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INFLUENCE OF AGE, GENDER AND SIRE LINE ON YOUNG CATTLE BEHAVIOUR TRAITS

VPLYV VEKU, POHLAVIA A LÍNIE OTCA NA UKAZOVATELE SPRÁVANIA MLADÉHO HOVÄDZIEHO DOBYTKA

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ABSTRACT

The aim of this study was to test effects of age, gender, and sire line on dairy cattle behaviour. We have analyzed results of ethological tests for 40 Holstein breed animals (23 males and 17 females), offsprings of three sires. Maintenance behaviour were observed at the age of 90, 130 and 170 days. Behaviour in the maze was conducted at the age of 119 days, an open-field test was applied at the age of 124, 168, and 355 days. The social behaviour was determined by feeding on 155th day of the age. The times and the number of periods in all activities of maintenance behaviour were changing significantly ($P<0.001$) according to the age. The total time of lying, lying with ruminating, ruminating, feeding was increasing from the age of 90 days to the age of 170 days, on the other hand the time of standing was decreasing.

The times of total lying, lying with ruminating, total ruminating, feeding were increased, and time of standing was decreased from the age of 90 days to the age of 170 days. Calves spent more time lying on the left side than on the right side. The number of ruminating periods was increasing according to the age. Eating periods were decreasing from the age of 90 to 170 days. The most of lying periods were recorded at the age of 130 days. The differences between sex were found in total time of lying, lying on the right side ($P<0.05$), and the males rest longer and had more periods of lying than females. We have found differences in times of feeding ($P<0.001$), total lying, standing ($P<0.01$), and lying on the left side ($P<0.05$) according to sire by comparing behaviour of the calves.

Sire genotypes were significantly manifested in period number of total lying (P<0.001), lying on the right side, feeding (P<0.01), and standing (P<0.05). Males stood in the first part of maze longer than females (P<0.001), also length of total standing was longer by bulls (P<0.01). Heifers took shorter time to leave the maze than bulls (P<0.05). Sire lineages significantly differed in times of standing in the first part of maze and maze leaving. We did not find any significant differences either among sire lineage groups or between genders in locomotor behaviour measured by the number of crossed squares in open-field test. During all observations were more mobile heifers. No significant differences were found between males and females in social behaviour. The sire line influenced only the number of total duels (P<0.001). We found significant positive relationship between live body weight and time of staying in the first part of maze (r=0.3957**), time of maze leaving (r=0.3720**), and number of total and win duels (0.4031**, 0.3216*). Significant relationships were recorded in almost maintenance behaviour activities (P<0.001). Consistency of locomotor behaviour was proved only between the ages of 124 and 168 days (r=0.3177*). Significant relationship between maze behaviours and number of crossed squares were found only in ages of 119 and 124 days (r=-0.3721**; r=-0.4110**; r=-0.3994**).

Keywords: cattle, growth, behaviour, age, gender, sire

DETAILED ABSTRACT

Cieľom tejto štúdie bolo testovať vplyvy veku, pohlavia a línie otca na správanie dobytka. Analyzovali sme výsledky etologických testov u 40 zvierat plemena Holštajn (23 býčkov a 17 jalovíc), ktoré pochádzali od troch plemenníkov. Udržovacie správanie sa sledovalo vo veku 90, 130 a 170 dní. Bludiskové správanie sa hodnotilo vo veku 119 dní a open-field test sa aplikoval trikrát, vo veku 124, 168 a 355 dní. Sociálne správanie sa určovalo pri kŕmení vo veku 155 dní. Časy a počty období udržovacieho správania sa menili preukazne vekom (P<0.001) vo všetkých aktivitách. Časy celkového ležania, ležania s prežúvaním, celkového prežúvania a príjmu krmiva sa predlžovali od veku 90 do 170 dní, čas státia sa skracoval. Teľatá strávili ležaním na ľavej strane dlhší čas ako na pravej. Počet období prežúvania sa zvyšoval vekom, počet období príjmu krmiva sa znižoval od 90 do 170 dní. Najviac období ležania sa zistilo vo veku 130 dní. Rozdiely medzi pohlaviami sa zaznamenali v celkovom čase ležania a čase ležania na pravej strane a v počte období ležania a ležania na pravej strane (P<0.05), býky ležali dlhšie a mali viac období ležania. Pri porovnávaní správania teliat podľa otcov sme zistili rozdiely v čase príjmu krmiva (P<0.001), celkového ležania, státia (P<0.01) a ležania na ľavej strane (P<0.05). Genotypy otcov sa preukazne prejavili v počte období celkového ležania (P<0.001), ležania na pravej strane, príjmu krmiva (P<0.01) a státia (P<0.05). Býci stáli dlhší čas v prvej časti bludiska ako jalovice (P<0.001), tiež dĺžka celkového státia bola dlhšia u býkov (P<0.01). Jalovice prebehli bludisko za kratší čas než býky (P<0.05). Línia otca bola preukazne rozdielna v časoch státia v prvej časti bludiska a v čase prebehnutia bludiska. Nezistili sa preukazné rozdiely v pohybovom správaní meranom počtom prebehnutých štvorcov v open-field aréne medzi skupinami po

otcoch, ani medzi pohlaviami. Počas všetkých pozorovaní boli jalovice pohyblivejšie. Nezaznamenali sa preukazné rozdiely medzi býkmi a jalovicami v sociálnom správaní, línia otca ovplyvnila len počet celkových duelov (P<0.001). Zistili sme preukazné pozitívne vzťahy medzi živou hmotnosťou a časom státia v prvej časti bludiska (r=0.3957**), časom prebehnutia bludiska (r=0.3720**) a počtu celkových a víťazných duelov (0.4031**, 0.3216*). Preukazné korelácie so živou hmotnosťou sa zaznamenali u takmer všetkých aktivít udržiavacieho správania (P<0.001). Opakovateľnosť pohybového správania sa dokázala len medzi vekmi 124 a 168 dní (r=0.3177*). Preukazné vzťahy medzi ukazovateľmi bludiskového správania a počtom prekročených štvorcov sa zistili len vo vekoch 119 a 124 dní (r=-0.3721**; r=-0.4110**; r=-0.3994**). Výsledky použitých etologických testov naznačujú, že udržovacie správanie mladého dobytka je ovplyvňované vekom, pohlavím a pôvodom po otcovi. Vplyvy pohlavia a línie otca sa tiež prejavili pri riešení bludiska.

Kľúčové slová: hovädzí dobytok, správanie, vek, pohlavie, plemenník

INTRODUCTION

The use of modern housing systems needs cattle resistant to stress and able to adapt to altered conditions of environment in continuity with new procedures of dairy husbandry management (automatized feeding, robotization of milking) [5, 33, 19]. The farm animals should be kept in harmony with their physiological and safety needs and should manifest natural behavior [36, 17]. Cattle rearing methods are similar for the male and female animal, but the purpose may be quite different, because a much larger proportion of females must be retained for breeding compared with the males [54, 42, 32]. Bulls are, therefore, almost all reared for meat. Heifer calves born on a dairy farm are mostly reared for potential cow replacements rather than for meat. Heifers grow to a smaller mature size than bulls, they also mature earlier [22, 30, 48]. Healthy, productive herd replacements are the result of good management from birth until the cow enters the milking herd.

Calves spend most of their time lying when they were very young (90 % of their time at 1-5 weeks), but this need for rest decreases with age (75 % of their time at 21-25 weeks and the age of 5 months 69 %). Rumination occurred in about 80 % of the resting periods [45, 11, 19].

Quantifying behaviour is a difficult problem because it covers different aspects like fearfulness and reactions to social separation and has specific or non specific behavioural components as well [49, 40]. A number of authors have suggested that the environment and farm management could influence the behaviour of animals in a variety of ways, including their responses to potentially stressful situations [20, 3, 21, 10].

The ability of an animal to change its behavior to cope with environmental circumstances is due to learning. Farm animals must have the capacities to learn and remember [7]. The maze learning apparatus is a type of operating conditioning and

may be called instrumental learning [25]. The speed and correctness of an animal in running through various types of mazes has long been used as a measure of animal intelligence and learning ability [1]. Arave et al. [2] proved that Holstein heifers of some sires showed higher level of activity and better ability to learn in the maze.

The open field test has been used extensively to measure emotionality and consists of measuring the reactions of individual animals to a novel environment [18]. According to Burrow [16], the system of management under cattle are raised and kept has a profound effect on their temperament. This term has been of interest since the domestication of livestock. Especially cows have been selected for docility through the ages [43].

There is little evidence in the literature of relationship between open-field behaviour and learning ability. The correlation of movement in the open-field test with total error scores in the maze test was positive and significant ($r=0.45^{**}$), and similarly the locomotor behaviour correlated with learning result ($r=0.54^{**}$) [34, 35].

The genetic influences on behaviour can be clearly manifested by the study of influence of sires [31, 55]. The sire lineage influences a large part of the population so its genetic qualities are effective as a stabilization factor. The sire is effective during a relatively short period in the herd, so the complex of factors to which are exposed its daughters during rearing should not be of such variability [39, 9]. Father has significant influence on behaviour of daughters [37]. Some authors indicated that there are differences between genotypes in a cattle locomotor behaviour [8, 13]. Little information is available on the effect of gender on behaviour in unknown environment [51, 6, 11].

The aim of presented work was to test four hypotheses: a) The age, gender and sire line of cattle influences their maintenance behaviour, time of traversing the maze, locomotor behaviour in open-field tests, and competetive behaviour. b) There are relationships among live body weight and behaviours. c) The locomotor behaviour measured by a number of crossed squares at the age of 124 days is repeated at the age of 168 and 355 days. d) There exist relationships between the time of traversing the maze and number of crossed squares in the arena of open-field test.

Materials and methods

40 Holstein cattle (23 males and 17 females) offspring of 3 bulls (Sire 1, n=12; Sire 2, n=16; Sire 3, n=12) were used. The animals were kept in pens of loose housing. The experiment and all tests were made in the exact condition on the experimental farm of Animal Production Research Centre Nitra.

We conducted three observations of maintenance behaviour at the age of 90, 130 and 170 days. At intervals of 10 minutes the general activity of each of the animals were recorded, using following categories: lying (laterality on the left and right side), standing, eating, and ruminating.

The maze learning ability tests were performed in the indoor space at the age of 119 days. The 6-unit maze was constructed in the pen 16.4 x 4.5 m from 1.5 m high steel fencing covered with a black plastic sheet. Five barriers were installed inside which marked the beginning and the end of the route and also particular parts of the maze. The calves were tested individually during 2 consecutive days, four times at the each day. Total times of staying in first part of maze, staying in maze, and maze leaving were recorded for both days.

The open-field test was applied at three ages, 124, 168, and 355 days. At the first and second age were tests conducted in the inside arena 4.5 x 4.5 m marked off into 9 squares. The calves were given four 5-minute tests during 2 consecutive days. The third test was carried out in a 10 x 10 m arena. The concrete floor was also divided by white lines into 9 equal squares. Each animal was subjected to two 10 min runs. The animals were exposed to isolation and silence. The behaviour was analyzed directly from a monitor screen and checked up from video tape afterwards. The number of crossed squares during the first minute of the first test at the age of 124, 168, and 355 days was observed.

The social dominance rank was determined by recording herd mate encounters during 1 h feeding on access to limited amounts of feed (three consecutive days, from 155th to 157th day of the age). The main types of encounters recorded were threat, butt and physical combat, displace, and turn away. The social index was calculated by dividing the number of win duels by the number of total duels [52].

We used descriptive methods for mathematical evaluation and Linear model for the calculation of correlation coefficient (Pearson). The data were analyzed using a General Linear Model ANOVA (three ways with the interactions) by the statistical package STATISTIX, Version 9.0. The dependent variables were ethological parameters and the independed variables were factors of the age, gender, and the sire lineage. Values were expressed as means ± SE. The normality of data distribution was evaluated by the Wilk-Shapiro/Rankin Plot procedure. All data confirmed the normal distribution. Significant differences between groups were tested by Comparisons of Mean Ranks through Tukey's test.

Results and discussion

Maintenance behaviour

The time of maintenance behaviour was changing significantly (P<0.001) according to age in all activities (Table 1). The total time of lying, lying with ruminating, ruminating, feeding was increasing from the age of 90 days to the age of 170 days; on the other hand the time of standing was decreasing. Calves, like the young of all species, require more rest than adults [4, 19]. At the present work, calves spent longer time lying on the left side.

The number of ruminating bahaviour periods was increasing according to age (Table 2). Eating periods were decreasing from the age of 90 to 170 days (16.82±0.33, 15.22±0.29, 15.14±0.31; P<0.001). The most lying activities pariods were recorded at the age of 130 days.

Sex differences were found in total time lying and time of lying on the right side (830.00±8.66 min. vs. 807.06±11.78 min.; 398.55±7.56 min. vs. 379.02±9.28 min.; P<0.05) and numbers period of lying and lying on the right side (39.14±0.61 vs. 38.22±0.81; 19.78±0.52 vs. 18.31±0.64; P<0.05), males rest longer and had more lying bounts (Table 1 and 2). The live body weights of both genders were not different during observations.

We have found differences in times of feeding (P<0.001), total lying, standing (P<0.01), and lying on the left side (P<0.05) according to sire by comparing behaviour of the calves (Table 1). Sire genotypes were significantly manifested in number period of total lying (P<0.001), lying on the right side, feeding (P<0.01), and standing (P<0.05) (Table 2).

There were significant interactions recorded between Age*Sire in almost all variables of times and periods of maintenance behaviour. In the number period of feeding was calculated interactions between Sex*Sire (Tables 1 and 2).

An important criterion in the assessment of dairy calve welfare is their maintenance behaviour. Presented maintenance activities are used as an indication of animal comfort, and lying and standing behaviours are often used as a sign of well-being in cattle [12, 27]. The patterns of activity during a day depend on housing conditions, diet and daily lighting rhythm [46]. Changes in the time budget may reflect adaptation to specific conditions [29, 43]. However, experimental animals were kept in the same environment during the whole experiment.

Maze behaviour

The differences in the length of standing in the first part of maze apparatus and total standing for gender factor were significant. Males stood in the first part of maze longer than females (211.87±27.18 s vs. 155.00±19.35 s; P<0.001), also length of total standing was longer by bulls (366.22±49.56 s vs. 236.00±36.39 s; P<0.01).

Heifers took shorter time to run across the maze than bulls (471.41±54.34 s vs. 630.43±68.01 s, P<0.05). Sire lineages significantly differed in times of standing in the first part of maze and maze traversing (Table 3). We have recorded interactions between Sex*Sire while standing in the first part of the maze (P<0.01). The groups after different sires can react differently. It could indicate that there may be differences in their capacity for adaptation.

The behavioural differences between genders could be probably a reflection of the temperament. It would mean that the movement of the animals in the maze apparatus space reflected their agitation when placed in a threatening environment [51, 28]. This movement would be considering for exploratory behaviour. Although these animals had been raised and handled in the same conditions since an early age, individual differences clearly appeared in the reactions of young cattle to different experimental tests designed to examine fearfulness and sociabless [56]. The our results proved highly significant differences among sires in learning ability of their descendants measured by the time of leaving the maze, similarly to the work of Arave et al. [1]. The entire adaptability of the population through the sires can be important. Studies of comparative intelligence can answer some questions about the role of particular learning abilities in the survival of a species. The dairy cattle can probably be preconditioned to stressful situations. If such preconditioning to psychological stresses is to be economically achieved, farm animals must have the abilities to learn and remember.

Locomotor behaviour

The specific aim of this study was to test hypotesis that behaviour of dairy cattle is determined by the gender and sire line. At the present work, we did not find significant differences neither among sire lineage groups nor between genders in locomotor behaviour measured by the number of crossed squares during the first minute of the first open-field test (Table 3). During all observations were more mobile heifers (9.17±0.48 vs. 10.19±0.69). Also Hafez [23] and Goddard et al. [21] could show that behaviour of ruminants differed according to gender. No significant differences were recorded among observations at 124, 168, and 355 days of age (8.57±0.67; 9.62±0.57; 10.62±0.82). This may be due to a response to habituation. However, age group must have impact on behaviour. Kovalcik et al. [38] compared the behaviour of mothers and their daughters in open-field tests and they found out that the total time of motion was significantly longer in mothers.

Open-field test is the recommended method to evaluate the temperament of animals and their ability to adapt to new unknown conditions [34, 53]. Also, Burrow and Dillon [15], Micinski et al. [44] suggested that ethologists could select potentially calm animals on the basis of their temperament before entry to the unknown space to improve welfare and performance. But our results obtained during observations in the open-field test did not confirm this hypothesis. We presume that it can be applied to a full extent only on animals which were reared on pasture or in extended pens. Calves used to regular treatment, manipulation and frequent displacements are temperate

and cannot express their nature. However, most differences are not related to age or sex but some genetic basis may be tended to [56, 41].

It is also possible that the Holstein breed animals are not easy to evaluate because of their very docile temperament and discipline. As Burrow and Dillon [15] wrote, there are great differences among temperament tests, scoring systems, previous handling experience and housing locations. An open-field test developed for laboratory animals was adapted for farm animals, but, it is possible that we do not precisely distinguish the kind of motivation in cattle which is expressed by ambulant behaviour: fear, exploration or social motivation.

Social behaviour

No significant differences were found between males and females in social behaviour (Table 3). Neither live body weights (130.30±2.87 kg vs. 134.31±2.58 kg) nor ages of males and females (126.91±3.01 days vs. 133.00±3.79 days) differed during the observation. The sire line influenced number of total duels only ($P<0.001$). Cattle sired by various fathers develop differently in their patterns of competetive activities during feeding. The interaction between Sex*Sire ($P<0.01$) were calculated in social index.

One of the aims of the present study was to objectively quantify relationship between live body weight and behaviours at the observation tests, consistency over time in arena open-field behaviour, too. Therefore, cattle were of the same breed, and reared under the same, controlled housing.

Relationship between live body weight and behaviour

We found out highly significant positive relationship between live body weight and behaviour during learning test - time of staying in the first part of maze (r=0.3957**), and time of maze leaving (r=0.3720**) (Table 4). No significant correlations were found between body weight and open-field test. Significantly and positive correlated with live body weight also competetive behaviours, number of total and win duels (0.4031**, 0.3216*). Very highly significant positive relationships were recorded in almost maintenance behaviour activities ($P<0.001$), only total time of standing and number of standing periods were negative (-0.5292***, -0.5493***) (Table 4).

Consistency of locomotor behaviour over time

Stability over time between number of crossed squares at the ages of 124 and 168 days was proved by significant correlation across individual calves (r=0.3177*). Positive correlation across ages suggested that repeatability of locomotor behaviour in the open-field test exists also 6 weeks later. Similar findings were mentioned also by Jensen et al. [26] during the evaluation of the number of entered squares in calves 2 and 10 weeks old (r=0.40***). We presume that the shorter the period between observations, the higher the repeatability. Although the environment was not totally unknown to our animals, the arena was bigger at the age of 355 days. The results of

Passillé [50] suggest this as well. May be, the individual differences in nervousness are stable with age. Dellmeier et al. [20] noted that, when calves were repeatedly tested over several weeks, the amount of running and jumping increased, which they concluded was a response to the novelty of the open-field.

Relationship between the maze and locomotor behaviour

Connection of behavioural traits has been also calculated. Significant relationships between maze leaving times and locomotor behaviour in the open-field test (r=-0.3721**; r=-0.4110**; r=-0.3994**) were found mostly when the sequence of observations followed after a week long pause (ages of 119 and 124 days) (Table 5). The problem lies probably in a suitable method of testing, because temperament is mostly determined as the animal's flight speed or the restraint test.

The relationship between this behaviour changed as the cattle aged. Significant relationship were found only between times acrossing the maze at the age of 119 days and locomotor behaviour measured by the number of crossed squares one week after the maze observation (age of 124 days). However, long-term consistency was not demonstrated, primarily due to age efects. During the long period between 124th and 355th days, the animals were obviously influenced by many effects of environment as well as by body development and sexual maturity. As Munksgaard and Jensen [47] wrote, behavioural responses in the open-field arena are typically interpreted in terms of fear and exploration. It is possible that dominant motivation has fundamentally changed from fear to exploration; therefore, there cannot be a significant relationship between the learning ability at the age of 119 days and locomotor behaviour at the age of 355 days.

Correlation coefficients were negative (r=-0.3721**; r=-0.4110**; r=-0.3994**), which indicates that calves that resolved the maze faster were more lively in the open-field test. This could suggest that animals that are more lively [14] with worse, poor or bad temperament have a higher learning capacity in the maze and may be suitable for modern systems of management. This offends to a generally presented opinion that individuals which orientates themselves quickly and behave calm during the open-field tests tests will react calmly in other non-model situations which arise during their life.

The open-field behaviour resulted from two factors: their level of general activity and their disturbance in response to novelty [51, 50]. But there is a certain risk of subjectivity. Although a subjective method to measure animal reactions may provide information on the individual responses, objective behavioural tests would facilitate the comparison of individuals in a standardised way [51, 25, 24]. However, it is possible that some tests that identify particular aspects of animal behaviour also have favourable correlations with other behavioural aspects.

Learning ability is of special interest for today. This form of associative learning in which several successive responses are associated with a reinforcer is involved in learning how to get from one place to another. Farm animals readily learn their way

around the area available to them on farms so it is to be expected that they can learn to run mazes [24, 36, 19]. Dairy cattle must learn to cope with environments vastly different from the habitats to which their ancestors were adapted. Floors, partitions, noises, overcrowding, light, food and bedding are just a few of the unnatural environmental conditions imposed by domestication.

Conclusions

The results of used ethological tests indicated that maintenance behaviours of young dairy cattle are affected by the age, gender, and sire. Effects of gender and sire lineage were also manifested at the solving of maze path.

Further studies are recommended to understand the dairy cattle behaviour. In addition, the study of learning can be used as a new approach to investigate the processes of handling in progressed management.

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Table 1 Times of maintenance behaviour (minutes)
Tabuľka 1 Časy udržiavacieho správania (minúty)

Variable Premenná	`x	SE	F value F hodnota Age Vek	Sex Pohlavie	Sire Otec
Total lying Ležanie celkom	820.25	7.11	0.0000***	0.0466*	0.0012**
Lying on the left side Ležanie na ľavej strane	433.50	5.57	0.0004***	NS	0.0361*
Lying on the right side Ležanie na pravej strane	390.25	5.91	0.0000***	0.0257*	NS
Lying on the left side while ruminating Ležanie na ľavej strane s prežúvaním	233.25	5.44	0.0000***	NS	NS
Lying on the right side while ruminating Ležanie na pravej strane s prežúvaním	156.83	4.34	0.0000***	NS	NS
Lying with rumination Ležanie s prežúvaním	390.08	8.05	0.0000***	NS	NS
Total rumination Prežúvanie celkom	415.42	8.74	0.0000***	NS	NS
Total standing Státie celkom	609.08	6.91	0.0000***	NS	0.0013**
Total feeding Žranie celkom	333.08	5.93	0.0000***	NS	0.0000***

N = 120, SE = standard error of mean; NS = non significant
SE = štandardná chyba priemeru; NS = nie je preukazné
*P<0.05; **P<0.01; ***P<0.001
Interactions:
Interakcie:
Total lying - Age*Sire = 0.0002***
Ležanie celkom - Vek*Otec = 0.0002***
Lying on the right side - Age*Sire = 0.0002***
Ležanie na pravej strane - Vek*Otec = 0.0002***
Lying on the left side while ruminating - Age*Sire = 0.0074*
Ležanie na ľavej strane s prežúvaním - Vek*Otec = 0.0074*
Lying on the right side while ruminating - Age*Sire = 0.0003***
Ležanie na pravej strane s prežúvaním - Vek*Otec = 0.0003***
Lying while ruminating - Age*Sire = 0.0000***
Ležanie s prežúvaním - Vek*Otec = 0.0000***
Total rumination - Age*Sire = 0.0004***
Prežúvanie celkom - Vek*Otec = 0.0004***
Total feeding - Age*Sire = 0.0064**
Žranie celkom - Vek*Otec = 0.0064**

Table 2 Number of periods of maintenance behaviour
Tabuľka 2 Počet períód udržiavacieho správania

Variable Premenná	`x	SE	F value F hodnota Age Vek	Sex Pohlavie	Sire Otec
Total lying Ležanie celkom	38.75	0.49	0.0000***	0.0362*	0.0000***
Lying on the left side Ležanie na ľavej strane	19.61	0.29	0.0044**	NS	NS
Lying on the right side Ležanie na pravej strane	19.16	0.41	0.0000***	0.0023**	0.0059**
Lying on the left side while ruminating Ležanie na ľavej strane s prežúvaním	7.97	0.17	0.0000***	NS	NS
Lying on the right side while ruminating Ležanie na pravej strane s prežúvaním	6.61	0.16	0.0000***	NS	NS
Lying while ruminating Ležanie s prežúvaním	14.57	0.26	0.0000***	NS	NS
Total rumination Prežúvanie celkom	16.99	0.33	0.0000***	NS	NS
Total standing Státie celkom	37.17	0.77	0.0000***	NS	0.0124*
Total feeding Žranie celkom	15.73	0.21	0.0004***	NS	0.0030**

N = 120; SE = standard error of mean; NS = non significant
SE = štandardná chyba priemeru; NS = nie je preukazné
*P<0.05; **P<0.01; ***P<0.001
Interactions:
Interakcie:
Total lying - Age*Sire = 0.0000***
Ležanie celkom - Vek*Otec = 0.0000***
Lying on the right side - Age*Sire = 0.0000***
Ležanie na pravej strane - Vek*Otec = 0.0000***
Lying on the right side while ruminating - Age*Sire = 0.0003***
Ležanie na pravej strane s prežúvaním - Vek*Otec = 0.0003***
Lying while ruminating - Age*Sire = 0.0003***
Ležanie s prežúvaním - Vek*Otec = 0.0003***
Total rumination - Age*Sire = 0.0073**
Prežúvanie celkom - Vek*Otec = 0.0073**
Total standing - Age*Sire = 0.0294*
Státie celkom - Vek*Otec = 0.0294*
Total feeding - Sex*Sire = 0.0438*
Žranie celkom - Pohlavie*Otec = 0.0438*

Table 3 Learning, locomotor and social behaviours
Tabuľka 3 Učenie, pohybové a sociálne správanie

Variable Premenná	N	`x	SE	F value F hodnota		
				Age Vek	Sex Pohlavie	Sire Otec
Time of staying in first part of maze (s) Čas státia v prvej časti bludiska	40	187.70	17.78		0.0001***	0.0000***
Total time of staying in maze (s) Celkový čas státia v bludisku	40	310.88	32.84		0.0083**	NS
Total time of maze leaving (s) Celkový čas prebehnutia bludiska	40	562.85	45.81		0.0064**	0.0027**
Number of crossed squares during the 1st minute of the 1st test at the all ages Počet prekročených štvorcov v 1. minúte prvého testu vo všetkých vekoch	120	9.61	0.40	NS	NS	NS
Social index Sociálny index	40	0.47	0.03		NS	NS

N = 40, SE = standard error of mean; NS = non significant
SE = štandardná chyba priemeru; NS = nie je preukazné
**P<0.01; ***P<0.001
Interactions:
Interakcie:
Time of staying in first part of maze - Sex*Sire = 0.0031**
Čas státia v prvej časti bludiska - Pohlavie*Otec = 0.0031**
Social index - Sex*Sire = 0.0049**
Sociálny index - Pohlavie*Otec = 0.0049**

Table 4 Correlations between live body weight at the test and ethological parameters
Tabuľka 4 Korelácie medzi živou hmotnosťou a etologickými parametrami

Variable Premenná	N	R	Variable Premenná	N	R
Time of staying in first part of maze Čas státia v prvej časti bludiska	40	0.3957**	Lying while ruminating Ležanie s prežúvaním	120	0.6018***
			Total ruminating Prežúvanie celkom	120	0.5629***
Total time of maze leaving Celkový čas prebehnutia bludiska	40	0.3720**	Total standing Státie celkom	120	-0.5292***
Number of total duels Počet celkových duelov	40	0.4031**	Periods of lying Periódy ležania	120	0.4202***
Number of win duels Počet víťazných duelov	40	0.3216*	Periods of lying on the left side Periódy ležania na ľavej strane	120	0.2978***
Total lying Ležanie celkom	120	0.6502***	Periods of lying on the left side while ruminating Periódy ležania na ľavej strane s prežúvaním	120	0.5133***
Lying on the left side Ležanie na ľavej strane	120	0.3132***	Periods of lying on the right side while ruminating Periódy ležania na pravej strane s prežúvaním	120	0.3637***
Lying on the right side Ležanie na pravej strane	120	0.4325***	Periods of lying while ruminating Periódy ležania s prežúvaním	120	0.5570***
Lying on the left side while ruminating Ležanie na ľavej strane s prežúvaním	120	0.6177***	Periods of ruminating Periódy prežúvania	120	0.5033***
Lying on the right side while ruminating Ležanie na pravej strane s prežúvaním	120	0.3419***	Periods of standing Periódy státia	120	-0.5493***

R = coefficient of correlation; NS = non significant
R = korelačný koeficient; NS = nie je preukazné
*P<0.05; **P<0.01; ***P<0.001

Table 5 Correlations between maze and open-field behaviour
Tabuľka 5 Korelácie medzi správaním v bludisku a open-field teste

Variable Premenná	Numbers of crossed squares during the 1st minute of the 1st test at the age Počet prekročených štvorcov v 1. minúte prvého testu vo veku		
	124 days 124 dní	168 days 168 dní	355 days 355 dní
Time of staying in first part of maze Čas státia v prvej časti bludiska	-0.3721**	-0.3581*	NS
Total time of staying in maze Celkový čas státia v bludisku	-0.4110**	NS	NS
Total time of maze leaving Celkový čas prebehnutia bludiska	-0.3994**	NS	NS
Number of crossed squares during the 1st minute of the 1st test at the age 124 days Počet prekročených štvorcov v 1. minúte prvého testu vo veku 124 dní		0.3177*	-0.3320*

N = 40; NS = non significant
NS = nie je preukazné
*P<0.05; **P<0.01