The avian pineal organs are highly variable in anatomical and histological structure, profiles of indoles content and mechanisms involved in regulation of MLT secretion. The turkey pineal organ is an attractive model for chronobiological research due to the strongest impact of direct photoreception on MLT secretion among all studied domesticated birds, well-working endogenous oscillator and high amplitude of MLT secretion rhythm. The studies on the pineal organ of turkeys are also important from a utilitarian point of view, because of significance of this species as meet-producing animal and role of light in its physiology.

The aim of the study was to characterize the metabolic profile of MLT synthesis-related indoles in domestic turkey, to analyse changes in the content of indoles and the activity of enzymes involved in MLT synthesis during postembryonic development from hatching to age of 45 weeks and to determine the effect of monochromatic light of different wavelength and intensity on the indole metabolism.

Studies on the effect of age on the metabolic profile of indoles in the pineal gland were conducted on turkeys reared from day 2 to 45 weeks of age in 12L:12D lighting conditions, with white light of 20 lux during the light phase. Pineal glands were taken from animals aged 2, 7, 14, 28 days and 10, 20, 30 and 45 weeks at intervals of 2 hours and frozen for biochemical tests. The experiment on the effect of monochromatic light of different colours and intensities was carried out on 4-week-old turkeys kept for 7 days under monochromatic green, red and blue light with intensity of 16, 32 or 64 lux during the photophase of 12L:12D cycle. The birds were euthanized at intervals of 4 hours. The indole content was measured in the pineal glands by high-performance liquid chromatography with gradient separation and fluorescence detection (HPLC). The activity of MLT synthesis pathway enzymes was determined by incubating pineal homogenate with appropriate substrates under optimal conditions for reaction velocity and determining the reactions products by HPLC. The results of the study were subjected to a two-factor analysis of variance with the Duncan test.

The results obtained in the posthatching period allowed to distinguish 4 stages of indole metabolism development in the turkey pineal gland. The first stage, from hatching to the age of 2 weeks, was characterized by a decrease in the 5-hydroxytryptophan (5-HTRP) concentration and an increase in the concentrations of serotonin (5-HT), MLT, 5-methoxyindoleacetic acid (5-MIAA) and 5-methoxytryptamine (5-MTAM). During the second stage, around the age of 1 month, the concentrations of N-acetylserotonin (NAS) and MLT reached a maximum. The synthesis and degradation of 5-HT were also the highest. The third stage, around the age of 10 weeks, was characterized by decreased levels of 5-HT (approximately 50%) and 5-hydroxyindoleacetic acid (5-HIAA) and a high level of 5-MTAM.

The last stage, covering the age from 20 to 45 weeks, was characterized by a large decrease in the synthesis, content, and degradation of 5-HT. Despite these changes, there were no prominent differences in the nocturnal levels of NAS and MLT between the third and fourth stages. The concentrations of all tryptophan derivatives showed daily fluctuations until the age of 45 weeks.

The monochromatic light significantly modified the pineal indole metabolism in turkeys and its effects were dependent on the color and intensity of the light. The prominent changes occurred in the course of daily rhythm of arylalkylamine N-acetyltransferase (AA-NAT) activity and, consequently, in MLT synthesis. The differences in light conditions affected: (i) the decline in AA-NAT activity after the photophase onset and the level of enzyme activity at the nadir, (ii) the increase in AA-NAT activity after the scotophase onset, and (iii) the time of the peak occurrence and the activity level at the peak. The decline in AA-NAT activity after the photophase onset was significantly higher in turkeys kept under blue light than under green and red light. Moreover, the inhibitory effect of light increased with the illumination intensity, independent of the light color. The increase in enzyme activity after the photophase onset was slower in animals kept under monochromatic light intensity of 16 lx than in those kept under light intensities of 32 and 64 lx. The peak of AA-NAT activity occurred at 02.00 in turkeys kept under red light and blue light with intensity of 32 and 64 lx, but at 06.00 in birds kept under green light and 16 lx blue light. The red light significantly affected the performance of 5-HT synthesis, increasing the activities of tryptophan hydroxylase and aromatic amino acid decarboxylase. This effect was prominently reflected in the 5-HT content, which during the photophase and early scotophase was approximately 2 folds higher in turkeys kept under red light than in other groups, and in the 5-HIAA, 5-hydroxytryptophol, 5-MIAA, and 5-methoxytryptophol levels. The red light influenced the course of daily rhythm of 5-MTAM, increasing the level of this amine in the second part of the night.