UDC: 636.5.087.7

EVALUATION OF A CHITOSAN–DRY WHEY-BASED COMPLEX FEED ADDITIVE ON GROWTH PERFORMANCE, HEMATOLOGICAL STATUS, AND SORPTION–PROTECTIVE EFFECTS IN BROILER CHICKS

Rakhmonov Farkhod Kholbayevich
Assistant, Zarmed University, Samarkand, Uzbekistan E-mail: farxod1313jon@gmail.com
Eshburiyeva Noila Rashidovna
Assistant, Zarmed University, Samarkand, Uzbekistan E-mail: eshburievanoila@gmail.com
Qodirova Nargiza Esanovna
Assistant, Zarmed University, Samarkand, Uzbekistan E-mail: nargizadodirova372@gmail.com

Abstract: *In intensive poultry production, rapid growth, high stocking density, and variability in feed raw-material quality create conditions in which maintaining intestinal stability, reducing toxic load, and optimizing growth outcomes become key management priorities. Biologically based feed additives that combine protective and nutritional functions are therefore of particular practical interest. Chitosan is a natural biopolymer derived from chitin and is characterized by sorption, bioadhesive, and “coating” properties that may strengthen protective–adsorptive mechanisms along the gastrointestinal tract; dry whey powder, in turn, provides high-biological-value protein and essential amino acids that can improve the nutritional completeness of broiler diets. In this study, a chitosan + dry whey powder complex was administered to Cobb cross broiler chicks via drinking water from 7 days of age at doses of 40, 60, and 80 mg per bird per day. Growth performance (body weight dynamics and average daily gain), survivability, and selected hematological–biochemical blood indicators were assessed under vivarium conditions. The results indicated that supplemented groups demonstrated improved growth parameters compared with the control, while metabolic markers remained within physiological ranges. The 60 mg dose showed a relative advantage in growth intensity, whereas the 80 mg dose was interpreted as more appropriate from the standpoint of survivability and sorption–protective orientation. Overall, the findings support the need to justify dose selection according to targeted production goals (maximal growth vs. enhanced preservation and protection) when implementing additives derived from secondary food-industry resources.*

Keywords: *chitosan, chitin, dry whey powder, broiler chick, growth rate, live body weight, average daily gain, hematological indicators, hemoglobin, erythrocytes, total protein, globulins, sorption–protective effect, poultry production.*

INTRODUCTION

Broiler poultry production is a high-output industry designed to increase meat yield within a short rearing period. The realization of genetic potential in modern crosses depends strongly on feed quality, intestinal health, and effective management of stressors. In practical settings, seasonal variability in raw materials, the risk of mycotoxin contamination, and high stocking density may destabilize the intestinal environment and impair metabolic homeostasis, ultimately affecting performance and flock uniformity [9, 22]. Consequently, along with reducing reliance on prophylactic antibiotics, there is sustained interest in additives based on sorbent, immunomodulatory, and nutritionally supportive components [1, 22].

Chitosan is a naturally occurring polysaccharide. Due to its bioadhesive and sorption properties, it may form a protective layer on the gastrointestinal mucosa, enhance adsorption of harmful compounds, and contribute to functional stabilization of the intestinal barrier; such effects are described in scientific sources addressing chitin/chitosan technologies and their application in animal feeding [8, 9, 15]. Dry whey powder is a secondary product of the dairy industry, rich in whey proteins and essential amino acids. By improving the biological value of the ration, whey can support growth performance and feed utilization in broilers [3, 17, 20]. The combined use of chitosan and whey is therefore expected to yield a complex outcome: sorption–protective action alongside improved protein–amino acid supply [3, 8, 15].

Aim of the study. To evaluate the effects of a chitosan and dry whey powder complex additive on growth performance, survivability, and selected hematological–biochemical blood parameters in broiler chicks and to substantiate a practical dose orientation for production use.

Main part. Studies conducted in the CIS region suggest that chitosan-based complexes may improve broiler growth dynamics, feed-use indicators, and economic outcomes under production conditions [13, 14, 16]. The sorbent capacity of chitosan, including potential mitigation of mycotoxin-related load and reinforcement of protective functions of the intestinal mucosa, is also widely discussed [8, 9, 15]. Furthermore, local and regional research has reported that certain chitosan-based complexes can enhance clinico-physiological indicators and survivability in broiler chicks [23, 24].

Regarding dry whey, the literature highlights the role of whey proteins (including bioactive peptides and a balanced amino acid profile) and lactose fractions in optimizing energy–protein supply, thereby improving growth rate and live body weight under appropriate conditions [3, 17, 18]. At the same time, effectiveness is influenced by inclusion level, overall diet composition, and management factors [22]. Accordingly, experimental evaluation of the dose-dependent efficacy of chitosan + whey combinations is of clear applied value [11, 12].

Methodology. The experiment was conducted under generally accepted vivarium protocols. Cobb cross broiler chicks were used as the biological model. A total of 100

chicks were allocated into four groups: one control group and three experimental groups. All groups were kept under identical conditions and fed the same commercial feed (“Super Don”). In experimental groups, the chitosan + dry whey powder complex was administered via drinking water starting from 7 days of age. Chitosan was first dissolved in a 2% acetic acid solution and then added to drinking water.

The dosing scheme was as follows: 40 mg per bird per day (chitosan 2 mg + dry whey 38 mg), 60 mg per bird per day (chitosan 4 mg + dry whey 56 mg), and 80 mg per bird per day (chitosan 6 mg + dry whey 74 mg). Throughout the trial, clinical condition, survivability, and body weight gain were monitored. Weighing was performed at 28 days and 42 days of age. Blood samples were collected during weeks 3–6 and analyzed for hematological (erythrocytes, hemoglobin) and biochemical indicators (total protein, albumin, globulins, and selected metabolites) [2, 7]. Meat moisture and chemical composition were assessed according to applicable regulatory documentation [4, 5]. Statistical processing was carried out in Microsoft Excel, and results are presented as mean ± standard error.

Table 1.

Experimental design and dosing scheme (from day 7)

Group Status Additive dose, mg/bird/day Composition (mg) chitosan + dry whey Administration route

1 Control 0 0 + 0 Drinking water (no additive)
2 Experimental 40 2 + 38 Via drinking water
3 Experimental 60 4 + 56 Via drinking water
4 Experimental 80 6 + 74 Via drinking water

Results and discussion. Clinical observations indicated stable general condition in all groups throughout the experiment; no pronounced adverse reactions were recorded in supplemented groups. Hematological dynamics showed positive trends within physiological ranges for erythrocytes and hemoglobin. At the beginning of the trial (day-old chicks), the erythrocyte count was 3.21±0.31×1012/L; over subsequent weeks, a gradual increase was observed, and by the end of the trial experimental groups demonstrated slightly higher values than the control. The favorable shifts in hemoglobin may reflect improved oxygen transport capacity and optimization of general metabolic activity [3, 8].

Biochemical assessments showed that, in some groups—especially under the higher dose—globulin fractions tended to increase, which can be interpreted as a potential enhancement of immune-functional activity [15]. Meanwhile, metabolic markers such as uric acid, glucose, bilirubin, and cholesterol remained within physiological limits, supporting a favorable safety profile for the tested scheme [10].

In growth performance assessment, the 60 mg dose group showed clearer advantages in average daily gain compared with the control, and body weight at week 5 approached higher values. This outcome is consistent with CIS reports indicating that chitosan complexes may support feed utilization and growth in broilers [13, 14,

16]. Since whey is also associated with improvements in growth-related metrics in broilers, the observed positive dynamics may have been strengthened by the nutritional contribution of whey components in the mixture [3, 17, 20].

In terms of survivability, the higher dose group exhibited a slight advantage over the control. This may be linked to chitosan’s sorption and mucosa-“coating” properties, which could contribute to intestinal stabilization and reduced toxic burden [8, 9, 15]. Supporting observations from local and regional studies also indicate that certain chitosan-based complexes can improve preservation rates in broiler chicks [23, 24]. In the organoleptic and toxic-biological evaluation of meat, samples met “fresh meat” criteria, and cooking tests reported clear broth and absence of off-odors. A tendency toward improved biological value can be linked to optimized protein–energy metabolism [3, 4].

Table 2.

Live body weight and average daily gain of broilers (M±m)

Group	Body weight at 2 weeks, g	Average daily gain at 3 weeks, g	Body weight at 5 weeks, g	Average daily gain at 5 weeks, g
Control	910±67.6	31.0	1934±64.9	45.1
40 mg	1078±62.5*	37.1	2085±70.6*	48.7
60 mg	1089±58.2*	37.5	2165±81.1*	50.6
80 mg	1051±48.7*	36.1	2182±61.3*	51.0

Note: *P<0.01 vs. control.

Table 3.

Selected blood indicators (M±m)

Indicator	Period	Control	40 mg	60 mg	80 mg
Erythrocytes, ×10^12/L	Start (day 1)	3.21±0.31	3.21±0.31	3.21±0.31	3.21±0.31
Erythrocytes, ×1012/L	Week 5	3.64±0.36	3.65±0.27	3.68±0.26	3.66±0.32
Hemoglobin, g/L	Week 5	137.46±14.6	132.68±21.8	139.62±17.1	140.7±19.27
Total protein, g/L	Week 4	34.4±3.07	34.4±3.07	34.4±3.07	34.4±3.07
Total protein, g/L	Week 5	31.34±2.67	34.0±1.75	36.6±3.06	35.8±2.81*
Globulins, g/L	Week 5	15.82±1.35	19.6±1.68	21.18±2.19	20.58±1.26**

Note: *P<0.05; **P<0.01 vs. control.

Outcome. Administration of a chitosan–dry whey powder complex via drinking water improved growth performance in broiler chicks: live body weight and average daily gain increased compared with the control, while key hematological and biochemical indicators remained within physiological limits. From a growth-intensity perspective, the 60 mg/bird/day dose appeared relatively more effective, whereas

from a survivability and sorption–protective orientation, the 80 mg/bird/day dose was interpreted as a practical option.

Conclusion. The chitosan and dry whey powder combination exerts a positive influence on live body weight, growth performance, and physiological status in broiler chicks. The maintenance of metabolic markers within normal ranges indicates relative safety of the tested scheme. For practical farm application, a 60 mg/bird/day dose can be considered when the primary goal is maximal growth, whereas an 80 mg/bird/day dose may be considered when preservation and reduction of toxic load are prioritized. Future studies should expand the biostatistical design and include feed conversion ratio (FCR), intestinal microbiota characterization, calcium–phosphorus metabolism, and bone mineralization parameters to refine dose–response interpretation and application recommendations.

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