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An Interrelation between the Level of Ribonucleic Acid in Leucocytes and Lymphocytes of Blood, the Fattening Growth and the Meat Utility of Pigs

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Summary. More and more work points towards the possibility of selecting pigs by utilizing the early indexes of fattening and slaughtering group. This work attempts to observe the early biochemical indexes which could indicate the later commercial value of pigs. An investigation was made of the ribonucleic acids, which take an active part in cytoplasmic biosynthesis of the protein forming the main mass of meat tissue in the animal.

In this work, an attempt is made to observe an interdependence between the content of ribonucleic acid in leucocytes and lymphocytes of pigs' blood and the level of the animals' productivity. The results obtained permit the following conclusions:

1. No statistically significant differences for the sexes were noted between P-RNA level in the leucocytes and lymphocytes in peripheral blood and fattening indexes and meat utility.

2. The dynamics of RNA in leucocytes and lymphocytes of peripheral blood may form a criterion for selecting earlier or later maturing time.

3. The obtained coefficients of correlation between the content of P-RNA in blood leucocytes and lymphocytes and the fattening growth and meat utility of pigs suggest that these blood indexes may be used as a criterion for selection, according to which the future fattening and meat output could be forecases during the initial period for pigs growth (4th month of life).

4. The results obtained may be of wider importance from the breeding point of view, providing that future investigations are performed on much wider populations of animals.

Introduction

During the last twenty years, more and more work has appeared on the possibility of selecting pigs by utilizing the early indexes of fleshiness and fattening growth (Mazaraki 1965; Aulstad 1969; Andersen 1970; Kerisit 1970; Smirnov 1969; Sova 1972).

The evaluation of fleshiness on the live animal speeds up selective work and allows utilization in breeding of valuable specimens. When evaluated by the post-slaughtering method, they are lost to the pedigree heard and only provide some information for the slaughtering meat evaluation of their parents or brothers and sisters.

Recent years have been marked by tremendous progress in the study of the structure and function of the nucleic acids and their role in biosynthesis of protein. This is a period of intensive investigation of the relation and interdependence of the nucleic acids with the vitality, health and rate of growth in animals.

More and more papers indicate the interrelation between ribonucleic acid content in various internal organs and the intensity of metabolic processes, as reflected in the level of animal productivity (Walter and Dmochowski 1965; Makarova 1966; Durand et al. 1967; Burcev 1969; Ladan 1970; Grolmus 1972).

This work attempts to observe an interdependence between the content of ribonucleic acid (RNA) in the leucocytes and lymphocytes of blood and the level of productivity.

Material and Methods

The material for this investigation comprised 23 pigs of the Large-White Polish breed from the pig-breeding farm "Ostromice", all about the same age and originating from mating 1 boar with 6 sows.

From each litter were selected 4 specimens (2 male and 2 female porklings), i.e. 2 males and 2 females from three litters, while in the other three litters - owing to shortage of females or males - the sex ratio was changed (3:1). The experimental animals were kept under the same environmental conditions.

The blood for analysis was taken from the tail (by incision), three times from the same specimen, i.e. in the 4th, 6th and 8th month of life. The biochemical analyses were performed in three repetitions. At the age of 8 months, the porkers were slaughtered.

The leucocytes were isolated from the pigs full blood by the fractional sedimentation method (Walter 1970) and the lymphocytes by application of the steelon gauze column (Walter 1970); the number of leukocytes were calculated in 1 mm^3 and the given quantity of cells, calculated against the volume of analysed sample.

Table 1. The characteristics of investigated material in relation to the examined features (level of P-RNA, rate

Group	No. of fattening piglet	Sex	µg of P-RNA/10^9 leucocytes at age (months)			µg of P-RNA/10^9 lymphocytes at age (months)			"Live" rate of growth in g/day at age (months)		
1	2	3	4	6	8	4	6	8	4	6	8
I	G 625 Sz 37/ 26	♀	391	393	461	590	660	459	364	456	394
	24	♂	223	456	398	719	462	475	364	472	481
	30	♀	226	234	405	453	408	768	446	555	585
	28	♂	398	278	414	562	445	577	446	527	510
	G 1073 Sz/26	♀	280	275	270	429	380	383	423	494	593
	G 1073 Sz/27	♀	432	475	376	413	311	365	387	453	563
	25	♂	432	366	593	628	496	559	351	424	550
	23	♂	264	230	351	420	547	389	414	459	497
	G 1028 Sz/32	♀	406	410	552	275	571	589	356	448	518
	33	♀	206	489	536	307	308	587	426	490	554
	29	♂	346	355	561	182	440	-	364	525	490
	31	♂	416	443	339	263	458	690	365	463	434
	G 1029 Sz/35	♂	473	377	699	496	572	843	365	462	498
	37	♀	277	752	413	698	734	615	398	479	477
	42	♀	344	503	580	449	488	652	325	415	461
$\bar{x}$			347,75	402,90	463,83	446,02	485,83	568,47	385,66	474,8	513,66
Sx			79,53	131,96	118,04	153,20	118,05	143,71	37,54	38,3	59,99
II	G 1024 Sz/32	♀	411	548	157	243	776	141	341	357	423
	26	♂	223	712	125	292	758	154	382	486	541
	29	♂	165	325	155	264	360	238	365	481	533
	28	♂	217	330	232	389	264	468	309	446	520
	G 1071 Sz/32	♀	171	235	203	352	230	284	352	440	535
	30	♀	208	334	195	223	408	365	336	408	478
	31	♀	230	616	235	197	804	338	311	429	514
	28	♂	509	264	111	859	532	243	344	319	410
$\bar{x}$			267,29	420,89	177,04	352,79	517,05	279,24	342,50	420,70	494,25
Sx			124,26	178,57	46,51	214,51	236,31	109,67	24,50	57,99	51,87

Table 2. Differences between the average P-RNA levels expressed in µg/10^9 of blood cells in relation to sex

Group	Sex	Age in months	n	-X in µg of P-RNA/10^9 leucocytes	-X in µg of P-RNA/10^9 lymphocytes	S for P-RNA in leucocytes	S for P-RNA in lymphocytes	S for R-RNA in leucocytes	S for P-RNA in lymphocytes
I	♀	4	8	332,25	451,76	69,78	138,34	41,76	85,92
	♂	4	7	364,57	467,14	91,80	193,36		
	♀	6	8	441,37	482,50	159,32	159,70	66,98	63,36
	♂	6	7	357,85	488,57	81,69	52,16		
	♀	8	8	449,12	352,25	104,25	139,07	62,80	80,13
	♂	8	7	479,85	588,83	138,93	160,47		
II	♀	4	4	255,00	253,75	106,81	68,15	94,47	142,73
	♂	4	4	278,50	451,00	155,85	277,22		
	♀	6	4	433,25	554,50	178,62	281,70	135,96	177,74
	♂	6	4	407,75	478,50	205,04	216,82		
	♀	8	4	197,50	282,00	32,05	99,85	31,42	83,76
	♂	8	4	155,75	275,75	54,04	134,51		

of growth, coefficient of growth intensity and technological fleshiness index of main meat cut)

Coefficients of growth intensiveness in g/kg at age (months)			Technological fleshiness index (TFI) in kg^2/dm^3				
4	6	8	Sirloin without fat	Back proper ham without fat	Fore prop. ham without fat	Neck portion without fat	Totals of main cuttings
8,27	5,49	4,14	6,59	6,52	3,34	4,25	21,35
8,27	5,49	4,14	7,26	6,46	3,87	4,94	23,70
8,27	5,49	3,87	8,95	9,63	5,37	6,06	29,20
8,27	5,49	4,15	7,17	7,38	4,26	5,01	23,98
9,00	5,81	4,32	7,91	9,46	4,97	5,94	28,21
9,00	5,81	4,33	7,59	8,57	4,78	5,31	26,03
9,00	5,82	4,33	7,23	7,42	4,52	5,30	24,49
9,00	5,81	4,33	7,48	7,99	4,12	6,03	25,49
7,72	5,15	3,98	7,41	8,48	4,93	5,35	25,95
7,74	5,16	3,99	7,92	9,30	5,93	5,03	27,67
7,74	5,15	3,99	7,23	7,81	4,73	5,31	25,02
7,74	5,15	3,99	5,84	6,46	4,03	4,15	22,82
8,11	5,32	4,08	7,15	7,87	4,74	5,11	24,82
8,12	5,32	4,08	6,12	7,59	5,24	4,76	23,86
8,12	5,32	4,08	5,71	7,22	4,66	4,99	22,91
9,29	5,45	4,14	7,17	7,94	4,63	5,17	25,03
0,36	0,21	0,12	9,84	0,97	0,65	0,56	2,14
8,10	5,44	4,06	5,86	6,40	4,59	3,78	21,26
8,13	5,40	4,07	7,16	7,46	4,19	5,87	25,18
8,11	5,40	4,08	8,01	8,32	5,36	5,01	26,42
8,12	5,40	4,07	7,45	8,79	4,86	5,21	26,09
8,19	5,43	4,08	6,85	7,78	4,76	5,66	25,00
8,19	5,44	4,08	7,58	7,82	4,71	5,95	25,86
8,13	5,43	4,08	6,09	7,95	4,97	5,59	24,62
8,19	5,40	4,10	5,89	6,12	4,19	4,28	21,12
8,14	5,42	4,08	6,86	7,58	4,70	5,17	24,44
0,05	0,02	0,01	0,83	0,91	0,39	0,78	2,09

according to groups and age of pigs

Differences between the averages and values of difference for	
P-RNA in leucocytes	P-RNA in lymphocytes
32,32	15,39
83,52	6,07
30,73	36,58
23,50	192,25
25,50	76,00
41,75	6,25

Table 3. Difference values indexes of slaughtering meat utility in relation to sex within the group

Particulars	Group	Sex	n	$\bar{x}$	S	Sd	Differences between the averages and difference values
TFI of sirloin without fat	I	♀	8	7,275	1,069	0,449	0,224
		♂	7	7,051	0,545		
	II	♀	4	6,395	0,781	0,595	0,533
		♂	4	7,128	0,897		
TFI of back proper ham without fat	I	♀	8	8,346	1,137	0,468	0,862
		♂	7	7,484	0,512		
	II	♀	4	7,488	0,729	0,690	0,185
		♂	4	7,673	1,172		
TFI of front proper ham without fat	I	♀	8	4,903	0,747	0,309	0,579
		♂	7	4,324	0,345		
	II	♀	4	4,758	0,159	0,296	0,108
		♂	4	4,650	0,569		
TFI of neck portion without fat	I	♀	8	5,210	0,594	0,300	0,089
		♂	7	5,121	0,560		
	II	♀	4	5,243	0,989	0,593	0,152
		♂	4	5,093	0,655		
TFI of totals for main buts	I	♀	8	25,648	2,743	1,118	1,317
		♂	7	24,331	0,902		
	II	♀	4	24,185	2,018	1,585	0,518
		♂	4	24,703	2,445		

Table 4. Difference values for the rate of growth in relation to sex within the age and group

Group	Sex	Age in months	n	"Live" rate of growth in g/day	S	Sd	Differences between the average and difference values
	♀	4	8	390,62	40,792	19,949	10,62
	♂	4	7	380,00	35,744		
I	♀	6	8	473,750	41,685	20,572	2,25
	♂	6	7	476,00	37,363		
	♀	8	8	518,12	69,427	32,115	9,35
	♂	8	7	508,57	52,147		
II	♀	4	4	335,00	17,34	17,954	15,00
	♂	4	4	350,00	31,443		
	♀	6	4	408,50	36,810	43,150	24,50
	♂	6	4	433,00	78,056		
	♀	8	4	487,50	49,020	39,238	13,50
	♂	8	4	501,00	61,281		

The preparations connected with the isolation of the cell homogenate fraction containing P-RNA were performed according to the techniques of Schmidt and Tannhausser (1945). The ribonucleic acids in blood leucocytes and lymphocytes were determined by the spectrophotometric method of Tsanev and Markov (1960). The number of P-RNA/10^9 cells were calculated according to the formulae of Tsanev and Markov (1960) modified by Walter (1970).

During the experiment, determinations were made on the live animal rate of growth according to Stahl (1955) and the index for growth intensity according to Kirchgessner, and Burgstaller (1966). After slaughtering the experimental animals, the fleshiness evaluation was performed on the main cuts (proper back ham without fat, proper fore ham without fat, neck-part without fat, sirloin without fat and totals of main cuttings) by applying the technological fleshiness index (TFI) according to Mazaraki (1965).

Any essential difference between the sexes was calculated for the investigated features, level of P-RNA, "live" rate of growth, indexes of fleshiness according to the formulae provided by Mudra (1958). Using the formulae of the same author, differences

were also calculated between the separated groups for such features, as level of P-RNA, "live" rate of growth within the age range and the fleshines indexes expressed by the technological index of fleshiness (TFI) of the main meat cuttings. The coefficients of correlation and regression between the level of P-RNA in leucocytes and lymphocytes of the peripheral blood at age 4, 6 and 8 months and the indexes of fattening growth and meat utility of pigs were calculated according to the formulae of Snedecor (1956).

Results and Discussion

The characteristics of the experimental material for the features analysed (level of P-RNA in leucocytes and lymphocytes of peripheral blood, the rate of growth, the indexes of growth intensity, the technological index of fleshiness) are presented in Table 1.

No statistically significant differences were noted between the sexes (Tables 2, 3, 4) for P-RNA content in leucocytes and lymphocytes, the indexes of fattening growth and meat utility.

The results presented in Table 1 show a wide range in the content of P-RNA in leucocytes and lymphocytes, particularly for the fattening specimens of group II. As the coefficients of dispersion for the group I pigs were limited to about 30%, the variation in this feature for the group II is much higher. Similar coefficients of variation were found by Zielińska (1973) in studying the level of nucleic acids in leucocytes of cattle blood and amounted to P-RNA 41.5-44.6%; Glen (1967) found values of 32% for leucocytes of human blood and Koćwin (1974) found 40% for leucocytes in pig blood. Probably such dispersion results from differing degrees of leucocyte maturity, changes in the proportions of types of leucocytes circulating in the blood and from various grades of relationship of the specimen within the groups.

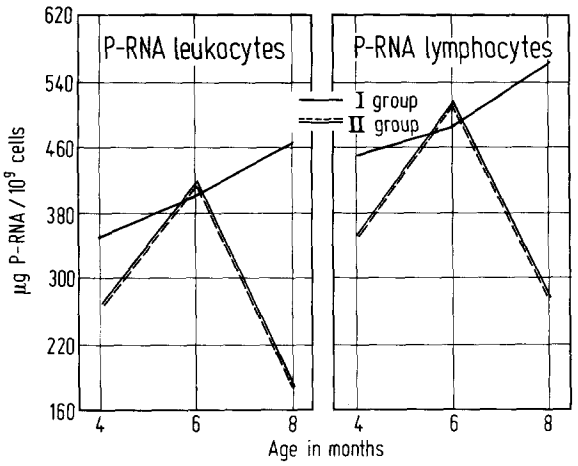

Fig.1. P-RNA dynamics in leucocytes and lymphocytes of pig peripheral blood

Analysing the results of the investigated material, the differences in P-RNA level in leucocytes and lymphocytes were observed between the 4th and 8th month of life. This permitted selection of two groups of animals characterized by a differing tendency to changes in P-RNA with time. Because of the genetic similarity of the specimens in a litter and the differences between litters resulting from the influence of the sow, the results were analysed for particular litters.

Table 5. Difference values for P-RNA level in lymphocytes and leucocytes of pig blood between the groups within the age

Particulars	Age in months	Group	$\bar{x}$	S	n	Sd	Differences between the averages and difference value
µg P-RNA/10^9 leucocytes	4	I	347,75	79,53	15	42,377	80,46
		II	267,29	124,26	8		
	6	I	402,90	131,96	15	65,281	17,99
		II	420,89	178,57	8		
	8	I	463,83	118,04	15	43,803	286,79**
		II	177,045	46,81	8		
µg P-RNA/10^9 lymphocytes	4	I	446,05	153,20	15	78,868	93,26
		II	352,79	214,22	8		
	6	I	485,82	118,05	15	73,42	31,22
		II	517,05	236,31	8		
	8	I	568,47	143,71	14	58,882	289,23**
		II	279,24	109,67	8		

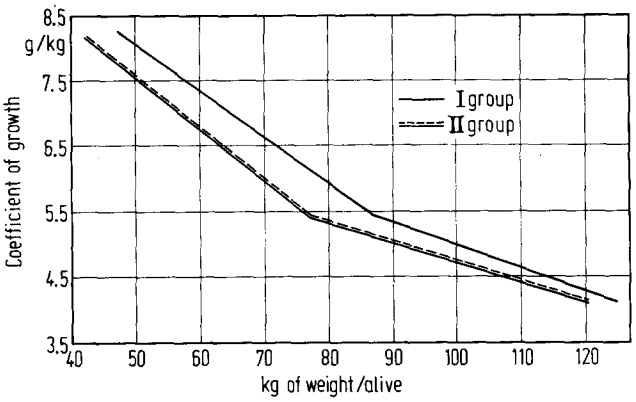

Fig.2. Coefficient of growth in relation to weight of alive pigs

The hereditary features of the mother and maternal environment have a greater influence than the father on the formation of biochemical and physiological features, on meat index and rate of growth (Gorin et al. 1970; Matiec 1970). The specimens originating from four mothers (coefficient of relation R_{xy} = 31.75%), numbering 15 head, showed a similar tendency to P-RNA changes and were included in group I, while the specimens from two mothers (coefficient of relation R_{xy} = 12.5%), numbering 8 head, demonstrated a different tendency to changes of the same index and were included in group II.

In group I, the P-RNA content showed a tendency to increase from the 4th month of life, while in group II, the quantity of P-RNA distinctly decreased from the 6th month of life (Fig.1). The differences between these groups are statistically highly significant at the age of 8 months (Table 5).

This observation formed a basis for analysing the indexes for fattening growth and meat utility of the examined pigs. The groups differ in growth and highly significant and significant differences were noted at the ages of 4 and 6 months (Table 6). The group I showed a higher index expressed by absolute growth. Higher increases (growths) result mainly from a higher rate of growth during the first half of the fattening period. Thus, the breaking point of the curve (Fig.2) could testify that the animals at this weight are attaining the point of fleshiness. Thus, group I attains such a point at the weight of 87 kg, while group II does so at 77 kg. The differences proved to be statistically significant (Table 6).

If the suggestions put forward above could be supported by further investigations on a larger population, the dynamics of RNA could provide a good, live index for determination of earlier or later maturing in pigs.

Highly significant and significant negative correlation coefficients were determined between the content of P-RNA in the leucocytes and lymphocytes of blood and the technological indexes of fleshiness of the main cuts of meat (Table 7).

The coefficients were high and the determined interrelations occurred mainly at a relatively young age (4 months). From the point of view of breeding, this

Table 6. Difference values between the groups with age for rate of growth and body weight

Particulars	Age in months	Group	$\bar{x}$	S	n	Sd	Differences between the averages and difference values
Rate of growth g/day	4	I	385,66	37,66	15	14,817	43,16**
		II	342,50	24,83	8		
	6	I	474,80	38,32	15	20,063	54,03*
		II	420,75	57,99	8		
	8	I	513,66	59,99	15	25,138	19,41
		II	494,25	51,87	8		
Body weight in kg	4	I	47	4,76	15	1,984	5*
		II	42	3,11	8		
	6	I	87	8,56	15	5,197	10*
		II	77	10,711	8		
	8	I	125	11,69	15	5,594	5
		II	120	12,81			

offers an early (one from many) index of selection for fleshiness providing, however, that it can be confirmed by further investigations on a distinctly larger population of investigated animals.

Grolmus et al. (1972) also showed a negative correlation between the RNA content in erythrocytes of the blood and the production of pure wool in sheep (r = -0247 for merinos). Similar interrelations were demonstrated in cattle by Burcev (1969) who found a higher content of RNA in the blood of cows having a higher milking capacity.

The level of RNA in blood erythrocytes of hens was investigated by Makarova (1966), who found a correlation with live-body-weight and a tendency for correlation with the egg-laying of mothers. Ladan (1970) ascertained that the concentration of nucleic acids in the thymus gland of bacon-breed pigs is higher than in meat-fat pigs. This points towards a more active metabolism of protein in bacon-type pigs.

Negative correlation coefficients were noted in this work between the RNA content in leucocytes and lymphocytes of blood and the "live" rate of pigs growth (Table 8). In the 4th month of life, the RNA in leucocytes already gives the negative statistically highly significant correlation with "live" rate of growth analysed in the 6th month of life (r = - 0.901**) and in the 8th month of life (r = - 0,922**). The content of P-RNA in lymphocytes determined in the 6th month of life is correlated with "live" rate of growth measured in the 8th month of life (r = - 0.515*).

Negative results were obtained by Petrenko (1969), who did not find such interdependence in his work on the interrelation between the quantity of nucleic acids in blood of pigs and the intensity of growth.

Conclusions

The results obtained here permit us to draw the following conclusions:

1. The investigations performed indicate that, within the examined stock, two groups can be separated which present different dynamics of RNA in leucocytes and lymphocytes of peripheral blood:

Table 7. Interrelation between the biochemical indexes of blood and meat indexes of pigs

Particulars	Group	Coefficients of correlation and regression dependence					
		P-RNA level in μg/10^9 leucocytes at age (months)			P-RNA level in μg/10^9 lymphocytes at age (months)		
		4	6	8	4	6	8
TFI for sirloin without fat	I	r-0,302	r-0-58* b-0,0037	r-0,136	r-0,149	r-0,515* b-0,0037	r-0,115
	II	r-0,764* b-0,0051	r-0,253	r+0,163	r-0,365	r-0,604	r+0,337
TFI for back proper ham without fat	I	r-0,398	r-0,271	r-0,138	r-0,274	r-0,546 b-0,0044	r-0,063
	II	r-0,886** b-0,0065	r-0,107	r+0,669	r-0523	r-0,503	r+0,676
TFI for front ham without fat	I	r-0,249	r+0,210	r+0,183	r-302	r-0351	r+0,298
	II	r-0,613	r-0,245	r+0,578	r-0,530	r-0,377	r+0,392
TFI for neck portion without fat	I	r-0,356	r-0,572* b-0,0020	r-0,145	r-0,153	r-0,339	r-0,188
	II	r-0,796* b-0,0050	r+0,104	r+0,418	r+0,419	r-0,228	r+0,408
TFI for totals of main cut	I	r-0,364	r-0,372	r-0,173	r-0,336	r-0,572* b-0,0104	r-0,003
	II	r-0,945** b-0,0159	r-0,076	r+0,498	r-0,542	r-0,487	r+0,517

r - coefficient of correlation
b - coefficient of regression

* - difference statistically significant
** - difference statistically highly significant

a) within the Ist group of animals, the P-RNA level tends to increase between the 4th and 8th months of life. The animals are characterised by a higher rate of "live" growth and higher body weight. This may indicate that the point of fleshiness is attained rather late (at 87 kg of body weight);

b) within the IInd group, the quantity of P-RNA within the 4-8 month age-group, increases up to the 6th month of life and afterwards distinctly decreases. The animals show a lower rate of "lively" growth and lower body weight indicating earlier maturing (at 77 kg of body weight).

2. The dynamics of RNA in leucocytes and lymphocytes in peripheral blood may give a criterion for selection of the earlier or later maturing time.

3. The obtained coefficients of correlation between the content of P-RNA in blood leucocytes and lymphocytes and the fattening growth and meat utility of pigs, suggest that the indicated blood indexes may be used as a criterion for selection, according to which the future fattening and meat output could be forecast during the initial period of growth (4th month of life); this, however, needs to be confirmed by further investigations on larger numbers of animals.

4. No statistically significant differences between the sexes were noted for the features examined: P-RNA level in leucocytes and lymphocytes of peripheral blood, indexes of fattening growth and meat utility of pigs.

5. The investigation ascertained the changes of P-RNA in blood leucocytes and lymphocytes in relation to age of the examined pigs.

6. The results justify further investigations to determine early indexes of fattening growth on live animals and of fleshiness on a much wider range of material.

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Table 8. Coefficients of correlation and regression between the blood biochemical indexes and rate of growth

P-RNA level in peripheral blood leucocytes and "live" rate of pigs growth					P-RNA level in peripheral blood lymphocytes and "live" rate of pigs growth				
Age in months	Group	n	r	b	Age in months	Group	n	r	b
4/4	I	15	-0,438	-	4/4	I	15	+0,038	-
	II	8	-0,073	-		II	8	+0,028	-
4/6	I	15	-0,379	-	4/6	I	15	-0,159	-
	II	8	-0,901**	-0,4203		II	8	-0,603	-
4/8	I	15	-0,302	-	4/8	I	15	-0,151	-
	II	8	-0,922**	-0,3850		II	8	-0,528	-
6/6	I	15	-0,359	-	6/6	I	15	-0,291	-
	II	8	+0,288	-		II	8	-0,208	-
6/8	I	15	-0,457	-	6/8	I	15	-0,515*	-0,2620
	II	8	+0,145	-		II	8	-0,295	-
8/8	I	15	-0,231	-	8/8	I	14	-0,250	-
	II	8	+0,414	-		II	8	+0,258	-

r - coefficient of correlation
b - coefficient or regression
n - number in group
* - difference statistically significant
** - difference statistically highly significant

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