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Changes in Small Round Follicles of the Thyroid Gland During Postnatal Ontogenesis of Hissar Sheep in Different Natural Regions

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ABSTRACT

The dynamics of changes in the morphometric parameters of the histological structures of the thyroid glands in sheep raised under natural conditions with varying degrees of iodine deficiency were studied during postnatal ontogenesis. In Hissar sheep raised in the Kashkadarya region, a rapid increase in the absolute diameter of small round follicles of the right lobe of the thyroid gland was observed from 3 days to 3 months of postnatal development, followed by a gradual decrease from 18 to 60 months of age. In Hissar sheep raised in the Fergana region, the absolute diameter of small round follicles showed a rapid increase from 3 days to 12 months of postnatal ontogenesis, reached its maximum at 24 months, and then significantly decreased by 60 months of age.

KEYWORDS: Hissar sheep, endocrine system, thyroid gland, right lobe, left lobe, small round follicle, postnatal ontogenesis, iodine deficiency, growth coefficient, morphometric parameters, absolute values.

Introduction

The productive characteristics of animals depend not only on feeding, housing, and management technologies, as well as the genotype of the organism, but also on the functional activity of the endocrine system.

According to research data, the condition of the thyroid gland in animals is closely associated with the iodine content in feed, water, plants, air, and soil. The primary cause of decreased thyroid gland function is iodine deficiency or excess in the biosphere, which has been proven to lead to iodine deficiency disorders such as endemic goiter or hypothyroidism, autoimmune thyroid diseases, and malignant tumors of the thyroid gland [1, 2, 3, 4].

Developmental abnormalities of offspring are observed among both domestic and wild animals. In farms located in environmentally unfavorable conditions, from 60% to 80%, and in some cases up to 100%, of newborn animals are reported to be morphofunctionally immature and to exhibit biochemical and immune deficiencies. In wild animal populations, such individuals are eliminated from the population through natural selection. In agricultural animals, however, human intervention allows their survival, which requires significant financial resources for disease prevention and treatment. Thus, the secretory activity of the thyroid gland in animals is influenced by other endocrine glands, geographical and climatic conditions, seasonality, production orientation, age, and the ecological state of the environment [3].

Materials and Methods

The scientific research was conducted on the thyroid glands of Hissar sheep raised under the conditions of the Fergana and Kashkadarya regions. For the study, thyroid glands were collected from animals at different stages of postnatal development: 3 days, 3, 6, 12, 18, 24, and 60 months of age.

Conventional morphological methods were used to obtain measurements of the histological structures of the thyroid glands.

All numerical data obtained during the study were subjected to mathematical processing according to the method proposed by Ye.K. Merkureva.

To determine the age-related dynamics of changes in the morphometric parameters of the thyroid gland structures, the growth coefficient was calculated using the formula $K = \frac{V_t}{V_0}$ developed by K.B. Svechin:

K – growth coefficient;

Vt – absolute value of the thyroid gland structure in adult animals;

$V0$ – initial value of the thyroid gland structure.

Mathematical and statistical analyses were performed using Student's t-test and Fisher's criteria with the help of Microsoft Excel spreadsheet software.

Results and Discussion

The results of the study demonstrated that the morphometric dimensions of the thyroid gland structures in Hissar sheep raised under iodine-deficient conditions exhibit distinct dynamics of change at different physiological stages of postnatal ontogenesis.

In female sheep raised in the Kashkadarya region, the absolute diameter of small round follicles in the right lobe of the thyroid gland increased from **230.0 ± 8.25 µm** at 3 days of postnatal development to **298.0 ± 7.95 µm** by 3 months of age, during which the growth coefficient increased to **1.3-fold**. Up to 12 months of age, this parameter remained almost unchanged compared to the 3-month stage, measuring **297.0 ± 8.01 µm** at 6 months (K = 1.0; $p < 0.03$) and **268.0 ± 9.22 µm** at 12 months (K = 0.9).

The absolute diameter of small round follicles in the right lobe of the thyroid gland reached its highest value at 18 months of age (**291.0 ± 8.63 µm**, K = 1.09; $p < 0.03$) compared to other age groups. Subsequently, a gradual decrease was observed, with values declining to **241.0 ± 9.22 µm** at 24 months (K = 0.83) and to **217.0 ± 8.73 µm** at 60 months (K = 0.9).

Overall, the growth coefficient of the absolute diameter of small round follicles in the right lobe of the thyroid gland over the entire period from 3 days to 60 months of postnatal ontogenesis was **0.94**, indicating a general trend toward age-related structural regression under iodine-deficient conditions.

The absolute diameter of small round follicles in the right lobe of the thyroid gland in **male Hissar sheep raised in the Kashkadarya region** showed a moderately rapid increase from the first 3 days to 3 months of postnatal ontogenesis, rising from **230.0 ± 8.2 µm** to **298.0 ± 8.0 µm** (K = 1.3; $p < 0.03$). Up to 18 months of age, this process slowed down, with the diameter measuring **295.0 ± 8.0 µm** at 6 months (K = 0.99), **239.0 ± 9.0 µm** at 12 months (K = 0.81), and **236.0 ± 8.0 µm** at 18 months (K = 0.99; $p < 0.4$). At the 24-month developmental stage, this parameter showed a slight decrease compared to younger animals, reaching **188.0 ± 8.0 µm** (K = 0.8), while at 60 months it remained almost unchanged at **182.0 ± 8.0 µm** (K = 0.97). Overall, the growth coefficient of the absolute diameter of small round follicles in the right lobe of the thyroid gland over the period from 3 days to 60 months of postnatal ontogenesis was **0.79**, indicating a general declining trend with age under the given environmental conditions.

In **sheep raised in the Fergana region**, the diameter of small round follicles in the right lobe of the thyroid gland increased rapidly from 3 days to 3 months of postnatal development, reaching **240.0 ± 5.5 µm** (K = 1.29; $p < 0.03$). At 6 months, it further increased to **317.0 ± 7.3 µm** (K = 1.03), and at 12 months it rose sharply to **649.6 ± 19.6 µm** (K = 2.05; $p < 0.02$), followed by a decrease at 18 months to **436.0 ± 9.8 µm** (K = 0.67). At 24 months of age, this parameter increased markedly compared to younger age groups, reaching **813.0 ± 22.0 µm** (K = 1.86; $p < 0.03$). By 60 months, however, a sharp decline was observed, with the diameter decreasing to **295.0 ± 6.6 µm** (K = 0.36). Overall, the growth coefficient of the absolute diameter of small round follicles in the right lobe of the thyroid gland from 3 days to 60 months of postnatal ontogenesis increased to **1.23**, reflecting pronounced regional and age-related morphometric variability.

The absolute diameter of small round follicles in the right lobe of the thyroid gland in **male sheep raised under the conditions of the Fergana region** increased from **239.0 ± 5.2 µm** at 3 days of postnatal ontogenesis to **308.0 ± 8.6 µm** by 3 months of age (K = 1.29; $p < 0.03$). At 6 months, this parameter showed no significant change, measuring **315.0 ± 8.0 µm** (K = 1.02; $p < 0.03$). By 12 months, the growth process intensified, and the diameter reached **620.0 ± 20.0 µm** (K = 1.97; $p < 0.03$). At 18 months of development, this indicator sharply decreased compared to younger age groups (**381.0 ± 9.0 µm**, K = 0.61; $p < 0.03$). In contrast, at 24 months it exhibited the largest size among all studied stages (**755.0 ± 22.0 µm**, K = 1.98). By 60 months, a pronounced reduction was observed, with the diameter decreasing to **256.0 ± 7.0 µm** (K = 0.34). Overall, the growth coefficient of the absolute diameter of small round follicles in the right lobe of the thyroid gland in male Hissar sheep over the investigated period from 3 days to 60 months of postnatal ontogenesis was **1.07**, indicating age-related morphometric variability under the environmental conditions of the Fergana region.

The absolute diameter of small round follicles in the **left lobe of the thyroid gland** in **female sheep raised under the conditions of the Kashkadarya region** increased rapidly from the first 3 days to 3 months of postnatal ontogenesis, rising from **231.4 ± 5.6 µm** to **302.0 ± 7.4 µm**, during which the growth coefficient reached **1.31-fold**. Up to 18 months of age, this parameter showed no significant changes, measuring **301.0 ± 7.3 µm** at 6 months (K = 1.0; $p < 0.03$), **294.4 ± 9.3 µm** at 12 months (K = 0.98; $p < 0.03$), and **304.0 ± 6.8 µm** at 18 months (K = 1.03; $p < 0.03$). At subsequent stages of development, a gradual decrease in this indicator was observed, with the diameter declining to **252.0 ± 5.6 µm** at 24 months (K = 0.83; $p < 0.03$) and further to **223.0 ± 5.6 µm** at 60 months (K = 0.88). Overall, the growth coefficient of the absolute diameter of small round follicles in the left lobe of the thyroid gland over the period from **3 days to 60 months** of postnatal ontogenesis was **0.96**, indicating a tendency toward age-related reduction in follicular size under the given environmental conditions.

The absolute diameter of small round follicles in the **left lobe of the thyroid gland** in **male Hissar sheep raised under the natural conditions of the Kashkadarya region** increased rapidly from **230.0 ± 5.6 µm** during the first 3 days of postnatal ontogenesis to **301.0 ± 7.4 µm** by 3 months of age (K = 1.31; $p < 0.03$). Up to 18 months of age, no significant changes were observed in this parameter, measuring **298.0 ± 7.0 µm** at 6 months (K = 0.99; $p < 0.03$) and **267.0 ± 9.0 µm** at 12

months (K = 0.9). At 18 months, the diameter in rams was **251.0 ± 7.0 µm**, followed by a gradual decrease at subsequent ages, declining to **197.0 ± 6.0 µm** at 24 months (K = 0.78) and to **188.0 ± 6.0 µm** at 60 months (K = 0.95). Overall, the growth coefficient of the absolute diameter of small round follicles in the left lobe of the thyroid gland throughout the investigated stages of postnatal development was **0.82**, indicating an age-related reduction in follicular size in male Hissar sheep under the given environmental conditions.

The absolute diameter of small round follicles in the **left lobe of the thyroid gland** in **female sheep raised under the conditions of the Fergana region** increased from **250.0 ± 7.6 µm** at 3 days of postnatal ontogenesis to **312.0 ± 7.6 µm** by 3 months of age (K = 1.25; p < 0.02). At 6 months, this growth process slowed down (**299.0 ± 7.6 µm**; K = 0.96), followed by a relatively rapid increase at 12 months, reaching **636.0 ± 16.0 µm** (K = 2.13; p < 0.02). At the 18-month developmental stage, this parameter showed a noticeable decrease to **561.8 ± 16.7 µm** (K = 0.88). In contrast, at 24 months, it reached the highest value compared to younger age groups (**705.8 ± 15.0 µm**, K = 1.26; p < 0.02). By 60 months of age, a sharp decline was observed, with the diameter decreasing to **301.0 ± 7.0 µm** (K = 0.43). Overall, the growth coefficient of the absolute diameter of small round follicles in the left lobe of the thyroid gland over the period from **3 days to 60 months** of postnatal ontogenesis was **1.2**, indicating pronounced age-related and region-specific morphometric variability.

The absolute diameter of small round follicles in the **left lobe of the thyroid gland** in **male Hissar sheep raised under the conditions of the Fergana region** increased from **249.0 ± 7.6 µm** during the first 3 days of postnatal development to **311.0 ± 7.6 µm** by 3 months of age (K = 1.25; p < 0.02). At 6 months, this parameter showed no significant change (**296.0 ± 8.0 µm**; K = 0.95), whereas at 12 months a marked increase was observed, reaching **605.0 ± 16.0 µm** (K = 2.04; p < 0.03). At the 18-month stage of development, this indicator slightly decreased (**504.0 ± 17.0 µm**; K = 0.83). In contrast, at 24 months it increased significantly compared to younger age groups, reaching **647.0 ± 15.0 µm** (K = 1.28; p < 0.02). By 60 months of age, a sharp decline was recorded, with the diameter decreasing to **261.0 ± 7.0 µm** (K = 0.40). Overall, the growth coefficient of the absolute diameter of small round follicles in the left lobe of the thyroid gland over the period from **3 days to 60 months** of postnatal ontogenesis was **1.05**, indicating moderate age-related morphometric variability in male Hissar sheep under the environmental conditions of the Fergana region.

Conclusion

1. The absolute diameter of small round follicles in the **right lobe of the thyroid gland** in Hissar sheep raised under the conditions of the **Kashkadarya region** showed a rapid increase from **3 days to 3 months** of postnatal ontogenesis, followed by a gradual decrease from **18 to 60 months** of age.
2. In Hissar sheep raised under the conditions of the **Fergana region**, the absolute diameter of small round follicles in the **right lobe of the thyroid gland** increased rapidly from **3 days to 12 months** of postnatal ontogenesis, reached its **maximum at 24 months**, and then **decreased significantly by 60 months** of age.

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