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The effect of using garlic (Allium sativum L.) on intestinal and liver morphology in broilers

Gabi Dumitrescu[1], Eliza Simiz[2], Ioan Peț[1], Elena Peț[3], Dorel Dronca[1], Mirela Ahmadi[1], Florin Dan Simiz[4], Liliana Petculescu Ciochină[1]

1 Biotechnology Department, Faculty of Bioengineering of Animal Resources, University of Life Sciences "King Mihai I", Timisoara, 300645, Romania
2 Animal Production Engineering Department, Faculty of Bioengineering of Animal Resources, University of Life Sciences "King Mihai I", Timisoara, 300645, Romania
3 Management and Rural Development Department, Faculty of Management and Rural Tourism, University of Life Sciences "King Mihai I", Timisoara, 300645, Romania
4 Department of Internal Medicine, Faculty of Veterinary Medicine, University of Life Sciences King Mihai I from Timisoara, Timisoara, 300645, Romania

INTRODUCTION & AIM

Poultry meat and eggs represent major sources of animal protein, and the optimization of poultry nutrition is essential for increasing productivity and ensuring safe, high-quality products. In the context in which the World Health Organization (WHO) has identified antibiotic resistance as a major public health concern, partly associated with their use in poultry production [4], scientific interest has increasingly focused on identifying natural alternatives to antibiotics, such as phytogenic feed additives.

Garlic (*Allium sativum*), traditionally used both as a food ingredient and as a pharmacologically active agent [6,7], is currently widely incorporated into farm animal nutrition due to its bioactive compounds [8,9]. In animal husbandry, garlic is administered in various forms, including crushed bulbs, powder, oil, or extracts, either alone or in combination with other medicinal plants [12]. Studies have demonstrated that dietary supplementation of broilers with garlic exerts antibacterial effects against strains such as *Escherichia coli, Enterobacteria spp.*, and *Salmonella typhimurium* [13], contributing to improved growth performance, enhanced feed conversion ratio, improved carcass quality (through reduced fat and cholesterol content), and decreased mortality rates [14].

Supplementation with 0.3% garlic powder has been associated with improved productive performance, as well as favorable immunological and lipid profile parameters [15]. Moreover, beneficial modifications in intestinal morphology—namely reduced crypt depth and increased villus height—have been reported following garlic administration [16,17]. Positive effects have been observed at inclusion levels of 1–3%, whereas concentrations exceeding 4.5% negatively affected most production parameters [14].

Based on these findings, the present study evaluated the effect of dietary supplementation with 1% garlic powder on intestinal and hepatic morphology, as well as on body weight development in broilers.

METHOD

Experimental design and biological material

The experiment was conducted on a number of 24 one-day-old male ROS 308 hybrids, randomly divided into two groups: the control group (LC) and the experimental group (LGa). Each batch was divided into two replications, of six individuals each.

The chicks were raised on the ground for a period of 42 days, on straw bedding. The growing period divided into three phases: the starter phase from day 0 to 10, the grower phase from day 11 to 35, and the finisher phase from day 36 to 42. Ad libitum feeding was utilized, utilizing combined feed (CF).

The CF had distinct nutritional specifications tailored to each growth stage. During the entire period of the experiment, the chickens of the control group were fed only with the basic diet, and the individuals of the experimental group (LGa) with the basic diet in which 1% garlic powder was incorporated.

Histomorphometric analysis of the intestine

The chickens were sacrificed at the age of 42 days, by the stunning method, samples were taken from the small intestine and liver and were fixed in neutral formalin (10%), then they were embedded in histological paraffin and were sectioned with the manual rotary microtome Leica RM 2125 RT, at a thickness of 5µ. After staining by the Mallory trichrome method [18], the obtained sections were analyzed using an Olympus Cx41 optical microscope, equipped with a digital photos camera Quick Photo Micro 2.2 software for histomorphometry. The monitored histomorphometric parameters were: the height of the intestinal villi, the width of the villi, the surface and the perimeter of the villi, the depth of the crypts, as well as a series of histological changes noted in the liver tissue. The measurements were made as follows: for the height, the distance between the base and the tip of the villus was determined; width was determined in the median area of each villus; the area and perimeter were determined by marking the outline of each villus, and for the depth of the crypts, the distance between the tip of the crypt and the muscularis mucosa was measured.

Statistical analysis

The statistical analysis of the histomorphometry findings was conducted using the IBM SPSS 23 software program (SPSS Inc., Chicago, IL, USA). The normality of all data was assessed using the Shapiro-Wilk test, and any variations between the experimental groups were analyzed using the Student's t-test. The results are shown as the average and standard deviation (mean ± SD). Differences are considered to be statistically significant at $p<0.05$.

RESULTS & DISCUSSION

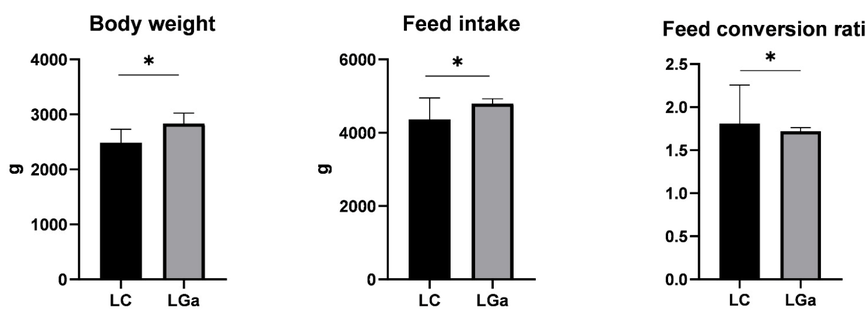

Figure 1. Effect of garlic supplementation on body weight, feed intake and feed conversion ratio (FCR) in 42-day-old broiler chickens

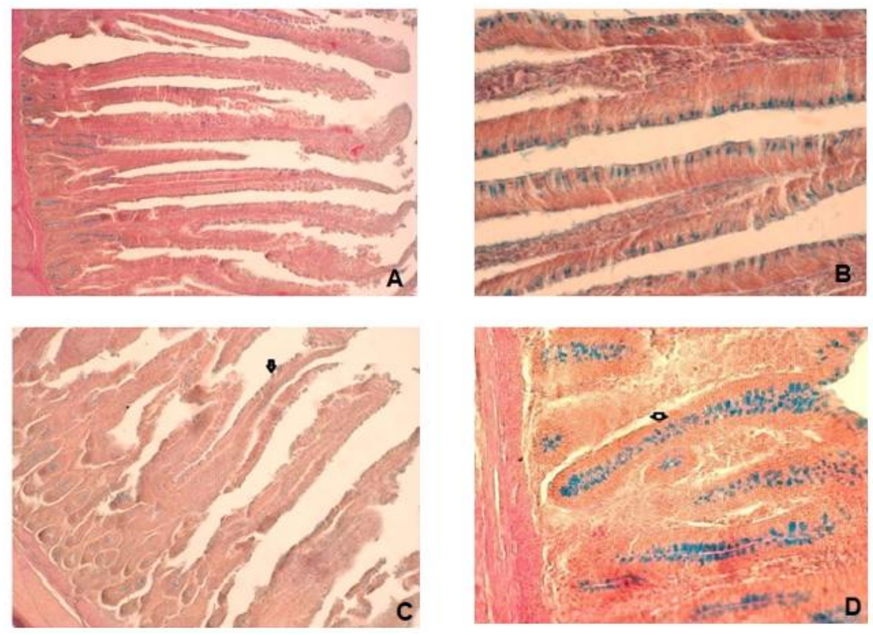

Figure 2. Intestinal mucosa: A, B - LC – intestinal villi (100x) and detail (200x); C, D– LGa - intestinal villi (arrow) (100x) and intestinal glands (arrow) (400x) (Mallory Trichrome Staining)

Table 2. Effect of garlic supplementation on height, area, perimeter, width of intestinal villus and crypts depth in 42-day-old broiler chickens (values are mean ± standard error)

Specification		LC	LGa	P values
Intestinal villus	Height (µm)	1245.82 ± 152.08[a]	1497.75 ± 79.37[b]	[a-b]p<0.01
	Area (µm^2)	108554.02 ± 26761.47[a]	172309.10 ± 48329.05[b]	[a-b]p<0.01
	Perimeter(µm)	2642.97 ± 254.92[a]	2389.70 ± 280.98[b]	[a-b]p<0.05
	Width (µm)	105.37 ± 12.46[a]	148.80 ± 26.02[b]	[a-b]p<0.01
Crypt depth (µm)		262.42 ± 55.40[a]	303.50 ± 57.04[b]	[a-b]p<0.05

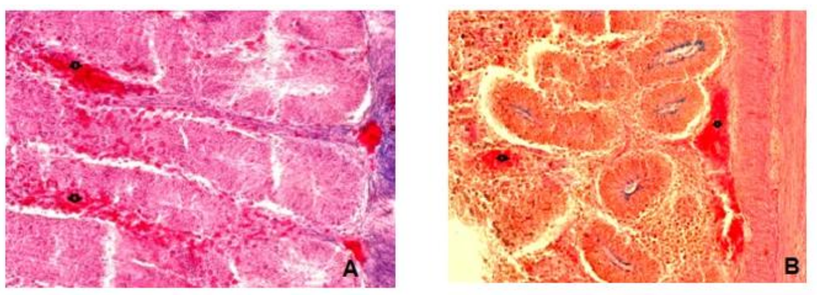

Figure 5. Intestinal mucosa – LGa – A, B - hyperemia in the chorion and submucosa and leukocyte infiltrates (Mallory trichrome staining, 400x)

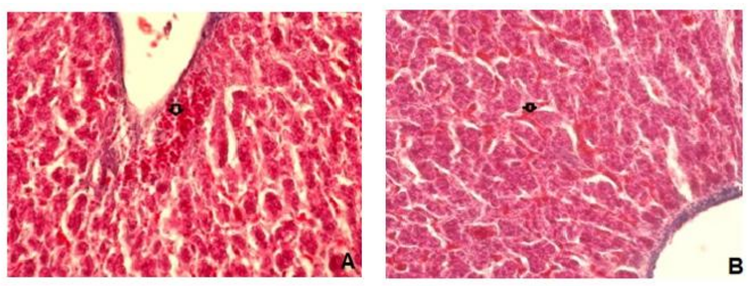

Figure 6. Histological section through the liver. A - LC – hepatocyte cords and perivascular leukocyte infiltrates; B -LGa - hepatocyte cords and capillary hyperemia (Mallory trichrome staining, 400x)

CONCLUSION

Dietary supplementation of broilers with 1% garlic powder resulted in a significant increase in intestinal histomorphometric parameters (villus height, width, surface area, perimeter, and crypt depth), suggesting an expansion of the absorptive surface and an improved nutrient utilization capacity, with a favorable impact on growth performance. At the intestinal level, vascular hyperemia and leukocyte infiltrates were observed, indicating a potential immunomodulatory effect, while hepatic findings included vascular hyperemia and hepatocellular hypertrophy. These modifications support the role of garlic as a natural growth promoter and a potential alternative to antibiotics in broiler nutrition.

FUTURE WORK / REFERENCES

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