

## **An attempt at objectivization the halfbred stallions' performance test in Poland. I. Eight-month test**

**Dorota Lewczuk<sup>1</sup>, Ewa Szarska<sup>2</sup>, Sławomir Pietrzak<sup>3</sup>**

<sup>1</sup> Polish Academy of Sciences Institute of Genetics and Animal Breeding,  
Jastrzębiec, 05-552 Wólka Kosowska, Poland

<sup>2</sup> Military Institute for Hygiene and Epidemiology,  
Kozielska 4, 01-163 Warsaw, Poland

<sup>3</sup> Chair of Horse Breeding and Utilization, Agricultural University of Lublin,  
Akademicka 13, 20-950 Lublin, Poland

*(Received February 18, 2004; accepted September 17, 2004)*

Investigated were the usefulness and possible objectivization of the results of stallions' 8-months performance test. No correlation was found between the total results of the test and the number of mares covered by tested stallions, suggesting that the use of stallions does not depend on the result of their 8-month test. Blood samples were analysed after the stamina trial (cross country gallop) and some parametres of free jumping were measured based on video image analyses. Moreover, an analysis of relations was done between performance test trials and investigated parametres. The correlations between evaluations of jumping traits in the performance test ranged from 0.28 to 0.65, while those between the results of jumping skills from the test and measurements based on video image analysis were weak and ranged from -0.2 to 0.3.

Blood physiological indicators showed a wide range of values. Lactic acid content was affected by individual riders and breeders and that of total protein by breeders only.

**KEY WORDS:** horse / performance testing / stallions

Over the past decade the stallions' performance tests in Poland were modified many times reflecting the changes in the goals of horse breeding. These revisions were motivated by the new requirements of sport and their influence on the directions of selection of horses. Over the past 50 years the halfbred horse was bred to be a multipurpose driving and/or riding animal. Horses were evaluated on the basis of an 11-month test and later according to their direct sport performance. The breeding goal mentioned became

obsolete around the year 1997. From then on, the carriage trial was abandoned. From 1997 to 2001 stallions were evaluated by means of a two-step selection procedure. The first step was the 100-day test and the second - the 8-month test. From the 100-day test only the best 20% of stallions were qualified for the 8-month test.

The aim of this study was to establish whether the results of stallions' performance tests were further used by breeders and whether it is possible to make them more objective. The problem seems interesting especially in the light of phenotypic correlations between a 100-day and 8-month test which were found to be moderately low and reach 0.3 [Koter and Lewczuk 1999].

The usefulness of both tests was investigated by analysing of relationships between the total results of stallions' performance tests and further use of these animals by breeders. Both tests are based on evaluation of hardly measurable traits judged according to the subjective opinion of a commission of experts. The possibility of objectivization of both tests was investigated by video-image analysis to assess the free jumping style and by applying physiological tests for assessing the benefits of training.

Considered were traits from trials that evaluate jumping, dressage and stamina skills from results of 8-month stallions' performance tests. Parametres of free jumping were compared with traits expressing jumping skill evaluated during the 8-month test. Results of physiological and biochemical tests (heart rate and blood indicators) were compared with stamina skill evaluated during the cross-country trial of this same 8-month test.

## **Material and methods**

### **Total results of performance test and the number of mares covered**

Partial correlations between stallions' total results of 8-month performance tests (8-mPTs) and the numbers of mares covered by each stallion were estimated in order to define the usefulness of these results for breeders. The results were considered of 101 stallions kept in the years 1998-2000 at the stallions' stations belonging to the following eleven State Studs: Łąck, Bogusławice, Klikowa, Kętrzyn, Białka, Starogard Gdański, Gniezno, Łobez, Książ, Sieraków. The stallions studied were tested in 8-mPTs in the years 1997 and 1998. Partial correlations were received using GLM Manova procedure from SAS programme. The analysis of variance included the effect of the successive number of reproduction season (first, second, etc.), the number of stallions' stations at which the stallion was kept in one reproduction season, as well as the number of stallions kept on the same station, on the total number of mares covered.

### **Performance test results and free jumping parametres**

Jumping skill in 8-mPT consists of traits evaluated during:

- the trial evaluated by the judges;
- the trial evaluated by independent riders - "jumpability";
- all the training period according to the trainers' opinion - jumping under the rider and free jumping.

In order to compare the coefficients of correlation between the different traits of jumping skill the Pearson's correlations were calculated between all jumping traits in the 8-mPT. Marks for free jumping given by the trainer were compared with values expected to be more objective, *i.e.* free jumping parameters measured.

The study was conducted on a group of 50 young stallions which passed their 8-mPT in year 2000. The horses were examined during the last month of training. Free jumps were filmed in a riding hall on a double bar fence standing in a corridor as part of a special jumping test for young stallions. The fence was 95, 105, 125 and 140 cm high and 80 cm wide. Digital video frames (25/s) were analysed and measured by video image analysis. The following jumping parameters were taken into account:

- take off distance;
- lifting the legs over the fence (separately for each leg);
- height of some specific points that characterize the bascule of the horse over the fence (the highest points of the head, withers and croup);
- position of the head at the highest point of the air-borne phase of the jump;
- landing distance.

A full description of the measuring method was given in an earlier paper by Lewczuk [1999].

Pearson's correlations for traits of the test were calculated by the Corr procedure of the SAS programme. Partial correlations between the measured free jumping parameters and marks for free jumping from 8-mPT were estimated with an adjustment for statistically significant effects of height of the fence and the successive number of the jump using the GLM Manova from the SAS programme.

#### **Results of performance test and heart rate and blood indicators**

Stamina skills were evaluated during the cross-country trial at the end of the 8-mPT. Marks for cross-country as the overall trial, marks for gallop evaluated additionally by the cross trial and total results of the test were taken into account. During the cross-country trial, heart rates and blood indicators were determined in 22 young stallions of three Polish halfbred groups. Heart rate was measured using the POLAR heart rate monitor, pre- and post-effort. The heart rates were assessed during a 2.5 km cross-country gallop including 10 fences at a minimum speed of 250 m/min, and then during a 500 m racing gallop with minimum speed of 700 m/min. In the third minute after finish blood samples were obtained from the jugular vein. The following parameters were measured: hematocrite (Ht), ESR after 15, 30, 45 and 60 minutes, lactic acid, total protein, creatinine phosphokinase (CPK), potassium (K), sodium (Na), phosphorus (P) and chlorides.

Haematological indicators were analysed with the use of a microhematocrite centrifuge for hematocrite (Ht) and Westergren's standers for ESR analysis. Total protein, P and CPK were determined in the blood serum with the use of ALPHA Diagnostic tests, while serum Na, K and chlorides with the the MEDICA ionic analyzers. Lactic acid was measured in the whole blood by the Accusport tests (BOEHRING). For all physi-

ological and biochemical results the analysis of variance (GLM, SAS) was performed with fixed effects of breed, horse breeder and rider. Total riding time of cross-country gallop was used as linear regression. The Pearson's correlations were calculated between stamina traits of cross-country trial and physiological indicators.

## Results and discussion

### Total results of performance test and the number of mares covered

During the years 1998-2000 the mean number of mares covered by one stallion was 16.8 (figures not tabulated). This number depended on neither the reproductive season (first and second) of year of covering, nor the number of stations on which the stallion was used in one year. A significant effect ( $P < 0.001$ ) was ascertained only for the number of stallions kept at the same station.

Pearson's correlation between the stallions' results in performance tests and the number of mares covered reached 0.08 and was not found significant. This may be caused by insufficient promotion of results of the stallions' performance test, or by the fact that performance tests do not follow the breeders requirements or expectations. This is particularly important, as it is not a new occurrence [Pikuła 1986, Geringer and Dobrowolski 1997]. The situation may also be caused by insufficient information about the stallions' skills given by the present evaluation system. Probably a more detailed information should be passed to breeders. Moreover, development of new methods may be useful as a helpful tool in the stallion's performance test.

### Results of jumping traits of 8-mPT and measured free jumping parameters

Average marks, standard deviations and extreme marks for all jumping traits evaluated in the 8-mPT for the year 2000 are presented in Table 1. The results are comparable with values reported for earlier years by Lewczuk *et al.* [2001].

The results obtained may be compared with those given by Interstallion Group responsible for international estimations of breeding value of horses. In comparable performance tests for young stallions cited by the Group, in most cases the score reached 6-7 points with standard deviations of 0.7 to 1.7 [Bruns *et al.* 2001, Koenen

**Table 1.** Means and their standard deviations (SD) for scores of evaluation of stallions' jumping traits in the 8-month test

Trait	Mean	SD	Minimum/maximum	Scoring scale
"Jumpability" (independent riders' mark)	5.9	1.0	2.5/8.9	0-10
Jumping on the course (judges' mark)	7.9	1.3	1.9/9.8	0-10
Jumping under the rider (trainer's mark)	3.6	0.5	1.9/4.7	0-5
Free jumping (trainer's mark)	3.7	0.9	1.9/4.7	0-5

Objectivization of the halfbred stallions' performance test. I. Eight-month test

and Aldridge 2001]. The results for jumping traits of Polish halfbred stallions seem, in most cases, overvalued. Comparable are only the data for "jumpability" (Tab. 1). The same conclusion was reached earlier by Pietrzak *et al.* [1999]. Extreme scores given by Polish and international judges were similar.

Free jumping parameters based on video recording are shown in Table 2. The figures presented as well as their standard deviations appear comparable with the values reported earlier by Lewczuk [1999] for another group of young halfbred stallions.

**Table 2.** Means and their standard deviations (SD) for parameters of free jumping of stallions in the 8-month performance test referring to fence height

Fence height	Jump length (cm)		Bascule (cm)			Head angle (°)	Height of legs over the fence (cm)				
	taking off	landing	head	withers	croup		front left	front right	hind left	hind right	
95 cm	mean	324.0	245.3	150.2	154.4	143.6	22.0	34.4	37.1	37.5	38.8
	SD	71.2	88.4	23.8	22.3	21.9	4.4	13.2	14.1	15.9	17.4
105 cm	mean	324.6	254.1	128.3	131.1	123.2	23.0	21.1	24.1	21.9	23.0
	SD	69.5	74.9	18.9	19.3	21.7	4.8	11.1	10.9	10.7	11.4
125 cm	mean	324.5	279.5	117.0	120.8	122.7	23.7	14.3	18.0	14.9	16.2
	SD	68.0	82.7	21.4	18.2	77.2	4.7	9.2	10.3	11.4	11.4
140 cm	mean	328.3	310.5	94.3	115.4	108.6	22.9	18.4	18.1	17.4	17.8
	SD	50.1	94.9	19.4	24.2	20.8	5.4	10.9	8.5	9.7	10.5

Pearson's correlation coefficients between traits of the jumping skills scored within the 8-mPT ranged from 0.28 to 0.65 (Tab. 3). Correlations between marks for free jumping and jumping with rider were 0.29, 0.44 and 0.56. Between marks given for

**Table 3.** Phenotypic correlations between marks for jumping traits of stallions in the 8-month test

Correlated trait	Correlation coefficient
Jumping on the course (judge's mark) - 'jumpability' (independent rider's mark)	0.28
Fine jumping (trainer's mark) - 'jumpability' (independent rider's mark)	0.29
Jumping under the rider (trainer's mark) - jumping on the course (judge's mark)	0.42
Jumping on the course (judge's mark) - fine jumping (trainer's mark)	0.44
'Jumpability' (independent rider's mark) - fine jumping (trainer's mark)	0.56
'Jumpability' (independent rider's mark) - jumping under the rider (trainer's mark)	0.43
'Jumpability' (between two independent riders)	0.43

“jumpability” by two independent riders the correlation reached 0.63. The correlation between jumping on the course (judges’ mark) and “jumpability” (independent riders’ mark) was 0.28 and seemed not high enough. Correlations between marks for the same skill – jumping – present too wide range. It seems necessary to uniform the system of evaluation of jumping skills in horses.

The partial correlation between jumping traits scores and measured jumping parameters varied from -0,2 to 0,3 (Tab. 4). The highest values were estimated between lifting the front legs above the fence and mark for work of the front legs (0.3), as well as between the landing distance and mark for willingness to jump (0.3). Negative correlations were estimated between the mark for work of the trunk and height of the head above the fence (-0.1) and work of the trunk and head position during the highest phase of the jump (-0.2). Correlations between the objectively measured free jumping parameters and subjective marks issued by trainers appeared low, but their general trend seems to be the same as practitioners’ observations [Lewczuk 1999]. The estimated correlations showed that the measured parameters may be considered as a part of the horse’s free jumping style evaluation. Some more indices should be investigated to describe the horse jump more precisely.

**Table 4.** Phenotypic correlations between the free jumping components (trainer’s marks) in the 8-month test of stallions and their jumping parameters measured by video image analysis

Correlated trait (free jumping)		Correlation coefficient
trainer’s mark	jumping parameter measured (video image)	
Mark for the work of front legs	height of front legs over the fence	0.3
Mark for the work of hind legs	height of hind legs over the fence	0.2
Mark for the work of the trunk	height of head over the fence	-0.1
Mark for the work of the trunk	height of withers over the fence	0.1
Mark for the work of the trunk	height of foretop over the fence	0.2
Mark for the work of the trunk	height of hind legs over the fence	0.2
Mark for the work of the trunk	placement of head in the bascule position	-0.2
Mark for the willingness to jump	take off distance	-0.1
Mark for the willingness to jump	landing distance	0.3
Mark for the willingness to jump	height of withers over the fence	-0.2
Mark for the willingness to jump	height of foretop over the fence	-0.1

Evaluation of jumping skills is difficult and requires a lot of experience of the judging committee. Free jumping is not the same skill as jumping with the rider and correlations between the two seem relatively low. Correlations between measurements of jumping parameters with or without a rider received in the earlier publications with video image analysis are comparable (0.35-0.59) - Lewczuk [1999].

#### Heart rate and blood indicators

The results of physiological and biochemical determinations are shown in Table 5. The widest variation appeared in lactic acid, CPK and the heart rate during the cross-

Objectivization of the halfbred stallions' performance test. I. Eight-month test

**Table 5.** Means and their standard deviations (SD) for heart rate and post-effort blood indicators in stallions in the 8-month performance test

Parameter	Mean	SD	Minimum	Maximum
HR (in rest, beats/min.)	35.24	2.5	29.0	39.0
HR minimum (beats/min.)	69.39	17.3	35.0	97.0
HR maximum (beats/min.)	148.4	31.2	115.0	215.0
HR mean (beats/min.)	110.72	23.7	68.0	147.0
SD for HR	21.12	8.9	8.6	42.3
Lactic acid (mmol/l)	6.02	1.7	3.0	9.5
ESR15 (mm)	0.05	0.2	0.0	1.0
ESR30 (mm)	2.09	4.6	0.0	20.0
ESR45 (mm)	8.41	10.3	2.0	45.0
ESR60 (mm)	17.91	14.4	5.0	65.0
Hematocrite (%)	53.27	3.5	42.0	59.0
Total protein (g/l)	79.27	4.4	71.0	86.0
P (mmol/l)	1.27	0.2	0.9	1.6
K (mmol/l)	4.25	0.3	3.8	4.7
Na (mmol/l)	138.00	1.2	136.0	140.0
CL (mmol/l)	103.68	1.0	102.0	106.0
CPK (IU/l)	323.75	82.3	232.0	390.0

**Table 6.** Means and their standard deviations (SD) for post-effort lactic acid blood content (mmol/l) in stallions on the basis of 8-month performance test across individual riders

Item	Rider 1	Rider 2	Rider 3	Rider 4	Rider 5	Rider 6	Rider 7	Rider 8
LSM	7.3 <sup>ab</sup>	4.5 <sup>cd</sup>	5.1 <sup>abc</sup>	6.0	5.8	8.5 <sup>abcd</sup>	3.9 <sup>b</sup>	6.4 <sup>c</sup>
SE	0.8	0.7	0.6	0.6	0.8	0.6	0.6	0.8

<sup>ab</sup> Means bearing the same superscripts differ significantly at: small letters - P<0.05; capital - P<0.01.

**Table 7.** Means and their standard deviations (SD) for post-effort lactic acid blood content (mmol/l) in stallions on the basis of 8-month performance test across individual breeders

Item	Breeder 1	Breeder 2	Breeder 3	Breeder 4	Breeder 5	Breeder 6	Breeder 7	Breeder 8
LSM	6.6 <sup>a</sup>	5.7 <sup>a</sup>	8.5 <sup>abc</sup>	6.5 <sup>ab</sup>	7.0 <sup>ab</sup>	3.4 <sup>cd</sup>	2.9 <sup>cd</sup>	6.5 <sup>ab</sup>
SE	0.8	0.8	0.8	0.6	0.8	0.8	1.2	0.6

<sup>ab</sup> Means bearing the same superscripts differ significantly at: small letters - P<0.05; capital - P<0.01.



**Table 8.** Means and their standard deviations (SD) for total protein blood content (mmol/l) in stallions on the basis of 8-month performance test across individual breeders

Breeder	Breeder1	Breeder2	Breeder3	Breeder4	Breeder5	Breeder6	Breeder7	Breeder8
LEM	75.1 <sup>a</sup>	74.2 <sup>a,c</sup>	78.9	84.8 <sup>a*</sup>	84.1 <sup>b,c</sup>	74.9 <sup>d</sup>	82.2 <sup>d</sup>	75.4 <sup>e</sup>
SE	3.2	2.9	3.8	2.3	3.0	2.6	3.2	1.1

<sup>a\*</sup> Means bearing the same superscripts differ significantly at: small letters -  $P \leq 0.05$ ; capitals -  $P \leq 0.01$ .

country gallop. The horses' responses to effort followed the physiological reference values [Szarska 1999], but extremely wide variation in lactic acid blood content (3.0-9.5 mmol/l) is surprising. Such wide inter-individual differences might be caused by a horse's individual ability to work or by different preparation rate of animals for the final 8-mPT. Lactic acid content of blood was found significantly affected by a rider (Tab. 6) and breeder (Tab. 7). Significant differences between breeders were ascertained also for the total protein content of blood (Tab. 8). Wide variation was also observed in ESR, CPK and post-effort heart rate. The effects mentioned may be interpreted as influences of diversity of environmental conditions under which the horses grew and/or their different abilities to adapt to training. The significant differences shown in Tables 5, 6, 7 and 8 confirm the necessity of much more detailed evaluation of the physiological status of young stallions before and during training. The effect of rider may undermine the concept of identical training for all horses, what is fundamental for the institution of training centres for young stallions as well as for performance tests. Investigation described here was made as a pilot recognition on only very limited number of animals.

It can generally be concluded that the lack of correlation between the results of 8-mPT and the number of mares covered demonstrate that breeders do not pay much attention to results of official 8-mPT. Blood analyses and heart rate examination at start and on the end of the test should solve the problem of the physiological and biochemical differentiation of horses. No correlation was ascertained between physiological or blood indicators and results of the 8-mPT showing that physiological response of the horse to training did not matter for the overall result of the test. Physiological investigations performed to provide another opportunity of making performance of young stallions more objective and precise were arranged by Catherine *et al.* [1999] and Sloet [1999]. Moreover, it may be useful to develop additional new methods which may be used as a helpful tool in the stallions' performance test.

As a general conclusion to all the problems presented here it can be claimed that the lack of correlations between the results of 8-mPT and the number of mares covered demonstrates that breeders do not pay enough attention to the results of performance tests of stallions.



New methods such as video image analysis of a jump as well as physiological tests seem to be a promising tool in evaluating the skills and training results of young halfbred stallions in 8-mPT.

#### REFERENCES

1. BRUNS E., SCHOBER M., FREDRICKSON I., 2001 – A cross-country evaluation of testing methods and data availability/suitability. Proceedings of the 52nd Annual Meeting of the EAAP, Budapest, Hungary, Book of Abstracts, p.347.
2. CATHERINE M., TYLER-McGOWAN., LARRAINE C., GOLAND, EVANS D.L., HODGSON D.R., ROSE R.J., 1999 – Haematological and biochemical responses to training and overtraining. Equine Exercise Physiology 5. *Equine Veterinary Journal* (Supplement) 30, 621-625.
3. GERINGER H., DOBROWOLSKI M., 1997 – Zależności między ocenami ogierów rasy śląskiej a intensywnością ich użytkowania rozplodowego (Relationships between results of stallions evaluation and intensity of their use for reproduction). In Polish. Summary in English *Zeszyty Naukowe AR w Szczecinie* 177, Zootechnika 35, 245-249.
4. KOENEN E.P.C., ALDRIDGE L.I., 2001 – Breeding objectives for sport horses: a review. Proceedings of the 52nd Annual Meeting of the EAAP, Budapest, Hungary, Book of Abstracts, p. 346
5. KOTER T., LEWCZUK D., 1999 – Ocena korelacji pomiędzy wynikami ogierów po teście 100-dniowym i 8-miesięcznym. (Correlation between stallions' evaluation results obtained with 100-days vs 8-months performance tests) Międzynarodowe Sympozjum "Aktualne kierunki hodowli i użytkowania koni w Europie" – Materiały. (International Symposium on Current Trends in Horse Breeding and Utilization in Europe). In Polish. Cracow, 17-19 September, Materials, pp.298-303.
6. LEWCZUK D., 1977 – Investigation on horse free jumping parameters using video image analysis. Proceedings of the 48<sup>th</sup> Annual Meeting of the EAAP, Vienna, Book of Abstracts, 391.
7. LEWCZUK D., 1999 – Komputerowa analiza obrazu jako metoda oceny użyteczności sportowej ogierów w Zakładach Treningowych (Computer image analysis as a method for evaluation the stallions sport value by Training Centres) In Polish. PhD Thesis. Institute of Genetics and Animal Breeding, Jastrzębiec.
8. LEWCZUK D., KOTER T., ŁUKASZEWICZ M., 2001 – Wstępna analiza wyników prób dzielności ogierów półkrwi (Preliminary analysis of factors influencing the results of performance testing of half-bred stallions). In Polish with English summary. *Prace i Materiały Zootechniczne* 59, 51-59.
9. PIETRZAK S., KRZYŻANOWSKI R., WOJNAROWSKI M., STRZELEC K., 1999 – Próba zastosowania testu niezależnych jeźdźców w ocenie predyspozycji sportowych krajowych 3-letnich ogierów półkrwi (An attempt at applying the independent rider test in evaluation of sport traits in three-year old halfbred stallions). Sympozjum Międzynarodowe "Aktualne kierunki hodowli i użytkowania koni w Europie". Materiały. (International Symposium on Current Trends in Horse Breeding and Utilization in Europe), Cracow, 17-19 September. Materials, pp.207-214.
10. PIKUŁA R., 1986 – Wykorzystanie wyników prób dzielności prowadzonych z zakładach treningowych (The use of results of performance tests applied in training centres). In Polish. PhD Thesis, Agricultural University of Cracow.
11. SLOET M. van OLDRUITENBORG-OSTERBAAN, WENSING TH., BARNEVELD A., BRENKINK H.J., 1999 – Standardized exercise tests and blood biochemistry. Chapter VI. Usability in the selection and training of breeding stallions.
12. SZARSKA E., 1999 – Badania laboratoryjne w treningu koni (Laboratory examinations in horse training). In Polish. Published by Agencja Reklamowa "Crex" S.C.

Dorota Lewczuk, Ewa Szarska, Sławomir Pietrzak

## Próba obiektywizacji próby dzielności ogierów półkrwi w Polsce.

### I. Test 8-miesięczny

#### Streszczenie

Tematem prezentowanej pracy było wykorzystanie i możliwość obiektywizacji wyników 8-miesięcznych prób dzielności. Nie znaleziono korelacji między wynikami próby a liczbą pokrytych klaczy, co sugeruje, że wykorzystanie ogierów nie zależy od ich wyniku uzyskanego w próbie dzielności. Analizie poddano pomiary tętna i wyniki analizy próbek krwi pobranych po próbie wysiłkowej (krosowej) oraz parametry skoków koni luzem mierzone za pomocą komputerowej analizy obrazu. Dodatkowo przeanalizowano zależności między badanymi parametrami a wynikami prób dzielności. Korelacje między skokowymi składowymi prób dzielności wyniosły od 0,28 do 0,65, podczas gdy korelacje między badanymi parametrami a wynikami skokowymi próby okazały się słabsze (od -0,2 do 0,3).

Wskaźniki fizjologiczne krwi wahały się w szerokich granicach. Zawartość kwasu mlekowego we krwi zależała od efektu jeźdźca i hodowcy, podczas gdy zawartość białka całkowitego tylko od hodowcy.