STRUCTURE AND DEVELOPMENT OF THE GENETIC RESOURCE OF THE "OLD KLADRUB HORSE" WITHIN THE PERIOD FROM 1993 TO 2003

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The Old Kladrub horse is the most important genetic resource in the Czech Republic. Today the breed is divided into 5 gray and 5 black sire lines. The Old Kladrub horses can be traced back to the founder sires, which represent sire lines existing today. The breed consists of the Stud Kladruby nad Labem with the grey variety and the Stud Slatiňany with the black variety and 100 private breeders with both colour varieties. The majority of the studs are located in the middle of Bohemia and in the southern parts of Moravia. The structure of the breed in 2003 was: 39 sires and 350 dams. The breed was closed against immigration in 1992. In 1993 and 2003 coefficients of inbreeding ($F_{\bar{x}}$) were calculated from 5 parental generations for sires and dams in the whole breed, white and black variety and sire lines within the varieties. From 1993 to 2003 decreased $F_{\bar{x}}$ (%) in the breed for stallions from 5.65 to 5.52 and for mares from 7.75 to 4.88. The effective population size was in 1993 N_e = 114.00 and in 2003 N_e = 140.36. The increment of N_e during the 10-year period was 26.36 animals. No tendency caused by the inbreeding depression was found in the fertility rate within the period of 1995 and 2003. The average heterozygosity estimated on the frequencies of bloodtypes, biochemical markers and microsatellites was enough large and was connected with a low coefficient of inbreeding.

Old Kladrub horse; structure and development; rate of inbreeding; effective population size; dam fertility; polymophism

INTRODUCTION

The Old Kladrub horse is an important Czech horse breed, which fulfills most of the criteria for genetic resources. The breed is endangered, well adapted to specific environmental conditions, shows unique traits and has a high cultural and historical value. The historical development of the breed was published by Volenec et al. (1995) and the conformation was described by Jakubec et al. (1999). The breed is kept and bred at the studs Kladruby and Slatiňany of the National Stud at Kladruby nad Labem. The rest of the breed is located on 100 private farms.

Today the population is divided intro 5 gray lines (GENERALE, GENERALISSIMUS, SACRAMOSO, FAVORY, RUDOLFO) and 5 black lines (SACRAMOSO, SOLO, SIGLAVY PAKRA, ROMKE, GENERALISSIMUS). The Old Kladrub horse can be traced back to the founder sires, which represent sire lines existing today (Table 1).

The oldest founder was the grey stallion Generale, of Italian-Spanish origin, born in Kopčany (Moravia) in 1787, who became the predecessor to what is now called the GENERALE line. Founder of the GENERALISSIMUS line was his son Generalissimus I, born also in Kopčany 1797. Today the GENERALISSIMUS line in-

Table 1. Survey of founder sires

No.	Name	Variety	Date of birth	Breed	Origin
1	Generale	Grey	1787	Old Kladrub	Kopčany stud (Moravia)
2	Generalissimus I	Grey	1797	Old Kladrub	Son of Generale (Kopčany)
3	Sacramoso	Black	1800	Old Kladrub	Kroměříž stud (Moravia)
4	Napoleone	Black	1845	Old Kladrub	Rome – line ceased in 1922
5	Solo	Black	1927	Old Kladrub	Son of Sacramoso XXIX
6	Favory	Grey	1938	Lipizzan[1]	Bábolna stud (Hungary)
7	Siglavy Pakra	Black	1946	Lipizzan[1]	Lipica stud (Slovenia)
8	Romke	Black	1966	Friesian[1]	The Netherlands
9	Rudolfo	Grey	1968	Lusitano[1]	Portugal

[1] breeds of Old Spanish origin

cludes not only grey animals but also black ones. The SACRAMOSO line, originally black, was established by the stallion Sacramoso, who was born in 1800 in the stud of the Olomouc Archbishopric in Kroměříž, also in Moravia. The SACRAMOSO line has now two varieties, a black and grey one. The next oldest founder of the black NAPOLEONE line was the stallion Napoleone, born in 1845. The NAPOLEONE line ceased in 1922 since the stallion Napoleone Sola VI did not have sons. The black Solo line was derived from the Sacramoso line since the founder of this line, Sacramoso XXXI, born in 1927 was a descendant of the stallion Sacramoso XXIX and the dam 271 Sacramoso XXVII. Succesful was the mating of Old Kladrub mares with the Lippizzan stallion Favory, born in 1938 in the Bábolna stud (Hungary). He founded with his five sons and nine daughters, who have been born between 1951 and 1959, the new grey line FAVORY. The black Lipizzan stallion Siglavy Pakra, born in Yugoslavia in 1946 was used in the Slatiňany stud from 1957 to 1967 and founded the black line SIGLAVY PAKRA. The founders of both lines were in the type of the Old Kladrub horse. The Lippizzan breed is of the similar origin as the Old Kladrub horse, since both breeds have been derived from Old Spanish horses.

The lines founded last were the grey line RUDOLFO and the black line ROMKE. The founder of the RUDOLFO line was the Lusitano stallion Rudolfo, born in Portugal in 1968. He was mated to the Old Kladrub mares and produced progeny between 1977 a 1985. The Friesian stallion Romke, born in the Netherlands in 1966, was used as a sire in the Slatiňany stud from 1974 to 1985. As in the case of the Lippizzan breed, both breeds had their origin also in the Old Spanish horses. This was the reason why this both of these stallions were imported.

From the very beginning it has been a population of limited number and because of this inbreeding took place over centuries and especially in the past decades. Inbreeding in its consequences could lead to inbreeding depression, especially in characters related to fitness (reproduction traits). This is why it is necessary, in the framework of repeated genetic analyses, to pay attention to the rate of inbreeding. Volenec et al. (1995) carried out a preliminary study of inbreeding of the Old Kladrub horse. As a result of this analysis the population was closed in 1992 against gene immigration from related breeds of Spain origin.

MATERIAL AND METHODS

The structure of the breeding animals in the year 2003 (colour varieties, sires and dams) was analysed. In the Old Kladrub breed the pedigrees of the individuals are known, and so the coefficient of inbreeding could be deduced directly from the pedigrees. The genetic analysis was carried out in the year 2003 in the same way as in the year 1993. Coefficients of inbreeding were calculated for all horses (stallions and mares) from the information of 5 generations of ancestors according to Wright (1922).

For the calculation of inbreeding coefficients a special software was developed in the year 1992. The individual coefficients of inbreeding were used for the calculation of average coefficients of inbreeding for various groups of animals (whole population, varieties, type of studs, sex and lines).

The actual results of the analysis (2003) were compared with those obtained in 1993 and the shift in the rate of inbreeding within this 10-year breeding period was analysed.

The coefficients of inbreeding were used as a measure of dispersion (dispersive process) since the random genetic drift was also discussed. The effective population size (N_e) and expected increment of inbreeding (ΔF) in one generation were calculated according to Falconer and Mackay (1996). The rate of inbreeding is also an expression for the variance of the change of gene frequency ($\sigma^2_{\Delta q}$) in one generation (random genetic drift) resulting from the dispersive process (inbreeding and sampling).

The dispersion of the gene frequencies, which is described by reference to one locus in many populations, could equally well be described by reference to the frequencies at a number of different loci in one population, provided they all started from the same initial frequency, and were unlinked.

The mentioned two agencies (sampling, inbreeding) of the dispersive process differs from the systematic processes (mutation, migration, selection). The systematic processes are acting in "large populations" and the dispersive process is restricted to "small populations" (genetic resources).

The dispersive process has three important consequences:

1. Differentiation between sub-populations.
2. Reduction of genetic variation within small populations. The individuals of the population become more and more alike in genotype (genetically uniform).
3. Increase in the frequency of homozygotes at the expense of heterozygotes. This, coupled with the general tendency for deleterious alleles to be recessive, is the genetic basis for the loss of fertility and viability that almost always results from inbreeding.

The increase of homozygosity results in a reduced *fitness*. This change of genotype frequencies resulting from the dispersive process and reduced fitness is the genetic basis of the phenomenon of *inbreeding depression*. To find out if the Old Kladrub breed is endangered by the inbreeding depression the fertility of dams was analysed in the time span from 1995 to 2003.

The counterpart of the mathematical tools for describing the genetic diversity are genetic tools which analyse the frequencies of alleles. Differences in these frequencies can be shown by different types of markers:

1. Bloodtypes
2. Biochemical markers
3. Microsatellites (noncoding loci).

Bloodtypes and biochemical markers are less favorable than molecular genetics markers (noncoding loci) and have roles to fulfil in the physiology of animals. Noncoding loci include DNA sequences, which are not a part of the functional genes. By means of them small changes in the nucleotids of the fragments of DNA can be found. In 1993 and 1994 182 progeny (stallions and mares of different age) were tested for 7 systems of bloodtypes (A, C, D, K, P, Q and U) and 10 systems of biochemical polymorphism: 5 systems of genetic variants in the serum or plasma – ALB (albumin), TF (transferrin), ES (carboxylesterase), GC (vitamin D binding protein), A1B (β-glycoprotein) and 5 systems in red blood cells – HBA (haemoglobin), CA (carbonic anhydrase), GPI (glucose phosphate isomerase), PGD (6-phosphogluconate dehydrogenase) and PGM (phosphoglucomutase). The results of the test were used for the estimation of average heterozygosity and were published by Jakubec et al. (1996). Hořín et al. (1998) tested the same blood type systems and systems of genetic variants in the serum or plasma as Jakubec et al. (1996) and these 5 systems in red blood cells: GPI (glucose phosphate isomerase), PGD (6-phosphogluconate dehydrogenase), PGM (phosphoglucomutase), HBA (haemoglobin) and Pi (protease inhibitor). The individuals were in both cases grouped into both colour varieties (grey and black). The average heterozygosity was by both authors estimated according to Nei and Roychoudhuri (1974).

RESULTS AND DISCUSSION

Development of the breed

The structure of the breeding animals of the Old Kladrub horse in the year 2003 (colour varieties, sires and dams) is shown in Tables 2 and 3. The grey variety is located at Kladruby nad Labem and the black one at Slatiňany. Both locations are situated in the region of Pardubice approximately 100 km west from Prague. The majority of the 100 private breeders are located in the middle of Bohemia and in the southern parts of Moravia. The breeding population consists of 389 breeding horses (39 sires and 350 dams).

Within the 10-year breeding period (1993–2003) the number of sires increased from 33 to 39 (Table 2). This increment was only slight, and it was due the increase of sires in the grey variety (from 16 to 22). The number of sires in the black variety was the same (17) in both years 1993 and 2003. During the same period the number of mares increased from 209 (95 grey and 114 black) to 350 (169 grey and 181 black) – Table 3.

Rate of inbreeding

Stallions

Table 2 shows also average inbreeding coefficients of stallions within sire lines and both varieties in 1993 and 2003.

Table 2. Average inbreeding coefficients of stallions within sire lines and both varieties in 1993 and 2003

Year		1993		2003		Difference	Min.	Max.
Variety	Sire line	n	$F_{\bar{x}}$ (%)	n	$F_{\bar{x}}$ (%)	$F_{\bar{x}}$ (%)	* $F_{\bar{x}}$ (%)	* $F_{\bar{x}}$ (%)
Grey	Generale	2	11.25	5	7.03	–4.22	0.00	9.57
	Generalissimus	3	8.23	4	3.86	–4.37	1.95	5.86
	Favory	6	2.42	6	4.82	2.40	1.56	7.23
	Rudolfo	2	7.25	2	2.64	–4.61	2.53	2.73
	Sacramoso	3	6.93	5	5.47	–1.46	3.32	7.23
	Average	16	6.06	22	5.20	–1.06	0.00	9.57
Black	Sacramoso	5	1.06	6	9.44	8.38	4.69	11.72
	Solo	6	7.83	7	5.08	–2.75	2.34	8.98
	Siglavy Pakra	3	4.50	2	3.61	–0.89	2.73	8.98
	Romke	3	7.90	1	0.00	–7.90	0.00	0.00
	Generalissimus	–	–	1	1.56	1.56	1.56	1.56
	Average	17	5.26	17	5.94	0.68	0.00	11.72
Total	Generale	2	11.25	5	7.03	–4.22	0.00	9.57
	Generalissimus	3	8.23	4	3.86	–4.37	1.95	5.86
	Favory	6	2.42	6	4.82	2.40	1.56	7.23
	Rudolfo	2	7.25	2	2.64	–4.61	2.53	2.73
	Sacramoso	8	3.26	11	7.64	4.38	3.32	11.72
	Solo	6	7.83	7	5.08	–2.75	2.34	8.98
	Siglavy Pakra	3	4.50	2	3.61	–0.89	2.73	8.98
	Romke	3	7.90	1	0.00	–7.90	0.00	0.00
	Average	33	5.65	39	5.52	–0.13	0.00	11.72

* – the minimal and maximal $F_{\bar{x}}$ refer to values in 2003

Table 3. Average inbreeding coefficients of mares within sire lines and both varieties in 1993 and 2003

Variety	Sire line	1993			2003			Difference	Min.	Max.
		Sires	Dams	$F_{\bar{x}}$	Sires	Dams	$F_{\bar{x}}$	$F_{\bar{x}}$ (%)	* $F_{\bar{x}}$ (%)	* $F_{\bar{x}}$ (%)
		n	n	(%)	n	n	(%)			
Grey	Generale	2	10	8.59	2	21	6.32	–2.27	2.34	10.55
	Generalissimus	3	28	9.84	1	17	5.89	–3.95	2.54	10.74
	Favory	6	30	4.19	3	77	3.48	–0.71	0.39	13.48
	Rudolfo	2	8	7.29	1	15	1.75	–5.54	0.39	5.66
	Sacramoso	3	19	9.96	3	33	4.24	–5.72	0.39	12.11
	Solo	–	–	–	2	3	2.21	2.21	0.00	6.64
	Siglavy Pakra	–	–	–	1	1	0.20	0.20	0.20	0.20
	Romke	–	–	–	1	2	0.00	0.00	0.00	0.00
	Average	16	95	7.29	14	169	3.99	–3.30	0.00	13.48
Black	Sacramoso	5	24	11.31	3	63	7.26	–4.05	2.34	17.58
	Solo	6	48	8.38	2	66	5.45	–2.93	1.37	17.97
	Siglavy Pakra	3	14	9.21	1	14	6.33	–2.88	2.34	15.82
	Romke	3	28	4.48	1	33	4.49	0.01	2.93	10.55
	Generalissimus	–	–	–	1	5	1.29	1.29	1.95	4.10
	Average	17	114	8.40	8	181	5.86	–2.54	1.37	17.97
Total	Generale	2	10	8.59	2	21	6.32	–2.27	2.34	10.55
	Generalissimus	3	28	9.84	2	17	5.89	–3.95	2.54	10.74
	Favory	6	30	4.19	4	82	3.35	–0.84	0.39	13.48
	Rudolfo	2	8	7.29	1	15	1.75	–5.54	0.39	5.66
	Sacramoso	8	43	10.71	6	99	6.03	–4.68	0.39	17.58
	Solo	6	48	8.38	4	66	5.55	–2.83	0.00	17.97
	Siglavy Pakra	3	14	9.21	2	15	5.91	–3.30	0.20	15.82
	Romke	3	28	4.48	2	35	4.23	–0.25	0.00	10.55
	Average	33	209	7.75	22	350	4.88	–2.87	0.00	17.97

* – the minimal and maximal $F_{\bar{x}}$ refer to values in 2003

The average coefficient of inbreeding for the whole population and in both varieties of the stallions remained within the 10 years period almost unchanged. The grey sire lines (GENERALE, GENERALISSIMUS, SACRAMOSO and RUDOLFO) showed a decline of the average inbreeding coefficient in the interval from –1.46% to –4.61% and in the line FAVORY increased $F_{\bar{x}}$ from 2.42% to 4.82%. For all grey sire lines the decrease of $F_{\bar{x}}$ from 6.06% to 5.20% (–1.06%) was recorded.

The average coefficient of inbreeding increased in the black sire lines from 5.26% to 5.94% (0.68%). This was mainly caused by the line Sacramoso with the $F_{\bar{x}}$ = 8.38% due to the highest numbers of sires and could be not changed by the lines SOLO, SIGLAVY PAKRA and ROMKE, which showed negative values of $F_{\bar{x}}$. Successful was the production of a black sire of the originally grey line Generalissimus. In the whole breed no success in the diminishing of the average coefficient of inbreeding for stallions within the population from 1993 to 2003 has been recorded. Despite the matings between as far as possible unrelated stallions and mares and realized circular group mating the average coefficient of inbreeding of the breed left unchanged during the period of ten years. This can be explained by the fact, that when stallions were selected for breeding emphasis was first of all put on the results of the performance test and conformation evaluation.

Mares

Table 3 shows average inbreeding coefficients of mares within sire lines and both varieties in 1993 and 2003.

The average coefficient of inbreeding for the whole population (grey and black lines) of mares decreased from the value 7.75% to 4.88% (–2.87%) within the 10-year period. The main reason for this phenomenon is the increase in the number of mares and the circular group mating. The coefficients of inbreeding were reduced in all lines. The highest difference was found in the lines RUDOLFO (–5.89%) and SACRAMOSO (–4.68%). The lowest difference was found in the lines ROMKE (–0.25%) and FAVORY (–0.84%).

The grey sire lines (GENERALE, GENERALISSIMUS, FAVORY, RUDOLFO and SACRAMOSO) showed a decline of the average inbreeding coefficient from –0.71% to –5.72%. Six dams of the lines SOLO (3 dams), SIGLAVY PAKRA (1 dam) and ROMKE (2 dams) showed small values of $F_{\bar{x}}$ from 0.00 to 2.12. These lines had originally been black and we can see that this is a new trend in changing the colours of lines. The breeders succeeded sooner to create a grey SACRAMOSO line in the past years. Changing colour from black to grey is much easier than the opposite due to the complete dominant allel G. The homozygotes (GG) and heterozygotes (Gg) are grey and the grey colour covers also the coloured spots on the horse body. When mating grey heterozygotes (Gg) among themselves or with recessive homozygotes (gg) there will be a proportion of recessive homozygotes (gg) which will be black, but they can show white spots obtained from the grey lines. A further complication is the base colour of grey animals which in the Old Kladrub horses can be different from the black colour (bay, brown, chestnut etc.). In order to keep the lines purely black, black horses should be mated with grey horses that have shown no spots but black colour at birth.

In the whole dam population the reduction of the average coefficient of inbreeding between 1993 to 2003 was remarkable from 1993 to 2003. Within the period of ten years the number of mares increased from 209 to 350, i.e. an increase of 141 mares (67.5%). Obviously two main reasons were responsible for this decrease of the coefficient of inbreeding. The first one was the application of circular group mating. The second one was the rapid breed growth which resulted also in an increase of the effective size.

Effective population size

According to the definition of FAO a breed is considered as:

- critically endangered if the total number of breeding females is less than 100
- endangered if the total number of breeding females is between 100 and 1000
- extinct if it is no longer possible simply to recreate its original genetic base and if most of its genetic variation has been lost.

From the number of females in the Old Kladrub breed we can see that the breed was endangered in both years (1993 – 209 mares; 2003 – 350 mares). The interval of ten years corresponds approximately to the generation interval of 10 years in the Old Kladrub horse. In the Old

Table 4. Fertility of the grey mares in the National stud at Kladruby and private studs

Year	National stud			Private studs			Total		
	Number of mated mares	Number of born foals	Fertility rate (%)	Number of mated mares	Number of born foals	Fertility rate (%)	Number of mated mares	Number of born foals	Fertility rate (%)
1995	65	44	67.69	35	18	51.43	100	62	62.00
1996	50	31	62.00	38	22	57.89	88	53	60.23
1997	59	44	**74.58**	40	25	62.50	99	69	**69.70**
1998	61	40	65.57	44	21	***47.73***	105	61	***58.10***
1999	67	48	71.64	40	26	65.00	107	74	69.16
2000	45	30	66.67	49	32	**65.31**	94	62	65.96
2001	62	41	66.13	47	29	61.70	109	70	64.22
2002	61	36	***59.02***	50	31	62.00	111	67	60.36
2003	50	35	70.00	59	35	59.32	109	70	64.22
Average	57.78	38.78	67.12	44.67	26.56	59.45	102.44	65.33	63.77

Table 5. Fertility of the black mares within the National stud at Kladruby and private studs

Year	National stud			Private studs			Total		
	Number of mated mares	Number of born foals	Fertility rate (%)	Number of mated mares	Number of born foals	Fertility rate (%)	Number of mated mares	Number of born foals	Fertility rate (%)
1995	49	32	65.30	73	51	69.86	122	83	68.03
1996	33	23	69.70	55	30	***54.55***	88	53	60.23
1997	46	33	71.74	61	46	75.41	107	79	73.83
1998	40	28	70.00	71	44	61.97	111	72	64.86
1999	37	24	64.86	62	40	64.52	99	64	64.65
2000	38	24	63.16	62	40	64.52	100	64	64.00
2001	43	28	65.12	53	41	**77.36**	96	69	71.88
2002	56	43	**76.79**	70	51	72.86	126	94	**74.60**
2003	33	16	***48.48***	**60**	36	60.00	93	52	***55.91***
Average	41.67	27.88	66.93	63	42.11	66.84	104.67	70	66.88

Table 6. Fertility of the grey and black Old Kladrub mares within the National stud at Kladruby and private studs

Year	National stud			Private studs			Total		
	Number of mated mares	Number of born foals	Fertility rate (%)	Number of mated mares	Number of born foals	Fertility rate (%)	Number of mated mares	Number of born foals	Fertility rate (%)
1995	114	76	66.67	108	69	63.89	222	145	65.32
1996	83	54	65.06	93	52	***55.91***	176	106	***60.23***
1997	105	77	**73.33**	101	71	**70.30**	206	148	**71.84**
1998	101	68	67.33	115	65	56.52	216	133	61.57
1999	104	72	69.23	102	66	64.71	206	138	66.99
2000	83	54	65.06	111	72	64.86	194	126	64.95
2001	105	69	65.71	100	70	70.00	205	139	67.80
2002	117	79	67.52	120	82	68.33	237	161	67.93
2003	83	51	***61.45***	119	71	59.66	202	122	60.40
Average	99.44	66.67	67.05	107.67	68.67	63.78	207.11	135.33	65.34

Table 7. The average heterozygosity and coefficient of inbreeding for sire lines and both varieties

Variety	Sire line	n	H	$F_{\bar{x}}$
Grey	Generalissimus	34	32.8	6.2
	Favory	14	31.0	5.7
	Rudolfo	5	25.1	0.0
	Sacramoso	20	30.2	8.4
	Total $H/F_{\bar{x}}$	73	31.2	6.3
Black	Sacramoso	25	34.9	9.5
	Solo	48	36.4	7.1
	Siglavi Pakra	15	34.3	6.8
	Romke	21	37.2	3.8
	Total $H/F_{\bar{x}}$	109	36.0	7.0
Total	Total $H/F_{\bar{x}}$	182	34.1	6.7

Table 8. Average heterozygosity at blood type, biochemical and mSat loci in the Old Kladrub breed (Hořín et al., 1998)

Variety	n	Blood type	Biochemical	Total	Total (Jakubec et al., 1996)	Microsatellite
Grey	63	0.47	0.34	0.41	0,31	0.67
Black	73	0.53	0.42	0.48	0,36	0.64
Total	136	0.50	0.38	0.44	0.34	0.65

Kladrub breed were in 1993 33 stallions and 209 mares and in 2003 39 stallions and 350 mares. We have found $N_e = 114.00$ in the year 1993 and $N_e = 140.36$ in the year 2003. The increment during the 10-year period was 26.36 animals.

The rate of inbreeding in a random mated population is

$$\Delta F = \frac{1}{8\,N_m} + \frac{1}{8\,N_f}$$

If random mating were applied, the rate of inbreeding with respect to the number of sires and dams would be 0.4386% in 1993 and 0.3562% in 2003. The change of inbreeding would be very low. For the whole population (grey and black lines) the average coefficient of inbreeding decreased in mares from the value of 7.75% to 4.88% (–2.87%) and in stallions from 5.65% to 5.52% (–0.13%).

Dam fertility

The data of the analysis of fertility in the Old Kladrub dams are shown in Tables 4–6. The data are specified according to the grey and black varieties within the National stud at Kladruby and private studs. The fertility rate of both varieties and both types of studs is 65.34% and the fertility rate values are within the span of 60.23% in 1996 and 71.84% in 1997. The lowest fertility rate of 55.91% was recognized in the private farms in 1996 and the highest fertility rate of 73.33% was found in the National stud in 1997. The difference between the lowest and highest value was 17.42%. No tendency caused by the inbreeding depression was found in the fertility rate within the period of 1995 and 2003.

Polymorfism of bloodtypes, biochemical markers and microsatellites

The average heterozygosity and coefficient of inbreeding for sire lines and both varieties are shown in Table 7. The average heterozygosity of the Old Kladrub breed was smaller than the same parameter estimated by another authors using blood type and biochemical polymorphic systems: Mayrhofer, Dworak (1983) 41.6–53.2%, Bowling (1994) 38.9–40.2%, Oom, Cothran (1994) 37.5%.

The average heterozygosity estimated by Jakubec et al. (1996) and Hořín et al. (1998) for blood type and biochemical polymorphic systems as well as microsattelite markers is specified in Table 8. Hořín et al. (1998) found higher values of the average heterozygosity (0.44) at blood type and biochemical loci than Jakubec et al. (1996) (0.34). The average heterozygosity of microsatellites (0.65) was much higher than in the blood type and biochemical loci (0.34 or 0.44, resp.). The average heterozygosity in the breed was enough large and was connected with a low coefficient of inbreeding.

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Struktura a vývoj genetického zdroje „Starokladrubský kůň“ v období od roku 1993 do 2003.

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Starokladrubský kůň je nejdůležitějším genetickým zdrojem v České republice. V současné době je plemeno členěno na pět bílých a pět vraných otcovských linií. Starokladrubský kůň je odvozen od hřebců zakladatelů, kteří poskytli názvy dnešním otcovským liniím. Plemeno se skládá z Hřebčína Kladruby nad Labem s bílou variantou a Hřebčína Slatiňany s vranou variantou a ze 100 chovatelů s oběma barevnými variantami. Většina stád je umístěna ve středních Čechách a na jižní Moravě. Struktura plemene v roce 2003: 39 plemenných hřebců a 350 plemenných klisen. Plemeno bylo uzavřeno vůči imigraci v roce 1992. Koeficient inbrídinku ($F_{\bar{x}}$) byl počítán na základě pěti rodičovských generací pro hřebce a klisny v celém plemeni, bílé a vrané variantě a v otcovských liniích uvnitř barevných variant. V letech 1993 až 2003 klesl $F_{\bar{x}}$ v plemeni pro hřebce z 5,65 % na 5,52 % a pro klisny z 7,75 % na 4,88 %. Efektivní velikost populace byla v roce 1993 N_e = 114,00 a v roce 2003 N_e = 140,36. Přírůstek v N_e za 10 let činil 26,36 jedinců. Nebyl zjištěn vliv inbrední deprese na tendenci oplození klisen v letech 1995 až 2003. Průměrná heterozygotnost odhadnutá na základě četnosti krevních skupin, biochemických markerů a mikrosatelitů byla dostatečně veliká a byla spojena s nízkým koeficientem inbrídinku.

Starokladrubský kůň; struktura a vývin; stupeň inbrídinku; efektivní velikost populace; mateřská plodnost; polymorfismus; průměrná hetezygotnost

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