width) and the circumference of the diaphysis of humerus between researched groups is found out.

Taking into consideration the function of skeleton as the support of muscular mass, for the selection work it isn't sufficiently to know only the anatomical properties (measures and shape) and the strength of particular bones, but is necessary also to know the relations among the properties of the same bones as well as the relations among the properties of different bones.

On Table 4 the results of researching the correlation among the properties of femur of investigated groups are given.

The coefficients of correlation (Table 4) established among the properties of femur in fattened pigs of Swedish Landrace suggest a positive and significant relation between the live weight of fattened pigs on the one hand and the weight, the diameter of proximal epiphysis and the diameters (thickness and width) of diaphysis of femur on the other hand. A medium-firm positive and significant relation is ascertained between the weight of the sides of pork on the one hand and the weight, the length and the diameters of proximal and distal epiphyses of femur on the other hand. The coefficients of correlation are on the 1% level of significance and positive between the weight on the one hand and the length, the diameters of proximal and distal epiphyses and the thickness, width and circumference of the diaphysis of femur on the other hand.

A medium-firm correlation is established between the length of femur and the diameters of proximal and distal epiphyses, while a not firm and statistically not significant relation is found out between the length of femur and the thickness, width and circumference of diaphysis.

As for the fattened pigs Hypor, (Table 4) a high-positive significant relation is established between their live weight and the weight of the cold sides of pork on the one hand and the length and the diameter of proximal epiphysis of femur on the other hand. Between the weight of femur on the one hand and the diameters of proximal and distal epiphyses and the circumference of femur on the other hand the relation is firm and on the 1% level of significance, while between the weight of femur and the thickness, the width and the circumference of diaphysis the relation is significant also, but with lower coefficients of correlation. A medium-firm correlation is ascertained between the length of femur and the diameters of proximal and distal epiphyses and the circumference of diaphysis. Finally, a high-positive significant relation there is between the diameters of proximal and distal epiphyses.

The coefficients of correlation among the properties of humerus are given of Table 5.

The coefficients of correlation ascertained among the properties of humerus in the fattened pigs of Swedish Landrace (Table 5) show that the relation between the live weight and the weight of the cold sides of pork on the one hand and the weight and circumference of humerus on the other hand is medium-firm and statistically significant on the 1% level.

Between the weight of humerus and the length, the diameter of proximal epiphysis and the circumference the relation is high-positive and significant, while it is medium-firm between the weight of humerus and the diameter of distal epiphysis and the circumference of diaphysis.

Very low coefficients of correlation are established between the length of humerus and the thickness of epiphysis and the circumference of diaphysis. The relation between the diameter of distal epiphysis and the length of humerus is negative, but not significant.

The relation between the diameters of proximal and distal epiphyses is negative and on the 1% level significance.

Table 4 Coefficients of correlation between characteristics of femur in Swedish Landrace and Hypor
 Tablica 4 Koefficijent korelacije između svojstava femura u švedskog landrasa i Hypora

Characteristics Svojstva	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉
Live weight Živa masa		0.8321**	0.3272**	0.2287	0.3440**	0.1642	0.3188**	0.3418**	0.1662
Cold carcasses Hladne polovice	0.9129**		0.5595**	0.4270**	0.4037**	0.3395**	0.3021*	0.2860*	0.1247
Weight of femur Masa femura	0.5592**	0.5087**		0.6927**	0.4752**	0.5069**	0.4504**	0.3646**	0.3532**
Length of femur Dužina femura	0.5655**	0.5817**	0.6532**		0.2739*	0.2988*	0.1375	0.0973	-0.0300
Diameter of prox. epiphyse Promjer prox. epifize	0.4382**	0.3748**	0.7365**	0.4708**		0.0824	0.2555*	0.2859*	0.2136
Diameter of dist. epiphyse Promjer dist. epifize	0.3535*	0.3105*	0.7808**	0.4579**	0.5931**		0.2583*	0.1149	-0.0073
Diameter of diaphyse (min) Debijina dijafize (min)	0.1448	0.1905	0.4188**	0.3217*	0.1810	0.1883		0.7253**	0.4127**
Diameter of diaph. (max) Širina dijafize (max)	0.1771	0.2435	0.3796**	0.3961**	0.1014	0.1558	0.8793**		0.4041**
Circumference Opseg	0.3007*	0.3106*	0.4559**	0.3067*	0.1723	0.2452	0.6352**	0.7009*	

** P < 0.01 Swedish Landrace (n=62) above diagonal - Švedski landras (n=62) iznad dijagonale

* P < 0.05 Hypor (n=53) under diagonal - Hypor (n=53) ispod dijagonale

Table 5 Coefficients of correlation between characteristics of humerus in Swedish landrace and Hypor
 Tablica 5 Koeffijenti korelacije između svojstava humerusa u švedskog landrasa i hypora

Characteristics Svojstva	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉
Live weight Živa masa		0,8321**	0,4219**	0,2591*	0,2351	0,0090	0,2641*	0,3128*	0,3487**
Cold carcasses Hladne polovice	0,9129**		0,5118**	0,3006*	0,1912	0,1057	0,3205*	0,2986*	0,3826**
Weight of femur Masa femura	0,5803**	0,5097**		0,6301**	0,5241**	0,2557*	0,4296**	0,4793**	0,5605**
Length of femur Dužina femura	0,5465**	0,5603**	0,5263**		0,4349**	-0,1463	0,1346	0,0547	0,0817
Diameter of prox. epiphyse Promjer prox. epifize	0,0787	0,1535	0,2924	0,2118		-0,3512**	0,1740	0,1345	0,1843
Diameter of dist. epiphyse Promjer dist. epifize	0,4086**	0,3141*	0,4475**	0,4139**	-0,3469*		0,3508**	0,3036*	0,3168*
Diameter of diaphyse (min) Debljina dijafize (min)	0,2171	0,2202	0,2832*	0,1518	0,1980	0,0211		0,5470**	0,5042**
Diameter of diaphyse (max) Širina dijafize (max)	0,2468	0,2650*	0,3006*	0,3605**	-0,0008	0,1312	0,6114**		0,6623**
Circumference Opseg	0,2523	0,2098	0,3738**	0,1873	0,0430	-0,0149	0,3811**	0,6930*	

** P < 0.01 Swedish Landrace (n=62) above diagonal - Švedski landras (n=62) iznad dijagonale

* P < 0.05 Hypor (n=53) under diagonal - Hypor (n=53) ispod dijagonale

Table 6 Coefficients of correlation between characteristics of femur and humerus in Swedish landrace
 Tablica 6 Koefficijenti korelacije između svojstava femura i humerusa i švedskog landrasa

Characteristics - Svojstvo	HUMERUS						
	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇
Weight Masa gr X ₁	0,7263**	0,4348**	0,3043*	0,2719**	0,2633*	0,3014*	0,5604**
Length Dužina mm X ₂	0,6938**	0,7343**	0,4249**	0,0072	0,1711	0,1857	0,3087*
Diameter prox. ep. Promjer prok. ep. mm X ₃	0,4214**	0,2633*	0,2563*	0,1944	0,3642**	0,2177	0,3189*
Diameter distal. ep. Promjer distal. ep. mm X ₄	0,2565*	0,1722	0,0735	0,2724*	0,1745	0,0371	0,1257
Diameter diaph. (min) Deblj. dijaf. mm X ₅	0,3331**	-0,0302	0,1598	0,2972*	0,4496**	0,4766**	0,5978**
Diameter diaph. Promjer dijafize (max) mm X ₆	0,4084**	0,0350	0,0910	0,3866**	0,4822**	0,5282**	0,5784**
Circumference Opseg mm X ₇	0,1817	-0,0743	0,0086	0,2692*	0,2834*	0,3152*	0,5484**

* P<0.05 ** P<0.01

Table 7 Coefficients of correlation between characteristics of femur and humerus in Hypor
 Tablica 7 Koefficijenti korelacije između svojstava femura i humerusa u hypor hibrida

Characteristics Svojstvo	HUMERUS						
	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇
Weight Masa	0,6731**	0,6065**	0,3176*	0,5047**	0,3396*	0,4039**	0,3505*
Length Dužina	0,5095**	0,7107**	0,2391	0,3357*	0,3839**	0,4457**	0,3145*
Diameter prox. ep. Promjer prok. ep.	0,5460**	0,5932**	0,3316*	0,4395**	0,1635	0,1608	0,0892
Diameter distal. ep. Promjer distal. ep.	0,5464**	0,5598**	0,3011*	0,4872**	0,0879	0,2166	0,1427
Diameter diaph. (min) Deblj. dijaf. (min)	0,2365	0,0805	0,1263	-0,0191	0,6662**	0,6605**	0,5746**
Diameter diaph. (max) Promjer dijafize (max)	0,2409	0,1655	0,0551	-0,0016	0,6549**	0,7843**	0,6545**
Circumference Opseg	0,4084**	0,1422	0,2066	0,0251	0,5202**	0,5931**	0,7301**

*P<0,05 ** P<0,01

The coefficients of correlation among the investigated properties of humerus in the fattened pigs Hypor (Table 5) suggest a significantly positive relation between the live weight and the weight of the sides of pork on the one and the weight and length of humerus on the other hand.

A medium-firm relation is established between the weight and length of humerus and the diameter of distal epiphysis and the circumference of diaphysis, while the relation between the same parameters of humerus and the diameter of proximal epiphysis and the thickness and width of diaphysis is weaker. The relation between the length of humerus on the one hand and the diameter of distal epiphysis and the thickness, width and circumference of diaphysis on the other hand is statistically significant and positive, but the coefficients of correlation are to a degree lower.

A significantly negative relation on the 5% level is found out between the diameters of proximal and distal epiphyses. Low, but not significant coefficients of correlation are found out between the diameter of proximal epiphysis and the thickness and circumference of diaphysis, while the relation between the same parameter of humerus and the width of diaphysis is negative. A firm correlation there is between the circumference and width of diaphysis. The correlation of the live weight and the length and circumference of femur and humerus has been investigated by Richmond R. J. and Berg R. T. (1972) in fattened pigs weighing from 23 to 114 kg; they arrived to the conclusion that abreast with the growth of live weight up to 83 kg arise linearly the length of femur and humerus, while the circumference increases up to 68 kg of live weight.

The relations between the researched properties of femur and humerus in the fattened pigs of Swedish Landrace and Hypor are demonstrated by means of the coefficients of correlation of Tables 6 and 7.

In the fattened pigs of Swedish Landrace (Table 6) a high-positive and significant correlation between the weight and length of femur and the weight and length of humerus is ascertained. Also, positive and significant in the 1% level coefficients of correlation, from 0,5484** to 0,5978**, are established between the circumference of humerus on the one and the weight, thickness, width and circumference of diaphysis of femur on the other hand.

The relations among the properties of femur and humerus in the fattened pigs of hybrid Hypor (Table 7) suggest, as well as those ones in the fattened pigs of Swedish Landrace, a significant correlation of the properties of the weight, length and diameters of proximal and distal epiphyses of femur on the one hand and the weight and length of humerus on the other hand. A firm positive correlation between the thickness, width and circumference of femur and the circumference of humerus is ascertained.

CONCLUSIONS

1. The fattened pigs of hybrid Hypor have a significantly greater weight of femur and humerus than those ones of Swedish Landrace. The hybrids Hypor have

- a significantly greater diameter and circumference of diaphysis, as of femur as of humerus, also.
2. Differences between the length of femur and humerus in the hybrid Hypor and the Swedish Landrace aren't significant, however the femur in Hypor is 1,96 mm longer and the humerus 0,63 mm shorter. That relation of lengths enables a greater share of leg in the side of pork in Hypor.
 3. The diameters of proximal and distal epiphyses and the minimal and maximal diameter and circumference of diaphysis there are in various correlation with the length and weight of femur and humerus, so a firmer conclusion upon the inherent laws of that correlation on grounds of our researching can't be drawn. However, one could presume that the mentioned relations are a consequence of different types of swine, i. e. Hypor and Swedish Landrace.

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Adresa autora - Author's address:

Primljeno: 13.12.1992.

Mr. Marija Đikić
Prof. dr. Ivan Jurić
Prof. dr. Nikola Stipić
Prof. dr. Romano Božac
Agronomski fakultet Zagreb,
Svetošimunska 25, 41000 Zagreb