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PSYCHO-EMOTIONAL STATE OF DOGS WITH DIFFERENT AUTONOMIC NERVOUS SYSTEM TONES UNDER ACUTE STRESS

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Annotation. The problem of stress resistance in dogs is an important aspect of modern veterinary medicine and ethology, as it directly affects the health, behavior, and performance of animals in service, sport, and therapeutic activities. The autonomic nervous system (ANS) plays a key role in regulating the psycho-emotional state, determining the speed and intensity of responses to stress stimuli. The aim of the study was to determine the specific effects of different types of autonomic tone on the dynamics of the psycho-emotional state of dogs under conditions of acute stress and ordinary anxiety, and to identify the mechanisms of ANS involvement in the formation of behavioral responses. The study was conducted on 30 dogs with different autonomic statuses. The psycho-emotional state was assessed using the modified FAS scale (FAS-M) in dynamics. It was found that normotonic dogs under acute stress exhibited a moderate increase in psycho-emotional state, indicating balanced reactivity and adaptive capacity. Vagotonics had minimal baseline values (0.3–1.5 units), but in response to acute stress they sharply increased (up to 2.5 units), followed by a rapid decline by the end of the experiment (1.3 units), indicating unstable adaptation dynamics. Sympathicotonics showed consistently high excitability levels (1.9–2.3 units) and the most pronounced stress response (up to 3.1 units), maintaining elevated anxiety even during ordinary anxiety days (2.5–2.8 units), which reflects their low adaptability. Analysis of the influence of individual ANS branches showed the dominance of sympathicotonia at the initial stages (0.4 units on the first day) with a gradual decline to 0.04–0.31 units in the following days, while vagotonia displayed a phase-like pattern: from moderate values at the start (0.22–0.36 units) to suppression on days 2–3 (0–0.02 units), and a renewed increase on day 5 (0.46 units). Thus, the type of autonomic tone is a determining factor in shaping the stress response in dogs. This suggests that autonomic tone type can be considered a prognostic marker of individual stress resistance and a basis for developing practical correction methods in veterinary practice.

Keywords: *dogs; autonomic status; sympathicotonia; vagotonia; normotonia; psycho-emotional state; stress; anxiety; adaptation*

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ПСИХО-ЕМОЦІЙНИЙ СТАН СОБАК З РІЗНИМИ ТОНУСОМ АВТОНОМНОЇ НЕРВОВОЇ СИСТЕМИ ЗА ГОСТРОГО СТРЕСУ

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Анотація. Проблема стресостійкості собак є важливим аспектом сучасної ветеринарної медицини та етології, оскільки вона безпосередньо впливає на здоров'я, поведінку й працездатність тварин у службовій, спортивній та терапевтичній діяльності. Автономна нервова система (АНС) відіграє ключову роль у регуляції психоемоційного стану, визначаючи швидкість і вираженість реакцій на стресові подразники. Метою дослідження було встановити особливості впливу різних типів вегетативного тонусу на динаміку психоемоційного стану собак за умов гострого стресу та звичайної тривожності та визначити механізми участі АНС у формуванні поведінкових реакцій. Дослідження проведено на 30 собаках різного вегетативного статусу. Психоемоційний стан оцінювали за шкалою FAS-M у динаміці. Встановлено, що у нормотоніків за умов гострого стресу відбувається помірне підвищення психоемоційного стану, що свідчить про збалансовану реактивність та адаптаційні можливості. У ваготоніків базові показники були мінімальними (0,3–1,5 ум. од.), однак у відповідь на гострий стрес вони різко зростали (до 2,5 ум. од.), з подальшим швидким зниженням до кінця експерименту (1,3 ум. од.), що вказує на нестійку динаміку адаптації. Симпатикотоніки мали стабільно високий рівень збудливості (1,9–2,3 ум. од.) та найвираженішу реакцію на стрес (до 3,1 ум. од.), зберігаючи підвищену тривожність навіть у дні звичайної тривожності (2,5–2,8 ум. од.), що відображає їхню низьку адаптивність. Аналіз впливу окремих ланок АНС показав домінування симпатикотонії на початкових етапах (0,4 ум. од. у перший день) із поступовим зниженням до 0,04–0,31 ум. од. у наступні дні, тоді як ваготонія мала фазовий характер: від помірних значень на старті (0,22–0,36 ум. од.) до пригнічення у 2–3 дні (0–0,02 ум. од.) та повторного зростання на 5-й день (0,46 ум. од.). Отже, тип вегетативного тонусу є визначальним чинником у формуванні стресової реакції собак. Це дозволяє розглядати тип вегетативного тонусу як прогностичний маркер індивідуальної стресостійкості та як основу для розробки практичних методів корекції у ветеринарній практиці.

Ключові слова: *собаки; вегетативний статус; симпатикотонія; ваготонія; нормотонія; психоемоційний стан; стрес; тривожність; адаптація.*

Introduction. *Relevance of the topic.* Stress is a universal biological phenomenon that significantly affects the physiological state, behavior, and overall well-being of dogs. In modern veterinary medicine, the issue of animal stress resistance is of particular importance, since dogs are widely involved not only as companion animals but also in service, sport, therapeutic, and search-and-rescue activities, where their ability to quickly adapt to extreme factors directly determines work efficiency (Salgirli Demirbas et al., 2023). It is well established that the autonomic nervous system (ANS) plays a leading role in regulating the stress response by integrating the effects of the sympathetic and parasympathetic divisions and coordinating the organism's response to external stimuli. The balance between these branches determines the nature, intensity, and duration of behavioral and physiological reactions to stressors (Koskela et al., 2024).

The sympathetic branch of the ANS ensures rapid mobilization of the body's resources through cardiovascular activation, catecholamine release, and the realization of the "fight-or-flight" response. This mechanism is critical in the initial stages of acute stress exposure; however,

its excessive or prolonged activation is associated with reduced adaptability, heightened anxiety, and the risk of pathological conditions (Wehrwein et al., 2016). The parasympathetic branch, in turn, plays a key role in the recovery phase, reducing excessive excitability and maintaining homeostasis. In recent years, special attention has been given to the role of vagotonic mechanisms in shaping delayed or chronic stress responses, which may be linked to the activation of the hypothalamic–pituitary–adrenal (HPA) axis and regulation of cortisol secretion (Mârza et al., 2024).

Thus, studying the role of different types of autonomic tone (normotonia, vagotonia, sympathicotonia) in regulating the psycho-emotional state of dogs provides new opportunities for understanding individual differences in stress resilience. Analysis of the interaction between sympathetic and parasympathetic influences not only helps explain different types of reactivity but also forms a theoretical basis for developing practical approaches to predicting, preventing, and correcting stress states in veterinary practice (Matsushita et al., 2022).

Analysis of Recent Studies and Publications. Recent research confirms the leading role of the autonomic nervous system (ANS) in shaping stress responses in dogs and highlights different aspects of its involvement. For instance, Flint et al. (2024) demonstrated that under acute emotional stimuli, dogs exhibit changes in heart rate, HRV, cortisol, and ACTH levels, with negative scenarios causing the most pronounced HRV reduction and elevation of hormonal stress markers (Flint et al., 2024). Dickinson et al. (2025) found that psychological stress in the form of frustration significantly decreased HRV and impaired search task performance in rescue dogs more than physical exertion, indicating the particular sensitivity of the ANS to emotional factors (Dickinson & Feuerbacher, 2025). Meanwhile, Koskela et al. (2024) reported a synchronization phenomenon of ANS responses in "dog–owner" pairs, revealing correlations between canine and human HRV, which underscores the complexity of psycho-emotional regulation and its dependence on social context (Koskela et al., 2024). Taken together, these findings suggest that acute stress in dogs is mediated by the close interaction of the sympathetic and parasympathetic branches of the ANS, manifested through changes in HRV and hormonal indicators, and can be modulated by both emotional and social factors.

Behavioral assessment of fear and anxiety in dogs has traditionally been carried out using various methods, including observational subjective categories, frequency recording of behavioral manifestations, ranking systems, or cumulative stress scores (Döring et al., 2009; Hauser et al., 2020; Kim et al., 2022; Stanford, 1981; Stephen & Ledger, 2005). However, the ambiguity of behavioral categories and the progressive nature of responses often complicate objective interpretation (Hauser et al., 2020). Existing tools, such as the Clinical Dog Stress Scale (Overall, 2013), demonstrate low to moderate inter-rater reliability (King et al., 2022; Mercier et al., 2023), while physiological indicators (e.g., cortisol, body temperature) do not always reflect the valence of stress (Beerda et al., 2000; Koolhaas et al., 2011). Therefore, the most promising approach is the development and validation of simple and reproducible behavioral scales suitable for practical use. One such tool is the Fear, Anxiety and Stress Scale (FAS; Fear Free, 2022) — an eight-point ordinal scale with illustrations and a color "traffic light" system, which allows for a quantitative assessment of stress responses in clinical settings: from 0 (green, calm) to 5 (red, severe aggression) (Gatehouse et al., 2025). At the same time, this scale does not fully meet the objectives of our study, as it was designed mainly for veterinary practice, has overly general descriptors, and does not account for the specifics of experimental conditions. Therefore, its application requires modification to include more detailed behavioral indicators and quantitative criteria, ensuring higher accuracy and reproducibility of results in our experiments.

Objective. To determine the specific effects of different types of autonomic tone (normotonia, vagotonia, sympathicotonia) on the dynamics of the psycho-emotional state of dogs under conditions of acute stress and anxiety, as well as to identify possible mechanisms of autonomic nervous system involvement in the formation of stress responses.

Research tasks: to assess the baseline psycho-emotional state of dogs with different autonomic nervous system tones; to determine the dynamics of psycho-emotional changes under

the influence of acute stress and ordinary anxiety; to compare the reactivity and adaptive capacity of dogs with normotonia, vagotonia, and sympathicotonia; to analyze the strength of influence of individual branches of the autonomic nervous system on the formation of psycho-emotional responses on different experimental days; to formulate conceptual statements on the role of the autonomic nervous system in regulating stress resistance in dogs and to outline prospects for the practical application of this knowledge in veterinary medicine.

Materials and Methods. The experiment was conducted on 30 dogs (Canis familiaris) of the German Shepherd breed, aged 2 to 5 years, with an average body weight of 4.0 ± 3.1 kg. Based on anamnesis, clinical examination, and complete blood count, all animals were classified as clinically healthy; no electrocardiographic or echocardiographic abnormalities were detected.

The state of autonomic regulation in dogs was assessed using the method of variational pulsometry. According to the results, three experimental groups were formed: dogs with normotonia (sympatho-vagal balance), dogs with sympathicotonia (sympathetic dominance), and dogs with vagotonia (parasympathetic dominance).

Acute stress was induced using the open field test. For this purpose, a 16 m² experimental arena (room) was equipped with a video camera to observe the dogs' behavior. Testing was carried out over five consecutive days at the same time (9:00–10:00 a.m.). On day 1, the dog was placed in the room and left alone for 10 minutes to adapt to the environment. On days 2 and 3, the dog was placed in the room, left alone for 3 minutes in silence, then exposed to thunder sound (90–100 dB) for 3 minutes, followed by 3 minutes of silence. On days 4 and 5, the dog was again placed in the same room and left alone for 5 minutes in silence (to assess baseline anxiety).

Behavioral responses were evaluated using an emotional and mental state scale developed as a modification of the Fear, Anxiety, Stress (FAS, Fear Free®, 2022) spectrum. The original FAS is an eight-point system used in veterinary practice to assess fear, anxiety, and stress (Gatehouse et al., 2025). In our study, the scale was adapted and simplified (FAS-M) to five levels (0–4): 4 = strong, pronounced aggression (attempt to attack the experimenter); 3 = pronounced arousal with increased locomotor activity and moderate aggression; 2 = excitability and fearfulness without aggression; 1 = worry or anxiety without aggressive or energetic movements; 0 = no visible changes in behavior. At all stages of the experiment, manifestations of acute stress were recorded, including fear, agitation and/or aggression, discomfort, trembling, yawning, protruded tongue, body posture (tail tucked between legs), as well as the dog's reactions to the owner and experimenter (Gutiérrez et al., n.d.; Kartashova et al., 2021). All data were entered into research protocols. The use of the modified FAS-M methodology ensured clear interpretation of the most significant behavioral manifestations.

Biometric data processing was performed using MS Excel 2019 with the built-in "Data Analysis" tool. Statistical analysis included descriptive statistics (means and standard deviations) and one-way analysis of variance (ANOVA). To quantify the effect size in one-way analysis of variance, the $\eta^2\chi$ (eta-squared) index was calculated, which reflects the proportion of the total variance of the studied parameter statistically explained by the effect of the analyzed factor. The probability of differences between mean values was verified using Student's t-test to assess statistical significance. Reliability of changes was determined at significance levels of $P \leq 0.05$, $P \leq 0.01$, and $P \leq 0.001$, ensuring robust interpretation of the results.

Results and Discussion. Autonomic tone is one of the key factors determining the individual reactivity of animals in stressful situations (Somppi et al., 2022). The psycho-emotional state of dogs, assessed using the FAS-M scale, reflects the level of their behavioral excitability and adaptive capacity under different testing conditions. Analysis of these dynamics in dogs with normotonia, vagotonia, and sympathicotonia revealed characteristic differences in stress responses and degrees of adaptation to experimental loads.

It was established that dogs with normotonia had moderate baseline values of psycho-emotional state (according to FAS-M), which gradually increased from 1.1 to 1.8 units before exposure during the experiment (Fig. 1). Under acute stress (days 2 and 3), their post-exposure values significantly rose (from 2.4 to 2.6 units), indicating a pronounced but moderate reaction.

During the evaluation of ordinary anxiety (days 4 and 5), the responses of normotonic dogs stabilized (2.3 units after exposure), reflecting partial adaptation to the testing conditions.

Dogs with vagotonia showed the lowest baseline psycho-emotional values (0.3–1.5 units) compared with normotonic dogs. However, in response to acute stress on day 2, they demonstrated a sharp increase from 0.5 to 2.5 units, nearly equaling or even exceeding the responses of normotonic dogs (2.4 units). In the following days, their reactivity declined more rapidly than in normotonic dogs, and by the end of the experiment they exhibited the lowest increases after exposure (1.3 units on day 5).

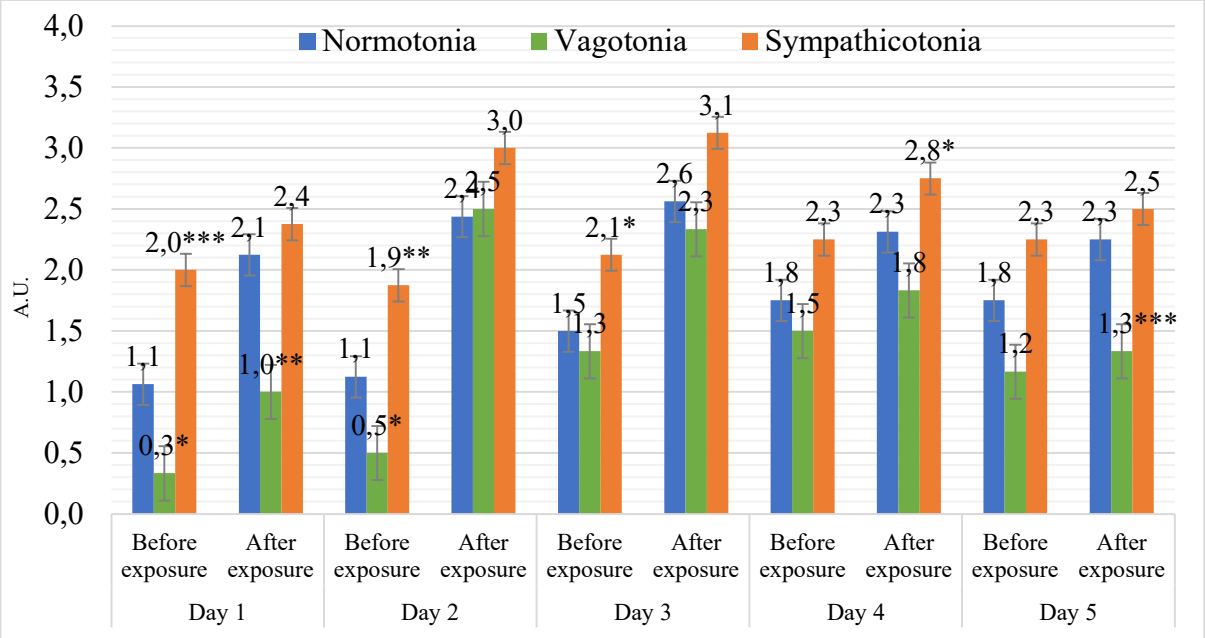

Fig. 1. **Dynamics of the psycho-emotional state of dogs with different ANS tones under acute stress and anxiety during the experiment (arbitrary units).**

Note. Significant differences compared with normotonic dogs: *P < 0.05; **P < 0.01; ***P < 0.001.

Dogs with sympathicotonia were characterized by consistently high baseline psycho-emotional values (1.9–2.3 units), considerably higher than those of normotonic dogs. Under acute stress, sympathicotonic dogs exhibited the strongest response (up to 3.1 units on day 3), significantly exceeding the values of normotonic dogs (2.6 units). During ordinary anxiety days (days 4 and 5), they maintained elevated levels of anxiety (2.8 and 2.5 units post-exposure), which indicates lower adaptability and a stronger tendency toward stress reactions compared with the normotonia group.

The interaction between the sympathetic and parasympathetic divisions determines the dynamics of adaptation processes, the level of anxiety, and the rate of recovery after load (Amaya et al., 2020). Assessing the strength of the influence of individual ANS branches on the behavioral responses of dogs on different experimental days makes it possible to trace their specific involvement at the initial stages of acute stress and during the further development of anxiety states. Figure 2 shows the dynamics of the influence of different branches of the autonomic nervous system on the psycho-emotional state of dogs during the five-day experiment, expressed as the impact strength index (η^2_χ; arbitrary units). On the first day of the experiment, vagotonia exerted a moderate influence on the dogs' state before (0.22 units) and after exposure (0.36 units; P < 0.001). However, this effect decreased significantly in the following days (especially on days 2 and 3, reaching minimal values of 0 and 0.02 units). On day 5, a marked increase in vagotonic influence was recorded after exposure (up to 0.46 units; P < 0.001), indicating an enhanced role in shaping anxiety responses toward the end of the experiment.

Sympathicotonia, in contrast, exerted the most pronounced influence on the dogs' psycho-emotional state at the initial stages of the experiment, reaching a maximum before exposure on day 1 (0.4 units; P < 0.001). During the subsequent days (days 2–5), the influence of sympathicotonia gradually decreased both before and after exposure, ranging from 0.04 to 0.31 units.

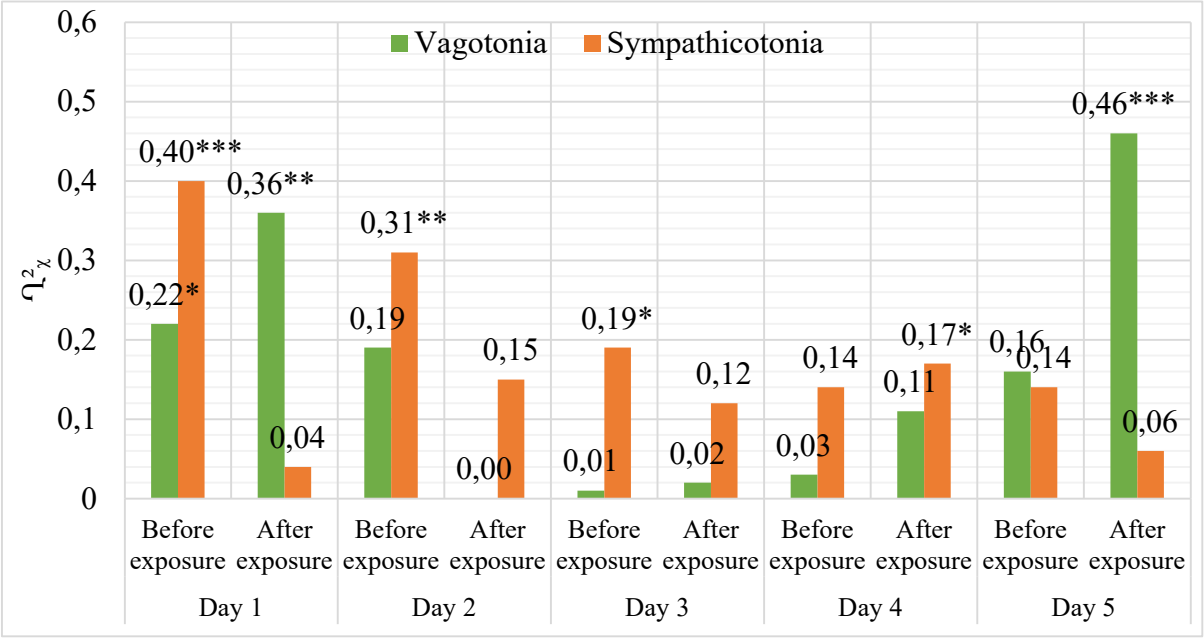

Fig. 2. **Dynamics of the influence of different ANS branches on the psycho-emotional state of dogs during the experiment (η^2_χ; arbitrary units).**

Note. Significant differences: *P < 0.05; **P < 0.01; ***P < 0.001.

The influence of the autonomic nervous system (ANS) on the manifestation of stress responses in dogs can be regarded as an integrated mechanism in which the sympathetic and parasympathetic branches shape individual behavioral patterns and levels of adaptation (Teo et al., 2022). In normotonic dogs, the balanced activity of both branches results in moderate anxiety elevation during acute stress, followed by stabilization, reflecting an optimal type of regulation. Sympathicotonic dogs exhibit high baseline activation and the strongest response at the early stages of stress, explained by the dominance of the sympathetic branch responsible for mobilizing the organism ("fight-or-flight"), increasing catecholamine release (adrenaline, noradrenaline), and activating the cardiovascular system. However, excessive and prolonged activation of this branch reduces adaptability and leads to chronic strain (Hekman et al., 2014).

Vagotonic dogs, on the other hand, start with low anxiety levels and demonstrate a delayed, phase-like reaction: the parasympathetic system initially suppresses excessive excitability, but in later days becomes more active and contributes to heightened anxiety states. This may be associated with changes in the balance between acetylcholine-mediated regulation and activation of the hypothalamic–pituitary–adrenal (HPA) axis (Tóth & Dobolyi, 2025). Thus, the possible mechanism lies in the fact that the sympathetic branch ensures rapid mobilization of the organism, the parasympathetic branch provides compensatory recovery and modification of responses in the delayed phase, while normotonia guarantees the most optimal integration of these processes, reducing the risk of pathological stress and promoting adaptation (Amaya et al., 2020).

Conclusions.

1. Autonomic tone determines individual differences in stress reactivity in dogs. Normotonic dogs are characterized by moderate increases in psycho-emotional state followed by stabilization, indicating higher adaptability. Sympathicotonic dogs show a high baseline level of anxiety and the strongest response to acute stress (up to 3.1 units), reflecting their tendency toward chronic strain. Vagotonic dogs demonstrate low baseline activation but exhibit a sharp increase in

values in response to acute stress followed by a rapid decline, indicating unstable adaptation dynamics.

2. Analysis of the influence strength of individual ANS branches revealed a phase-like pattern of their involvement in stress responses. Sympathicotonia dominated at the initial stages of the experiment (0.4 units before exposure on day 1; $P < 0.001$), but its contribution gradually declined in subsequent days (0.04–0.31 units). Vagotonia, in contrast, had a moderate effect at the start (0.22–0.36 units), was almost completely suppressed on days 2–3 (0–0.02 units), but re-emerged by the end of the experiment (0.46 units on day 5; $P < 0.001$), indicating its role in delayed or cumulative stress effects.

3. The type of autonomic tone can be considered a prognostic marker of individual stress resilience in dogs and may serve as a theoretical basis for developing practical approaches to prediction, prevention, and correction of stress-related conditions in veterinary medicine.

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