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REGIONAL MORPHOMETRIC STANDARDS OF THE RABBIT PITUITARY GLAND: IMPLICATIONS FOR ENDOCRINE FUNCTION ASSESSMENT

Abstract

This study presents a statistical analysis of the morphofunctional characteristics of the pituitary gland in non-breed male sheep raised in the Fergana Valley. The composite morphofunctional index of basophilic adenocytes, the relative mass of the adenohipophysis, and their stereometric proportion were examined. The findings provide a foundation for standardizing pituitary morphometric parameters and may serve as reference values in evaluating the effects of pharmacological agents.

Keywords: *pituitary gland, adenohypophysis, morphometry, basophils, Fergana Valley*

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РЕГИОНАЛЬНЫЕ МОРФОМЕТРИЧЕСКИЕ СТАНДАРТЫ ГИПОФИЗА КРОЛИКА: ЗНАЧЕНИЕ ДЛЯ ОЦЕНКИ ЭНДОКРИННОЙ ФУНКЦИИ

Аннотация

В данной работе проведён статистический анализ морфофункциональных характеристик гипофиза у беспородных самцов овец, выращенных в условиях Ферганской долины. Изучены интегральный морфофункциональный показатель базофильных аденоцитов, относительная масса аденогипофиза и их стереометрическая доля. Полученные данные могут служить основой для нормирования морфометрических параметров гипофиза

и использоваться как референтные значения при оценке действия фармакологических средств.

Ключевые слова: *гипофиз, аденогипофиз, морфометрия, базофилы, Ферганская долина*

Introduction

The morphofunctional characteristics of the pituitary gland are central to the regulation of the endocrine system, particularly through the activity of basophilic cells in the adenohypophysis, which synthesize tropic hormones influencing the thyroid gland, adrenal cortex, and gonads. Atherosclerosis is a major challenge in modern medicine [1, 2], and the search for plant-based hypolipidemic agents is considered a highly relevant and emerging trend [3, 4]. Despite the widespread use of intact animals as controls in pharmacological studies involving triterpene glycosides and other bioactive compounds [5, 6, 7], the detailed morphology of their pituitary glands has often been overlooked.

This gap underscores the importance of establishing regional morphometric standards for the pituitary gland as an independent subject of study. Environmental and geographic factors are known to influence the structure and function of endocrine organs. In this context, the examination of non-breed male rabbits raised in the Fergana Valley offers a unique opportunity to refine reference values for morphofunctional indicators and to support future comparative, pharmacological, and pathomorphological research [8].

Previous foundational works in medical morphometry have emphasized the value of quantitative histological analysis in understanding glandular function. Moreover, recent studies have demonstrated the utility of morphometric methods in assessing the thyroid gland and pituitary morphology under experimental conditions [9, 10]. These insights provide a methodological framework for the current investigation.

The objective of this study is to quantitatively assess the morphofunctional parameters of the pituitary gland in intact male rabbits raised in the conditions of the

Fergana Valley. Specifically, the analysis focuses on the composite morphofunctional index (CMI) of basophilic adenocytes, the relative mass of the adenohypophysis, the stereometric proportion of basophilic cells, and the stereometric proportion of stromal tissue. These findings are considered a region-specific characteristic of the pituitary gland and serve as a reference framework for future comparative, pharmacological, and pathomorphological studies.

Materials and Methods

Study Subjects: The study was conducted on 20 non-breed male rabbits aged 3–4 months, raised under the environmental conditions of the Fergana Valley. This population was selected to obtain region-specific morphometric data of the pituitary gland.

Methodology: Following humane euthanasia in accordance with bioethical standards, the pituitary glands were extracted. The tissues were fixed in 10% neutral formalin, processed using standard histological techniques, and stained with hematoxylin and eosin for microscopic evaluation.

Morphometric Parameters Assessed [11, 12, 13]:

1. Composite Morphofunctional Index (CMI) of basophilic adenocytes
2. Relative mass of the adenohypophysis (expressed as a percentage of the rabbit's body mass)
3. Stereometric proportion of basophils (percentage of the mass within the basophilic zone of the adenohypophysis)
4. Stereometric proportion of stromal tissue (percentage of the mass within the basophilic zone of the adenohypophysis)

Statistical Analysis: Data analysis was performed using StatTech v. 4.8.7 (developed by StatTech LLC, Russia, 2025). Quantitative variables were tested for normality using the Shapiro–Wilk test. For variables not following a normal distribution, the direction and strength of correlation between two quantitative

indicators were assessed using Spearman's rank correlation coefficient. Predictive models describing the dependence of quantitative variables on influencing factors were constructed using linear regression analysis. Differences were considered statistically significant at $p < 0.05$.

Results

An analysis of the composite morphofunctional index (CMI) of basophilic pituitary cells under normal conditions was conducted. The results showed that the median value of this indicator was 1.28 points, with an interquartile range (Q_1 – Q_3) of 1.07 to 1.57 points. The data are illustrated in Figure 1.

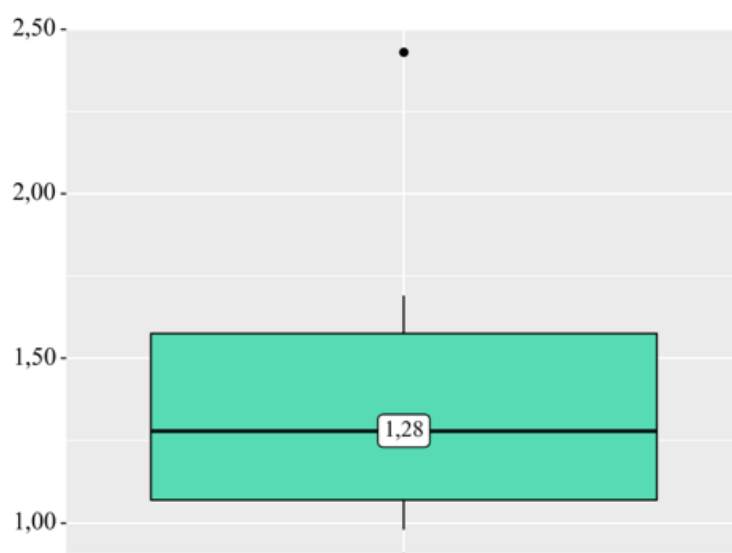


Figure 1. The CMI value of basophilic pituitary cells in rabbits under normal conditions.

The stereometric proportion of basophils is one of the key indicators of the morphofunctional status of the pituitary gland. The median value was 1.18%, with a range from 0.97% to 1.67%, and an interquartile interval (Q_1 – Q_3) of 1.00% to 1.31%. The data are illustrated in Figure 2.

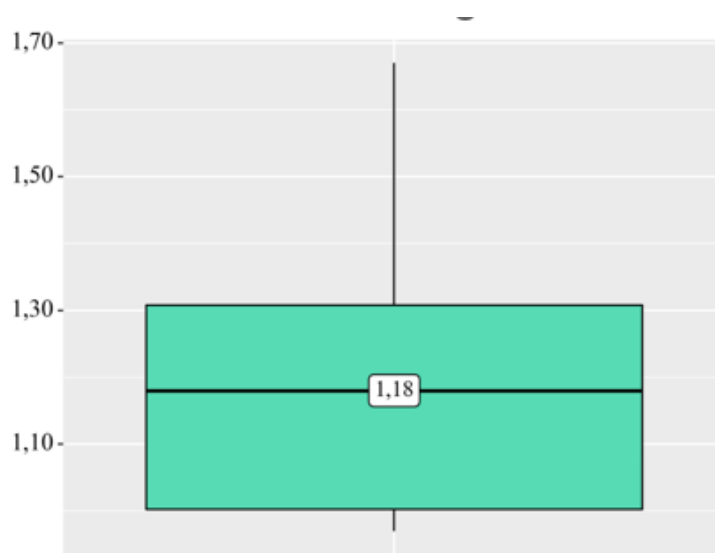


Figure 2. Stereometric proportion of pituitary basophils under normal conditions.

The median value of the relative mass of the adenohypophysis (RM-AH) was 6.14 mg/kg. The lower quartile (Q₁) was 5.83 mg/kg, and the upper quartile (Q₃) was 6.86 mg/kg. The results of our correlation analysis examining the relationship between the composite morphofunctional index (CMI) and the relative mass of the adenohypophysis are presented in Figure 3.

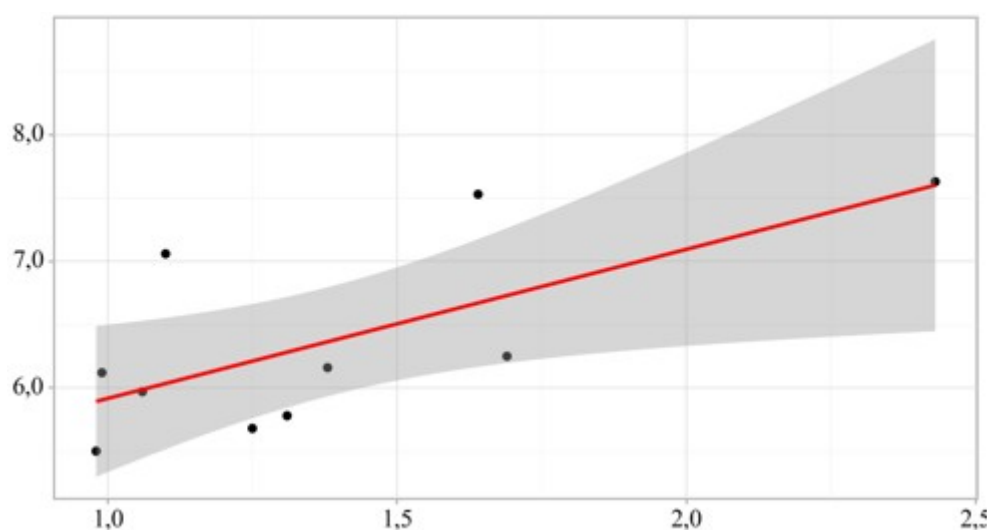


Figure 3. Regression graph illustrating the relationship between the relative mass of the adenohypophysis and the composite morphofunctional index (CMI).

A statistically significant direct correlation was established between the relative mass of the adenohypophysis and the composite morphofunctional index (CMI). The observed relationship is described by the linear regression equation: $Y_{\text{(Relative mass of AH)}} = 1.179 \times X_{\text{(CMI)}} + 4.738$. An increase of 1 point in the CMI is associated with an expected rise of 1.179 mg/kg in the relative mass of the

adenohypophysis. The resulting model accounts for 46.9% of the observed variance in the relative mass of the adenohypophysis.

The composite morphofunctional index (CMI) of basophilic adenocytes is influenced by their quantitative presence within the zone of basophil predominance. Accordingly, a correlation analysis was performed to examine the relationship between CMI and the stereometric (SM) proportion of basophils under normal conditions. The results are presented in Figure 4. A strong direct correlation was identified between the SM proportion of basophils and the CMI. The observed relationship is described by the linear regression equation: $Y_{(\text{SM proportion of basophils})} = 0.487 \times X_{(\text{CMI})} + 0.515$. An increase of 1 point in the CMI is associated with an expected rise of 0.487% in the SM proportion of basophils. The resulting model explains 97.7% of the observed variance in the SM proportion of basophils.

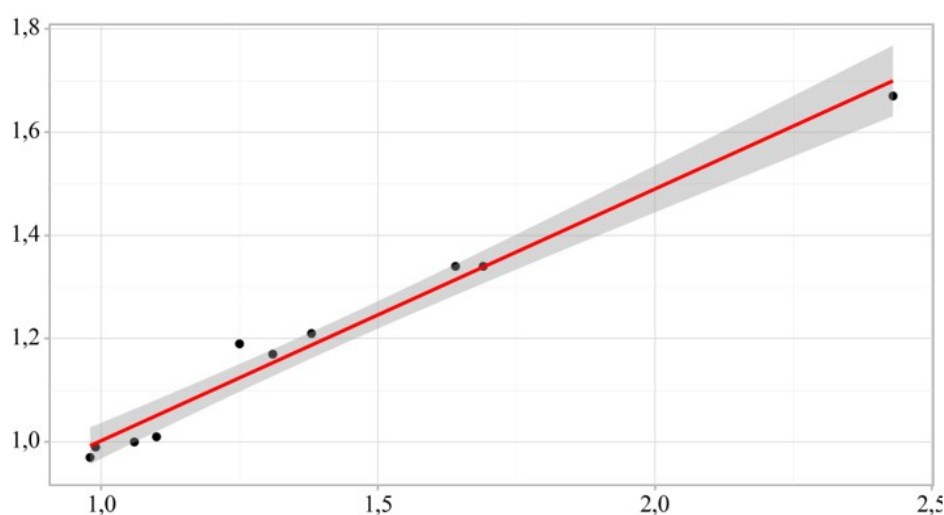


Figure 4. Regression graph illustrating the relationship between the stereometric proportion of basophils and the composite morphofunctional index (CMI).

Discussion

The obtained data demonstrate stable morphometric parameters of the pituitary gland in intact non-breed male rabbits raised under natural conditions in the Fergana Valley. This stability reflects the physiological maturity of the studied animals, the absence of pathological deviations, and the maintenance of homeostatic balance. The consistency of pituitary morphometry confirms the biological homogeneity of the

examined population and may serve as a reference standard for future comparative investigations.

The composite morphofunctional index (CMI) of basophilic adenocytes has proven to be a reliable indicator of pituitary hormonal activity. The strong correlation between CMI and key morphometric parameters confirms its prognostic value. This supports the consideration of CMI as a sensitive marker of the functional state of the pituitary gland under normal conditions and in response to various influences.

Particular attention should be given to the close relationship identified between CMI and the stereometric proportion of basophils. The pairwise linear regression analysis revealed that this relationship is described by the equation: $Y_{(\text{SM proportion of basophils})} = 0,487 \times X_{(\text{CMI})} + 0,515$.

This indicates that an increase of 1 point in the composite morphofunctional index (CMI) is associated with a rise of 0.487% in the stereometric proportion of basophils. The model explains 97.7% of the observed variance, reflecting a high degree of predictability and a strong functional relationship between the structural and morphofunctional parameters of the pituitary gland.

A direct correlation was also established between CMI and the relative mass of the adenohypophysis. The observed relationship is described by the equation: $Y_{(\text{Relative mass of AH})} = 1,179 \times X_{(\text{CMI})} + 4,738$.

An increase of 1 point in CMI corresponds to an expected increase of 1.179 mg/kg in the relative mass of the adenohypophysis. Although the model accounts for 46.9% of the observed variance, this value still indicates a meaningful association between the functional activity of the pituitary gland and its mass, particularly under physiological conditions.

The stereometric proportion of basophils reflects the spatial organization of the adenohypophysis and can be utilized to assess structural changes induced by pharmacological agents. This is particularly relevant in the study of triterpene glycosides, which, as demonstrated in several previous investigations, exert a pronounced effect on pituitary tissue. Thus, stereometric parameters may serve as a

morphological substrate for analyzing adaptive and reactive processes within the endocrine system.

It is important to emphasize that the data obtained represent the territorial-edge morphology of the pituitary gland, characteristic of animals raised under the environmental conditions of the Fergana Valley. This makes the findings especially valuable for the development of regional biomedical models, the establishment of veterinary standards, and the implementation of comparative studies in endocrinology, morphology, and pharmacology.

The morphometric evaluation of the rabbit pituitary gland presented in this study provides a foundational reference for assessing endocrine function in experimental models. Our findings demonstrate a strong correlation between the composite morphofunctional index (CMI) and both the stereometric proportion of basophils and the relative mass of the adenohypophysis, reinforcing the concept that regional and environmental factors significantly influence endocrine morphology.

This aligns with earlier observations that endocrine organs, including the thyroid and pituitary glands, exhibit morphofunctional variability depending on geographic and ecological conditions. For instance, Don et al. emphasized the importance of regional standards when evaluating thyroid morphology under experimental conditions. Similarly, Strukov and Kaktursky highlighted the diagnostic value of morphometry in pathological anatomy, particularly for endocrine tissues.

The high explanatory power of our regression models—especially the 97.7% variance explained in the stereometric proportion of basophils—supports the use of morphometric parameters as reliable indicators of glandular activity. This is consistent with the principles outlined by Avtandilov in his seminal work on medical morphometry and further supported by Chumachenko's concept of composite morphofunctional indicators.

Moreover, the relevance of our findings extends to pharmacological research. Several studies have explored the effects of bioactive compounds such as triterpenoid saponins and sesquiterpene lactones on cardiovascular and endocrine health.

However, many of these investigations, including those by Syrov et al. and Matchanov et al., utilized intact animals without detailed analysis of pituitary morphology. This underscores the necessity of establishing baseline morphometric standards, as provided in the present study.

The therapeutic potential of plant-derived compounds like those from *Artemisia juncea* has also been discussed in the context of drug development. Yet, as noted by Don et al., the morphofunctional status of endocrine organs must be carefully assessed to understand the full impact of such interventions.

In light of global health trends and demographic shifts, particularly in regions like Uzbekistan, the need for localized biomedical standards becomes increasingly important. Our data contribute to this effort by offering region-specific morphometric benchmarks for the rabbit pituitary gland, which may serve as a model for broader endocrine research.

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valuable for the development of regional biomedical models, the establishment of veterinary standards, and the implementation of comparative studies in endocrinology, morphology, and pharmacology.

Conclusion

This study establishes foundational morphometric parameters of the pituitary gland in intact non-breed male rabbits raised under natural conditions in the Fergana Valley. The results reflect a physiologically stable endocrine profile and provide region-specific reference values that can be employed as control benchmarks in future experimental and clinical investigations. These include studies assessing the impact of pharmacological agents, environmental factors, and pathomorphological alterations on pituitary structure and function.

The statistical robustness of the findings confirms their scientific reliability, while the conformity of data distribution to the normal law supports their use as reference standards for evaluating the functional state of the pituitary gland under physiological conditions. Moreover, the regional relevance of the data enhances their applicability in the development of biomedical models, veterinary guidelines, and comparative endocrine research.

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