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## **Duration of gestational length of mares from the East Bulgarian breed and the influence of some factors on it**

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### **Abstract**

A study on the breeding age of mares, the duration of gestational length, and the influence of selected factors was conducted in mares of the East Bulgarian horse breed. The data used in the study was obtained from the breeding registers and mating records of mares reared at the State Stud Farm Kabiuk near Shumen and covered a long-term period of breeding activity. The analysis included data from 24 mares with a total of 74 registered pregnancies. The average gestational length in mares of the East Bulgarian breed was  $333.8 \pm 3.50$  days. The results showed that the age of the mare had a highly significant effect on gestational length ( $p < 0.001$ ), while line affiliation also exerted a statistically significant influence ( $p < 0.01$ ). Mares from the middle reproductive age group showed a tendency toward shorter gestational periods, while younger mares had slightly longer values and older mares demonstrated similar durations with increased variability. Significant differences in gestational length were observed among the different breeding lines within the population. In contrast, the season of conception and family affiliation did not show a statistically reliable effect on the duration of gestation. These findings indicate that variation in gestational length in the East Bulgarian horse breed is mainly determined by age-related and genetic factors rather than the environmental conditions.

**Keywords:** breeding age, East Bulgarian breed, gestational length, mares, reproductive performance, warmblood horses

### **INTRODUCTION**

Gestational length represents the period from fertilization of the ovum to the birth of the offspring and is one of the main indicators characterizing reproductive capacity of farm animals. This period is marked by considerable variability, which results from the interaction between hereditary and non-genetic factors. The duration of gestation is influenced by animal species and breed, the age and physiological status of the dam, the gender and number of offspring, the season of conception, nutrition, and housing conditions (Parvanov et al., 1999; Winter et al., 2007; Nikolov, 2008; da Silva et al., 2021).

In mares, gestation usually lasts about 11 months; however, according to literature data, substantial variation is possible, ranging broadly

from approximately 310 to more than 380 days. This variability is often regarded as an individual characteristic expressed within the breed and strongly influenced by environmental conditions (Karaivanov & Barzev, 1994; Milojević et al., 2020). Contemporary studies on sport horse breeds confirm that, although breed-related differences exist, gestational length is also largely determined by paratype factors (Valera et al., 2006; Christmann et al., 2017; Cardona-García et al., 2024).

Differences have been established among the main types of horse breeds, with cold-blooded horses generally exhibiting a longer gestational period compared to warmblood and sport breeds. According to the literature, gestation in cold-blooded breeds most often lasts approximately 330–340 days, whereas in warmblood and sport breeds the range is

broader and varies depending on the breed and management conditions (Parvanov et al., 1999; da Silva et al., 2021).

The season of conception is among the most frequently discussed factors. Pregnancies initiated during the winter and early spring months are usually longer compared to those beginning in late spring and summer. Differences due to seasons may reach approximately one week and are associated with photoperiodic regulation of reproductive function and climatic conditions (Parvanov et al., 1999; Morel et al., 2002; Moraes et al., 2021).

The age of mares influences the duration of the gestational period, with the most stable and biologically optimal values observed in animals of middle reproductive age. For younger and older mares, a greater variability in gestational length is recorded, along with a tendency toward prolongation of the gestation period, which can be explained by developmental characteristics and age-related changes in the reproductive system (Satue et al., 2011; Fawcett et al., 2021).

The gender of the offspring is among the factors most frequently associated with differences in gestational length. Most authors report a longer gestation period for male offspring compared to females, with the difference usually amounting to several days and being observed across various horse breeds (Marteniuk et al., 1998; Taveira et al., 2007; Milojević et al., 2020). In addition, some studies report an effect of sire origin, particularly in selected sport horse breeds (Morel et al., 2002; Christmann et al., 2017).

Many authors have investigated the influence of the season and month of foaling on various reproductive traits. It has been established that foals born at the beginning of the calendar year are generally the result of a shorter gestation compared to those born during the spring months, which further emphasizes the importance of seasonal factors (Morel et al., 2002; Milojević et al., 2020).

In Bulgaria, a number of authors have investigated reproductive traits in different horse breeds, including the East Bulgarian breed, and have reported breed-related and seasonal differences in fertility and gestational length (Dobrev, 1981; Tsankov, 1987; Vasilev, 1997; Karadzhov, 1997; Sabeva, 1998). Nevertheless, changes in climatic conditions, breeding programs, and herd management practices necessitate contemporary studies aimed at evaluating the influence of some factors on gestational length and breeding age in mares of the East Bulgarian breed (da Silva et al., 2021; Cardona-García et al., 2024). Despite the available literature, information regarding the influence of these factors on gestational length in mares of the East Bulgarian breed remains limited and requires further investigation under contemporary breeding conditions.

The aim of the present study was to investigate the duration of gestation in mares of the East Bulgarian breed and to assess the influence of selected factors such as age group of the mare, season of foaling, and genetic affiliation.

## MATERIALS AND METHODS

The subject of the present study was mares of the East Bulgarian horse breed reared at the State Stud Farm Kabiuk, located near the town of Shumen. Data on the breeding activity of the mares were obtained from the stud farm breeding books and mating records, and records for all mares used for breeding during the examined ten-year period were analyzed.

The trait studied was gestational length, defined as the period from the date of conception to the date of foaling. The date of conception was considered to be the last recorded mating date of the mare. The analysis included data from a total of 24 mares with 74 registered pregnancies.

To process the data and evaluate the influence of individual factors on gestational

length, a multifactorial analysis of variance was applied. Linear models of the following form were used:

$$Y_{ijkl} = \mu + SZ_i + AG_k + SA_l + e_{ijkl} \text{ (M1);}$$

$$Y_{ijk} = \mu + SZ_i + AG_k + SSm_{eijk} \text{ (M2);}$$

where:  $Y_{ijklm}$  – observed value;  $\mu$  – overall mean constant;  $SZ_i$ ,  $AG_k$ ,  $SA_l$  and  $SSm$  are fixed effect of the season of fertilization ( $i = 4$ : spring – March to May; summer – June to August; autumn – September to November; winter – December to February); effect of the age group of the mare ( $k = 3$ : 1 – 3 to 6 years; 2 – 7 to 13 years; 3 – 14 to 23 years); effect of sire’s line ( $l=13$ ); effect of family affiliation ( $m=10$ );  $e_{ijk..}$  – residual error.

All statistical analyses were performed using SPSS (IBM, v. 21.0).

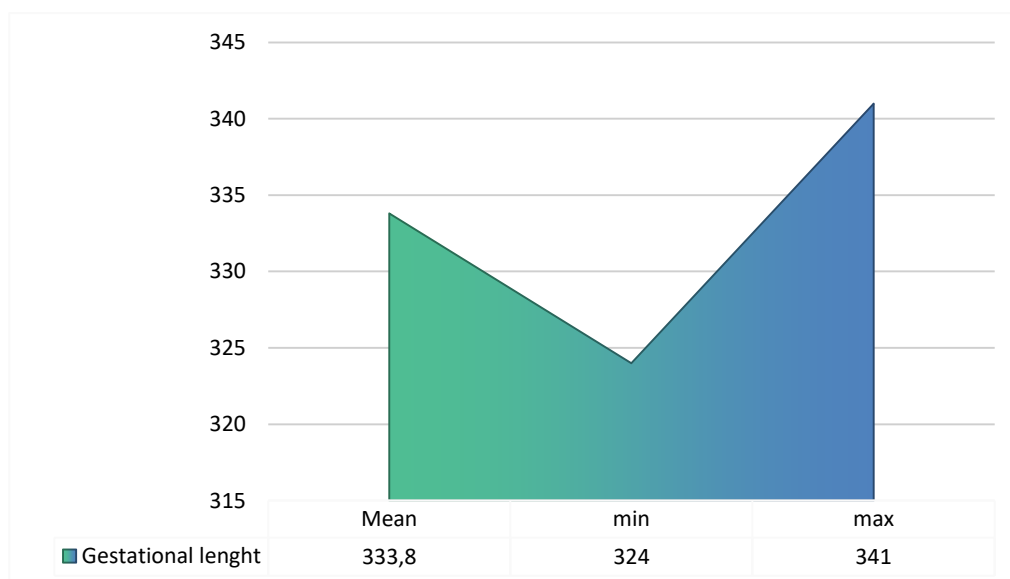
## RESULTS AND DISCUSSION

The results of the present study show that the average gestational length in mares of the East Bulgarian breed is  $333.8 \pm 3.50$  days (Figure 1). This value falls within the range reported in the literature for warmblood and sport horse breeds, in which the average gestational length most commonly varies between 330 and 345 days (Milojević et al.,

2020; da Silva et al., 2021). This indicates that the East Bulgarian breed is characterized by a gestational period comparable to that of other selected sport horse populations.

The multifactorial analysis of variance showed that the season of fertilization and family affiliation did not exert a statistically significant effect on gestational length in the studied mares (Table 1). Similar results have been reported in other sport horse breeds, in which the influence of seasonal factors on gestational length is weak or not statistically significant, particularly in herds maintained under homogeneous management and feeding conditions (Christmann et al., 2017; Cardona-García et al., 2024).

In contrast, the age of the mare ( $p < 0.001$ ) and line affiliation ( $p < 0.01$ ) had a statistically significant effect on gestational length in East Bulgarian mares (Table 1). Data presented in Table 2 show that the longest mean gestational length was observed in mares aged 3 to 6 years ( $336 \pm 3.01$  days), whereas slightly lower values were recorded in mares of the middle age group (7–13 years), with a mean value of  $333.1 \pm 2.93$  days. In mares aged 14 to 23 years, the mean gestational length was  $333.0 \pm 3.49$  days, representing an intermediate position close to that of the middle-aged group.



**Figure 1.** Mean gestational length in mares of the East Bulgarian breed (days).

**Table 1.** Effect of season of fertilization, age group of the mare, sire line, and family affiliation on gestational length, F-values and levels of significance.

Factor	M1		M2	
	df	F-value	df	F-value
Seson	3	0.853	3	1.601
Age group	2	<b>10.745***</b>	2	<b>3.125*</b>
Sire's line	8	<b>3.343**</b>	-	-
Family	-	-	7	0.628

Legend: Asterisks indicate statistical significance \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

**Table 2.** Gestational length at different ages in mares of the East Bulgarian breed (days).

Age group	N	LS $\pm$ SD	Minimum	Maximum
from 3-6 y.o.	24	336 $\pm$ 3.01	330	341
from 7-13 y.o.	35	333.1 $\pm$ 2.93	328	339
14-23 y.o.	15	333 $\pm$ 3.49	327	340

The observed pattern suggests a tendency for mares of middle reproductive age to exhibit a somewhat shorter gestational period, while younger mares showed a slight prolongation. In older animals, gestational length remained comparable to that of the middle-aged group but was accompanied by greater variability. Similar age-related patterns were reported by Satue et al. (2011) about the Carthusian breed, where mares aged 8–12 years exhibited gestation periods that were on average 5.3 days shorter ( $p < 0.05$ ) than those of mares aged 13–17 years. Comparable results have also been reported in sport horse breeds by Milojević et al. (2020) who demonstrated that the Thoroughbred mares the shortest gestational length occurs in animals of middle age, while Fawcett et al. (2021) reported increased variability and reduced reproductive efficiency in older mares.

Taken together, these findings are consistent with the concept that the middle age group may represent a biologically favourable period with respect to gestational regulation, although the differences observed in the present study were relatively small.

Line affiliation also exerted a statistically significant effect on gestational length ( $p < 0.01$ ) (Table 1). Data presented in Table 3 reveal substantial differences among the individual breeding lines.

The shortest mean gestational length was observed in mares belonging to the Laudon sire line (328.67  $\pm$  4.04 days), with values ranging from 324 to 331 days, whereas the longest gestation was recorded in mares from the Aistantser sire line (335.75  $\pm$  2.22 days), with a range of 333 to 338 days.

**Table 3.** Gestational length according to the sire line in mares of the East Bulgarian breed (days)

Sire's line	N	LS $\pm$ SD	Minimum	Maximum
Laudon	3	328.67 $\pm$ 4.04	324	331
Tihani	12	334.25 $\pm$ 3.17	331	339
Zenger	6	332.17 $\pm$ 1.72	330	335
Vustershir	21	334.81 $\pm$ 4.12	328	341
Edelknabe	10	333.2 $\pm$ 3.55	327	337
Gladiator	9	334.67 $\pm$ 3.08	331	339
Aistantser	4	335.75 $\pm$ 2.22	333	338
Cottage Son	4	331.75 $\pm$ 2.06	330	334
Gagne Si Peu	4	333.5 $\pm$ 2.38	332	337

Values close to the breed average data were found in mares from the Edelknabe ( $333.2 \pm 3.55$  days) and Gagne Si Peu ( $333.5 \pm 2.38$  days) lines, as well as in the Vustershir and Gladiator lines, in which the mean gestational length was slightly above the breed average.

Similar differences among breeding lines have been reported in other sport horse breeds, and line affiliation is generally considered to reflect the indirect influence of the sire genotype and inherited factors associated with the rate of intrauterine fetal development (Christmann et al., 2017; Cardona-García et al., 2024). The lack of a statistically significant effect of the family in the present study is likely due to the smaller number of observations within individual families and the relatively homogeneous genetic structure of the studied population, which is consistent with data reported in the contemporary literature (da Silva et al., 2021).

## CONCLUSIONS

The present study contributes to the updating of data on gestational length and the influence of some factors in mares of the East Bulgarian breed. It was estimated that the average gestational length is comparable to that reported for other warmblood and sport horse breeds, with the age of the mares and line affiliation being the main sources of variation in this trait. The obtained results have practical relevance for breeding practice, emphasizing the importance of using mares in optimal reproductive age and considering line affiliation when planning matings and predicting foaling dates. Future studies including a larger number of animals and additional factors are recommended, as they would allow a more comprehensive assessment of the reproductive characteristics of the East Bulgarian horse breed.

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