CHAPTER «AGRICULTURAL SCIENCES»

INFLUENCE OF THE TYPE OF NERVOUS ACTIVITY ON THE MILK PRODUCTION OF COWS

Lina Karlova[1]
Olena Lesnovska[2]
Roman Mylostyvyi[3]

DOI: https://doi.org/10.30525/978-9934-26-001-8-3-9

Abstract. The aim of the research was to evaluate the influence of the type of the nervous system on the productive and reproductive qualities of animals. The type of nervous system (strong, weak) of cows of the Ukrainian red dairy breed was determined by the index of the nervous system, which is based on the variability of the fat content in the morning milk yield after changing the conditions of cows keeping. Under the new conditions of keeping cows with a strong type of nervous activity, the coefficients of variability of the morning milk yield and the fat content in milk practically remained at the same level (their slight increase was noted at the level of 4.5 and 3.1%). In cows of a weak type under similar conditions of keeping, a significant increase in the variability of milk yield (by 53.6%) and fat content in milk (by 266.7%) was found. In animals of both types, in the first days of summer-camp keeping, in comparison with winter-stall keeping, there was an increase in milk yield and a decrease in fat content in milk. In cows of the strong type, the fat content decreased by 0.08% and of the weak type by 0.12%. The average index of the nervous system type in animals of the strong type is 1.18, and in cows of the weak type 2.71 ($P > 0.999$). Before

[1] Candidate of Agricultural Sciences, Associate Professor
of the Department of Animal Feeding and Breeding Technology,
Dnieper State Agrarian and Economic University, Ukraine.
[2] Candidate of Agricultural Sciences,
Associate Professor, Department of Livestock Production Technology,
Dnieper State Agrarian and Economic University, Ukraine.
[3] Candidate of Veterinary Sciences, Associate Professor
of the Department of Animal Production Processing Technology,
Dnieper State Agrarian and Economic University, Ukraine.

and during milking, the pulse rate in the cows of weak type was higher by 8.0 and 10.8 beats / min. ($P > 0.999$), compared with the strong type. The animals of strong type of the nervous system, in comparison with the weak type, had a smaller thickness of the concha and skin, a higher pulse and respiratory rate, and a lower rectal body temperature. In cows of a strong type of the nervous system in postnatal ontogenesis, the formation of productive traits took place more rapidly and they better adapted to the conditions of the external environment. This is evidenced by their high coefficient of relative decline in the growth at the age of one (85.0) than in animals with a weak type of nervous system (78.5). The advantage of cows with a strong type of nervous activity over a weak one in milk yield was 348 kg ($P > 0.95$) and in milk fat 8.0 kg. The service period in animals with a strong type of nervous activity was 6.3 days shorter. The animals with a strong type of nervous activity during the first lactation had a higher adaptation index compared with animals of a weak type. The difference for this indicator is 0.49 (or 3.7%). They also had a higher productivity index for the first (3.1%) and second (4.0%) lactation. Thus, the typological features of the nervous activity of cows affect the formation of the most important functions of the body, which can be used in breeding work to improve the herd.

1. Introduction

To improve economically useful characteristics of animals, it is important to select rational breeds, as well as to create intra-breed types of animals capable of high productivity in the conditions of industrial milk production technology [1, p. 66; 2, p. 169; 3, p. 97]. Each breed is characterized by its inherent biological and selection-genetic characteristics, which can be constantly improved through a continuous selection process [4, p. 29].

An important property of an organism that ensures its existence is the nature of its reaction to environmental factors [5, p. 97; 6, p. 172]. The integrity of the organism and its connection with the environment is carried out through the nervous system. Therefore, it is important for dairy cattle breeding to identify the relationship between the types of nervous activity and the economic and biological characteristics of animals, taking into account their breed [7, p. 26].

The type of nervous system predetermines a certain level of resistance to stress, on which the success of animal breeding depends on constantly

growing intensive use. It was proved [8, p. 61; 9, p. 299] that animals with a strong type of nervous system had higher adaptive, protective and compensatory capabilities of the organism. That is, the assessment of livestock by types of nervous activity makes it possible to predict future productivity and identify promising animals for breeding earlier and more accurately than assessing only by productivity.

Cows with a high level of stress resistance surpassed their peers with an average type of stress resistance in terms of milk yield and the amount of milk fat by an average of 11.0%, and with a low type of stress resistance –by 24.0% [10, p. 137]. The sensitivity of cows to factors stimulating milk flow was found [11, p. 286], as well as a direct dependence of the motor and secretory activity of the mammary gland on the duration of pre-milking stimulation of the udder. In particular [12, p. 87], the highest productivity and the rate of milk flow were observed in cows with a strong balanced mobile type of higher nervous activity. Animals with high resistance to stress milked twice as fast as animals with low stress resistance, having a higher milk flow rate by 1.4 kg / min ($P < 0.001$) [13, p. 466]. It was also reported [14, p. 526] that stress tolerant cows had less lead, cadmium, zinc and nitrate in milk.

The introduction of intensive technologies for the production of milk puts a great strain on the body of animals and, above all, on their nervous system. This leaves an imprint on the regularity and usefulness of reproductive functions and, ultimately, on the health and duration of the economic use of animals [2, p. 169; 15, p. 18]. In particular, the quality of semen depended on the level of stress resistance of bulls: culling of unusable semen among low-stress bulls was higher in the first year of breeding use, that is, by 22.2%; in the second year by 12.9% and in the third year by 24.2% [16, p. 493]. In cows with high stress tolerance, the duration of the service period was shorter in comparison with low stress tolerance. The strong type of nervous activity was characterized by early detection of readiness of cows for physiological use after calving and a better manifestation of reproductive qualities, and therefore, under the same conditions, breeding animals with a strong type of nervous activity is more economically expedient [17, p. 76; 18, p. 136; 19, p. 149].

So, the complex of traditional breeding traits must be supplemented with selection according to the type of higher nervous activity, which will

contribute to a more efficient and accelerated creation of herds that would combine the type of nervous processes with a high level of milk yield, harmonious constitution, high adaptability and good reproductive qualities.

The aim of the research was to evaluate the influence of the type of the nervous system on the productive and reproductive qualities of animals. The study of these issues is of great importance for the assessment and selection of animals when completing dairy herds. Their solution will contribute to more efficient production of products.

2. Research methodology

The studies were carried out in the conditions of LLC Beef factory Lyubomyrovka, Verkhnedneprovsky district, Dnepropetrovsk region.

When choosing a technique for determining the typological characteristics of higher nervous activity, we were guided by the following. The classic methods, most specific for dairy cattle, include mobile food technique. However, the long duration of the definition of types using this technique makes it inaccessible in a production environment.

Therefore, in our studies, the type of nervous system (strong, weak) in cows of the Ukrainian red dairy breed was determined with use of the index (INS) developed by I.M. Panasyuk [8, p. 61], which is based on the ratio of the variability of the fat content in the morning milk yield after changing the conditions of keeping cows to the indicator of its variability to changes in the conditions of keeping. In practical conditions of the farm, this technique is simple and does not require additional costs.

$$INS = Cv_2 : Cv_1, \quad (1)$$

where Cv_2 – is the coefficient of variability of the fat content in the one-time morning milk yield in the first 5 days in the changed conditions of keeping;

Cv_1 – is the coefficient of variability of fat content in a single morning milk yield in the last 5 days of long-term keeping (background indicator).

With an index value of less than 2, cows were assigned to the strong type, with a value of more than 2 – to the weak type. When distributing animals according to the strength of nervous processes, indicators of milk yield variability were also taken into account.

Productivity and reproductive ability were studied using the primary pedigree documentation of the zootechnical registration in the farm.

To assess the fertility of cows of different types of nervous activity, their productivity was taken into account according to the formula [1, p. 66]:

$$\text{Kp} = \frac{Ay}{(Sm : g) \times (Kg - 60 \times Nl)}, \quad (2)$$

where Kp is the coefficient of productive use of cows; Ay is the actual milk yield for all milking days of all recorded lactations (kg); Sm is the sum of milk production for all lactation (for 305 days or reduced lactations, kg); g is the number of these days; Kg is the number of calendar days from the date of the first calving to the date of the last period of holding up, Nl is the number of lactations.

The relative decline in growth up to one year of age in animals of different types of nervous activity was calculated by the formula [8, p. 61]:

$$\text{K} = \left[\left(\frac{Wt - Wo}{Wt + Wo} \right) \times 2 - \left(\frac{Wt_1 - W0}{Wt_1 + W0} \right) \times 2 \right] \times 100, \quad (3)$$

where K is the decline in the relative growth rate (%); *Wt* is live weight at the age of 6 months, kg *Wo* is live weight at birth, kg Wt_1 is live weight at the age of 12 months, kg.

Features of the exterior were determined by analyzing of measurements: height at the withers, depth of the chest, width of the chest behind the bladebones, width in makloks, oblique length of the body – with a measuring stick; the girth of the chest behind the bladebones and the girth of the metacarpus – with a measuring tape.

The thickness of the skin was determined in vivo on the right side of the body with a bench caliper [12, p. 87]. To do this, the skin was pulled back, squeezed by hand until its double folds were tightly connected. The thickness of the concha of the right ear was determined according to the commonly accepted method [10, p. 137]. It was measured with a caliper at the upward bend of the posterior side of the concha at a distance of 2 cm from the edge. The measurements were carried out in triplicate. The thickness of the skin was determined in such places on the body of the animal: the top of the elbow; middle of the last rib; lateral surface of the neck.

The adaptation index was determined taking into account the indicators of reproductive capacity and linear measurements of cows according to the formulas [1, p. 66]:

$$i = \frac{365 - PBC}{MF} \times 27,40, \quad (4)$$

where i is the adaptation index; PBC is period between calving; 365 is the number of days in a year; MF is milk production in kg of milk fat and productivity index.

$$ip = \frac{MF \times 365 \times WM}{PBC \times WC}, \quad (5)$$

where ip is the productivity index; M is milk productivity for 305 days of lactation, tn; F is fat content in milk, %; WM is width in makloks; WC is the width of the chest behind the bladebones.

Mathematical processing of the obtained results was carried out using the software package for statistical analysis "STATISTICA 10" (StatSoft, Inc., USA).

3. Determination of the type of nervous system of cows depending on their linear affiliation

LLC Beef factory Lyubomyrovka is one of the basic enterprises where the Ukrainian red dairy breed was created. The farm belongs to the leading ones in terms of the number of tested new plant lines and related groups.

Here, optimal feeding and housing conditions are necessary for the successful implementation of each program to improve the breeding and productive qualities of animals. The total annual feed costs per cow in recent years are 41.2-46.1 centners of feed units with the following structure (%): hay – 8.0, juicy feed – 66, concentrates – 26.

It is important for production specialists to establish a relationship between the types of constitution of animals, identified on the basis of morphological signs of constitution and types of nervous activity, determined on the basis of functional indicators.

Analysis of variance showed that the greatest influence on the variability of milk yield when changing the conditions of keeping cows is produced by the mobility of nervous processes (η^2=61.4%), and on the variability of the fat content in milk by the force of the excitatory process (η^2=79.9%). These data formed the basis for the development of the index of the type of the nervous system (INS), which was used in this study.

Fluctuations of indicators were studied in the last 5 days of winter-stall keeping of livestock and in the first 5 days during its transfer to summer-camp keeping. At the same time, it is important to study how a change in the method of keeping will affect the variability of milk yield and fat content in the milk of cows of different types of nervous activity.

The generalized data of one-time morning milk yield, fat content in milk and their variability depending on the type of nervous activity of cows with different methods of keeping are given in Table 1.

Table 1

Average indicators of morning milk yield, fat content in milk and their variability in cows of different types of higher nervous activity

Morning milk yield, kg	Cv, %	Fat content in milk, %	Cv, %
Last 5 days of winter stall keeping			
Strong type, n = 30			
7,7±0,32	6,6±0,85	3,64±0,037	3,2±0,42
Weak type, n = 10			
7,1±0,78	5,6±1,25	3,74±0,054	2,1±0,46
The first 5 days of summer-camp keeping			
Strong type, n = 30			
8,4±0,32	6,9±0,89	3,56±0,028	3,3±0,43
Weak type, n = 10			
7,8±0,76	8,6±1,94	3,62±0,063	5,6±1,26

It was found that under new (changed) conditions of keeping (summer-camp) in cows with a strong type of nervous activity, the coefficients of variability of both morning milk yield and fat content in milk practically remained at the level of the winter-stall period (Table 1). Their growth was insignificant and amounted to 4.5 and 3.1%, respectively. For cows of a weak type in the new conditions of housing, a significant increase in the variability of milk yield (by 53.6%) and, especially, the fat content in milk (by 266.7%) is characteristic compared to the background values (Figure 1). The difference in this indicator was 3.5 ± 1.34% ($P > 0.95$).

In cows of both types, during the first 5 days of summer-lager keeping, in comparison with winter-stall keeping, there is an increase in milk yield and

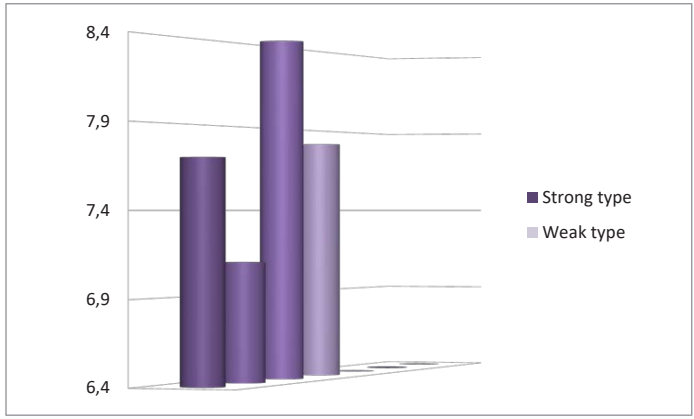

Figure 1. The level of milk yield in cows of different types of nervous activity before and after changing the way of keeping them

a decrease in fat content in milk. However, the magnitudes of the decrease in the latter trait in animals of different types were not the same. In cows of the strong type, the fat content decreased by 0.08 ± 0.046%, in the weak type by 0.12 ± 0.083% (Figure 1, 2).

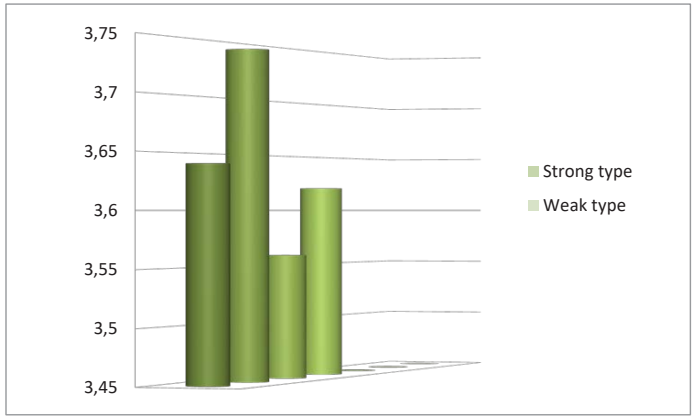

Figure 2. The level of fat in the milk of cows of different types of nervous activity

The average index of the nervous system type (INS) in strong type cows is 1.18 ± 0.080, and in weak type animals is 2.71 ± 0.151 with a veracious difference (P > 0.999).

The ratio between the studied types of strong-and-weak was 75:25%. A ratio close to this distribution was obtained also by other researchers. When comparing animals of different types of nervous activity among themselves, it can be seen that cows with a strong type of nervous activity are more stable when changing the way of keeping, as this is more indicatively confirmed by the curves of dynamics of one-time milk yield and fat content in milk (Figure 3, 4).

We have determined how the linearity of cows (Table 2) influenced on the distribution according to a certain type of nervous activity.

As can be seen from the data given in Table 2, the distribution of the daughters of individual parents by different types of nervous activity was quite similar. This allows, in our opinion, to assume that the linear affiliation of animals had almost no effect on the revealed differences in productivity between comparable types, but was mainly due to their typological characteristics of nervous activity.

To characterize the general state of the organism of cows of different types of the nervous system, we studied the pulse rate of cows 5 minutes before milking, during milking and 5 minutes after milking (Table 3).

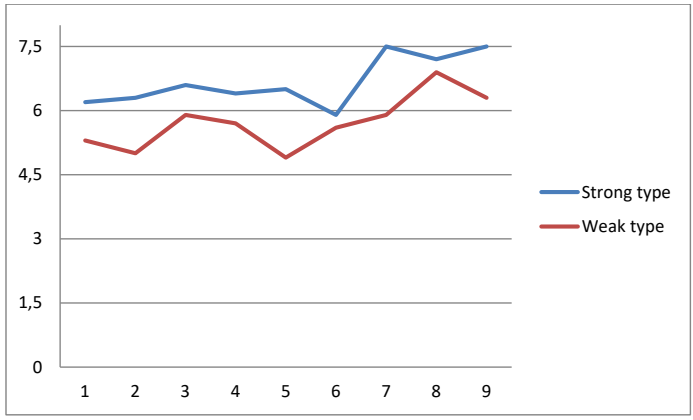

Figure 3. Dynamics of milk yield in cows of different types of nervous system

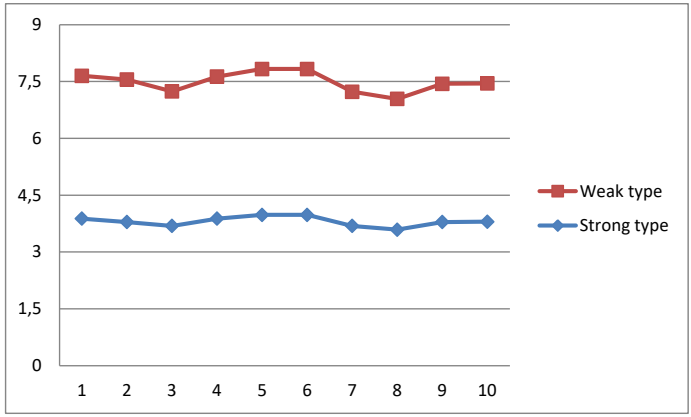

Figure 4. Dynamics of fat content in milk in cows of various types of the nervous system

Table 2

The proportion of daughters of individual sire bulls of various types of nervous activity, %

Father's name and accession number	Type of nervous activity	
	Strong	Weak
Danube 4939	16,7	10,0
Salon Et Red. 373870019	20,0	10,0
Rainer Et Red 23685	6,7	10,0
Sapphire Red. 76202600	23,3	30,0
Start 3673	13,3	10,0
Croquet Et Red. 395835	13,3	20,0
R. Rigel Et Re352882	6,7	10,0

Table 3

Pulse rate in cows of different types of nervous activity

Type of nervous system	n	Pulse rate, beats / min		
		5 minutes before milking	during milking	after 5 min. after milking
Strong	30	64,4±1,00	75,8±0,81	66,6±0,75***
Weak	10	72,4±1,60***	86,6±1,59***	84,6±1,42

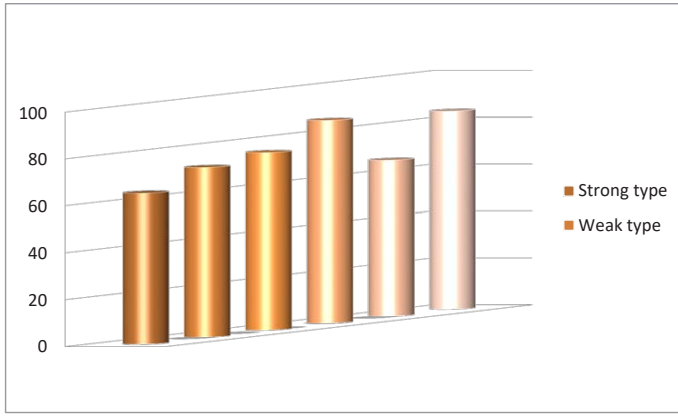

Figure 5. Comparative diagram of the pulse rate before, during and after milking in cows with different types of nervous activity

The data presented indicate (Table 3) that regardless of the type of nervous system, the pulse rate was the highest during milking of cows. In our opinion, this was due to the need for intensive blood supply to the mammary gland. Before and during milking, this indicator was significantly higher in weak type cows by 8.0 ± 1.90 beats / minute or 11%; ($P > 0.999$) and by 10.8 ± 1.78 beats / minute or 12.5% ($P > 0.999$) compared to the strong type. An inverse relationship is observed 5 minutes after milking. In cows of the strong type, a decrease in heart rate by 9.2 ± 1.13 or by 13.8% ($P > 0.999$) was established 5 minutes after milking. At the same time, for them this indicator is more likely to return to the initial level.

These data indicate that the process of excitation during milking is significantly higher in weak cows, since the pulse rate in animals after 5 minutes after milking remained almost unchanged (Figure 5).

Thus, our studies have shown that the change in the conditions of keeping cows associated with their transfer to summer-camp keeping less affected the function of the mammary gland of animals with a strong type of nervous system. Animals of the weak type were subject to the most significant influence, which indicates their significantly lower adaptive capacity.

Changes in the conditions of keeping cows, in our opinion, should be considered as a rather influential stress factor, and the rhythm of the

mammary gland function, in this case, can be probably used as one of the tests to determine the types of nervous activity in cows.

4. Influence of the exterior and physiological features of cows of different types of nervous activity on their productive characteristics

The intrabreed type of an animal determines the totality of the anatomical and physiological characteristics of the whole organism, caused by heredity and conditions of individual development. Well-pronounced exterior signs determine the physiological ability of animals to high milk production. Taking this into account, we have determined the conformation parameters in cows of different types of nervous activity by the main measurements (Table 4).

Table 4

Linear measurements of cows of different types of nervous activity, cm

Index	Type of nervous activity	
	Strong, n = 30	Weak, n = 10
Height at the withers	130,1±0,32	130,5±0,63
Depth of chest	64,3±0,78	63,4±1,48
Width of chest	46,1±0,52	46,8±1,08
Width in makloks	51,1±0,75	48,2±1,48
Oblique length of the body	147,8±1,85	144,3±1,34
Girth of the chest	194,4±0,85	191,9±2,40
Girth of the metacarpus	19,1±0,04	19,0±0,14

The results obtained (Table 4) indicate that in terms of the average values of the main linear measurements, cows of the strong type had an advantage in comparison with animals of the weak type of nervous activity.

It was important to establish the differences between the thickness of the skin and the physiological indicators of cows of different types of nervous activity, which in a complex combination determine the individual differences and the level of the adaptive capacity of the organism (Table 5).

It has been established (Table 5) that cows with a strong type of nervous system, compared with a weak type, have a tendency to slightly smaller

Table 5

Skin thickness, body temperature, respiration and pulse rate of cows with different types of nervous activity

Index	Type of nervous system	
	Strong, n = 30	Weak, n = 10
Thickness of the concha, mm	3,28±0,074	3,54±0,182
Thickness of the skin, mm: – top of the elbow	3,07±0,051	3,12±0,119
– last rib	4,52±0,085	4,75±0,257
− lateral surface of the neck, mm	5,22±0,125	5,35±0,189
Body temperature, °C	38,3±0,12	38,6±0,17
Respiration rate, movements / min.	18,4±0,19	18,1±0,40
Pulse, beats / min.	72,9±1,18	72,3±2,63

values of the thickness of the concha and skin, high rates of pulse and respiratory movements, with a lower rectal body temperature.

To determine the proportion of the influence of the activity of nervous processes on the physiological parameters of cows, we carried out a one-way analysis of variance (Table 6).

Table 6

The proportion of the influence of the total properties of nervous processes on the physiological indicators of cows

Index	Share of influence, %
Pulse rate	20,03**
Rectal body temperature	14,75
Frequency of respiratory movements	1,61

The data presented indicate that the peculiarities of the manifestation of the nervous processes in cows had a greater effect on the pulse rate and rectal body temperature ($P > 0.99$), and less on the frequency of respiratory movements.

During the period of embryonic development of farm animals, under the influence of heredity and physiology of the maternal organism, the structural features and physiological functions of their body are formed, and the growth rate of animals in the postnatal period is determined.

We found a difference in the coefficient of the relative decline in the growth up to one year of age between animals of different types (Table 7). They are highest in individuals belonging to the strong type (85.0 ± 1.74) and lower in animals of the weak type (78.5 ± 4.75). This indicates that the former were formed faster and were distinguished by better adaptive abilities to environmental conditions.

Table 7

The intensity of the decline in the growth of cows of various types of the nervous system up to one year of age

Type of nervous system	n	Decline in the relative growth rate, %
Strong	30	85,0±1,74
Weak	10	78,0±4,75
Average in the herd	40	81,4±1,57

Later (Table 8), cows of the strong type compared to the same-aged analogs of the weak type were noted for higher milk productivity.

Table 8

Milk productivity of cows of different types of nervous activity

Type of nervous activity	n	Average for the first three lactations		
		Milk yield, kg	Fat content, %	Milk fat, kg
Strong	30	4197±67,1*	3,78±0,006	158,8±2,39
Weak	10	3849±158,3	3,82±0,002	147,0±4,64

* P > 0,95

The research results (Table 8) indicate that the advantage of cows with a strong type of nervous activity over a weak one was 348 ± 171.9 kg in milk yield or 9.0% (P > 0.95), in terms of the amount of milk fat was 8.0 ± 5 21 kg or 8.0%. A negative veracious correlation (r = -0.48; P > 0.999) was established between the index of the nervous system and the average milk yield for the first three lactations.

It is known that the type of the nervous system determines the degree of reactivity of the organism to the activating and suppressive factors of

the environment, the intensity of unconditioned and conditioned reflex activity, the ability to adapt, the level of productivity and reproductive qualities.

Analysis of the reproductive qualities of cows indicates the dependence of individual traits on the typological characteristics of the nervous system (Table 9).

Table 9

Reproductive ability of cows depending on the type of higher nervous activity

Indexes	Type of nervous activity	
	Strong, n = 30	Weak, n = 10
Coefficient of productive use	1,07±0,017	1,07±0,50
The average duration of the service period, days	128,4±22,91	134,7±17,16
The average duration of the dry period, days	62,0±3,06	61,2±6,03
Live weight at first insemination, kg	398,4±7,86	401,1±9,81

As it can be seen from the data presented (Table 9), in animals with a strong type of nervous activity, the duration of the service period was shorter by 6.3 days (4.7%). The difference between the average length of the dry period was within 1.0%. The coefficient of productive use was the same in animals of both types, which indicates the need of selection on this indicator.

A rather significant level of differences was found between the types of the nervous system in terms of reproductive ability, however, in terms of live weight; the difference revealed insignificant and was within 1.0%.

For a comprehensive assessment of the organism's adaptation to natural and production conditions of existence, we calculated the indices of adaptation and productivity in cows of different types of nervous activity. For calculations, latitudinal measurements and indicators of reproductive capacity were used (Table 10).

It was found (Table 10) that animals of the strong type of nervous activity for the first lactation had a higher adaptation index as compared with animals of the weak type. The difference in this indicator was 0.49 (3.7%). In animals of a weak type, during this period, an violation of the internal balance is observed due to the harsh influence of environmental factors

Table 10

Indices of adaptation and productivity of cows of different types of nervous activity

Index	Type of nervous system			
	Strong, n = 30		Weak, n = 10	
	$\bar{X} \pm S\bar{x}$	Cv, %	$\bar{X} \pm S\bar{x}$	Cv, %
The first lactation				
Adaptation index	(-12,77)±4,724	195,7	(-13,26)±7,033	150,0
Productivity index	10,97±0,601	30,0	10,63±1,262	35,6
The second lactation				
Adaptation index	(-4,26)±3,967	510,0	(-3,66)±3,777	276,7
Productivity index	14,00±0,558	21,7	13,44±0,656	14,7

(primarily the level of feeding and conditions of housing), which, due to physiological depression, leads to self-elimination from reproduction. At the same time, an increase in the adaptation index for the second lactation in animals of the weak type of nervous activity by 0.6 (14.1%) as compared with the strong type, in our opinion, is associated with the stabilization and restoration of adaptive functions in the prevailing environmental conditions.

Cows with a strong type of nervous activity were also the best in terms of productivity in comparison with their counterparts of the weak type. The advantage was 0.34 (3.1%) for the first lactation and 0.56 (4.0%) for the second lactation. An increase in the productivity index indicates a harmonious combination of economic and biological foundations in these animals, while maintaining their productive qualities.

Thus, our studies have shown that the level of milk production of cows depends on the typological characteristics of the nervous system, the multifaceted activity of which supports the most important functions in the body, the leading of which is lactation. It has been established that highly productive animals with strong nervous processes are the most desirable for selection. The presence in the herd of different-quality groups of cows respectively to these characteristics indicates the prospects of selection according to the desired traits, which is important for further increasing the efficiency of the dairy farming industry.

5. Conclusions

The cortex of the cerebral hemispheres, as a regulatory center of the body, constantly ensures its connection with the environment with the help of conditioned and unconditioned reflexes. At the same time, the type of the nervous system of animals has a great influence on their vital activity, determining individual differences in the ability to adapt to unfavorable conditions, in the case when the mobilization of the protective and compensatory mechanisms of the organism is required. The use of the nervous system index (INS) in the creation of modern highly productive dairy herds does not require laborious work and additional cash costs. At the same time, the obtained research results indicate the need of the selection and use of animals that are able to withstand the action of stressors without reducing milk productivity and indicators of reproductive ability. The distribution of cows by the type of higher nervous activity makes it possible to create highly productive herds of animals that would combine the power of nervous processes with a high level of productive traits in combination with a harmonious constitution, high adaptability and good reproductive ability.

References:

1. Karlova, L.V. (2007). Biologicheskie osobennosti i produktivnyie kachestva korov novosozdannoy ukrainskoy krasnoy molochnoy porodyi [Biological characteristics and productive qualities of cows of the newly created Ukrainian red dairy breed]. *Problemyi povyisheniya effektivnosti proizvodstva zhivotnovodcheskoy produktsii: tez. dokl. mezhdunar. nauch.-prakt. konf. (Zhodino: nauch.-prakt. tsentr NAN Belarusi po zhivotnovodstvu)*, pp. 66–68. (in Russian)

2. Milostiviy, R.V., Vysokos, M.P., Kalinichenko, O.O., Vasilenko, T.O., & Milostiva, D.F. (2017). Productive longevity of European Holstein cows in conditions of industrial technology. *Ukrainian Journal of Ecology*, 7(3), 169–179. doi: 10.15421/2017_66

3. Vasilenko, T.O., Milostiviy, R.V., Kalinichenko, O.O., Gutsulyak, G.S., & Sazykina, E.M. (2018). Influence of high temperature on dairy productivity of Ukrainian Schwyz. *Scientific Messenger of LNU of Veterinary Medicine and Biotechnologies*, 20(83), 97–101. doi:10.15421/nvlvet8319

4. Lesnovskay, O.V., Karlova, L.V., & Deberina, I.V. (2019). Features of formation of milk productivity of cows of red steppe breed. *Theoretical and Applied Veterinary Medicine*, 7(1), 29–35. doi:10.32819/2019.71006

5. Chládek, G. & Máchal, L. (2004). Changes in the relationship between blood plasma glucose concentration and milk production in Czech Pied cows in the course of the year. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 2, 97–104.

6. Karlova, L.V., & Lesnovska, O.V. (2017). Adaptatsiina zdatnist pervistok iz riznoiu tryvalistiu yikh embrionalnoho rozvytku [Adaptive ability of first-calf heifers with different duration of their embryonic development]. Ahrarna nauka ta kharchovi tekhnolohii, zbirnyk naukovykh prats Vinnytskoho natsionalnoho ahrarnoho un-tu. *Vinnytsia: VTs VNAU*, 2(96), 172–179. (in Ukrainian)

7. Lamonov, S.A. & Pogodaev, S.F. (2004). Produktivnost korov raznyih tipov stressoustoychivosti [The productivity of cows of different types of stress resistance]. *Zootehniya,* 9, 26–27. (in Russian)

8. Panasiuk, I.M. & Karlova, L.V. (2007). Eksterierno-biolohichni osoblyvosti koriv novostvorenoi ukrainskoi chervonoi molochnoi porody zalezhno vid typiv konstytutsii ta nervovoi diialnosti [Exterior and biological characteristics of cows of the newly created Ukrainian red dairy breed, depending on the types of constitution and nervous activity]. *Problemy zooinzhenerii ta veterynarnoi medytsyny: zb. nauk. prats*, vyp. 15(40), ch. 1, pp. 61–67. (in Ukrainian)

9. Chernenko, A.N., Chernenko, E.I., & Sanjara, R.A. (2017). The quality of colostrum and vitality of calves, born from cows with different reaction to stress experiences. *Regulatory Mechanisms in Biosystems*, 8(2), 299–303. doi: 10.15421/021747

10. Panasiuk, I.M. & Karlova, L.V. (2009). Vplyv typu vyshchoi nervovoi diialnosti koriv na yikh klinichni pokaznyky zalezhno vid sezonu roku [Influence of the type of higher nervous activity of cows on their clinical parameters depending on the season]. *Visnyk Dnipropetrovskoho derzh. ahrar. un-tu*. Dnipropetrovsk, 1, pp. 137–140. (in Ukrainian)

11. Karlova, L.V., Lesnovska, O.V., Pryshedko, V.M., Dutka, V.R., & Yesina, E.V. (2018). Vplyv viku pershoho osimeninnia koriv riznykh porid na yikh produktyvni yakosti [Influence of the age of the first insemination of cows of different breeds on their productive qualities]. *Naukovo-tekhnichnyi biuleten derzh. naukovo-doslidnoho kontrolnoho instytutu vet. preparativ i korm. dobavok. Instytut biolohii tvaryn*. Lviv, vyp.19(1), pp. 286–291. (in Ukrainian)

12. Panasiuk, I.M. & Karlova, L.V. (2007). Interierni pokaznyky ta molochna produktyvnist koriv iz riznymy typamy nervovoi systemy [Interior indicators and milk production of cows with different types of nervous system]. *Tavriiskyi naukovyi visnyk: zb. nauk. prats KhDAU*. Kherson, vyp. 50, pp. 87–92. (in Ukrainian)

13. Chernenko, O.M., Chernenko, O.I., Shulzhenko, N.M., & Bordunova, O.G. (2018). Biological features of cows with different levels of stress resistance. *Ukrainian Journal of Ecology*, 8(1), 466–474. doi: 10.15421/2018_237

14. Chernenko, O.M., Sanzhara, R.A., Shulzhenko, N.M., Mylostyvyi, R.V., & Denisyk, O.V. (2019). Heavy metals, nitrates and radionuclides in milk of cows depending on their stress resistance. *Regulatory Mechanisms in Biosystems*, 10(4), 526–531. doi: 10.15421/021977

15. Batanov, S.D. & Starostina, O.S. (2005). Molochnaya produktivnost pervotelok raznoy stressoustoychivosti [Milk productivity of heifers of different stress resistance]. *Zootehniya*, 2, pp. 18–19. (in Ukrainian)

16. Chernenko, O.M., Prishedko, V.M., Mylostyvyi, R.V., Shulzhenko, N.M., Orishchuk, O.S., Chernenko, O.I., Tsap, S.V., & Khmeleva, O.V. (2019). Welfare

and sperm quality with a focus on stress resistance of Bos taurus. *Ukrainian Journal of Ecology*, 9(4), 493–498. doi:10.15421/2019_780

17. Krzyzewski, J., Strzalkowska, N., Reklewski, Z., Dymnicki, E. & Ryniewicz, Z. (2004). Influence of calving interval length in HFcows on milk yield, its composition and some reproductiontraits. *Medycyna Weterynaryna,* 60(1): 76–79.

18. Karlova, L.V., Lesnovska, O.V., Deberina, I.V., & Gavrilina, O.G. (2019). Productivity level of broad-bodied and narrow-bodied cattle. *Ukrainian Journal of Ecology*, 9(2), 136–143.

19. Karlova, L.V., Gavrilina, O.G., Alekseeva, N.V., & Peretyatko, O.V. (2018). Typological features of the nervous system of cows depending on the reactivity and stress resistance of the organism. *Ukrainian Journal of Ecology*, 8(2), 149–159.