THE EFFECT OF SEA BUCKTHORN (*HIPPOPHAE RHAMNOIDES*) IN THE DIET OF THE BROILER CHICKEN

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Abstract

The inclusion of sea buckthorn fruits (Hippophae rhamnoides) or by-products resulting from their processing in the diet of the chicken broiler is an effective strategy for improving biotechnical performance, due to the high content of vitamins (A, C, E), flavonoids and essential fatty acids. The administration of these phytogenic supplements stimulates the digestibility of nutrients and balances the intestinal microbiota, which leads to a significant increase in the average daily increase and a reduction in the feed conversion index (FCR). Also, the antioxidant properties of sea buckthorn protect the integrity of the intestinal barrier against oxidative stress, facilitating superior absorption of amino acids and minerals. Beyond the growth parameters, dietary supplementation positively influences the quality of the carcass, the carotenoid pigments in sea buckthorn ensuring a natural golden-yellow coloration of the skin, often correlated with an increased content of polyunsaturated fatty acids in muscle tissue.

Key words: *Hippophae rhamnoides, chicken brooches, natural carotenoids*

INTRODUCTION

The use of sea buckthorn (Hippophae rhamnoides) in chicken broiler nutrition has gained significant interest due to its bioactive profile rich in flavonoids, carotenoids and polyunsaturated fatty acids, which act as natural growth promoters. The inclusion of fruit meal or sea buckthorn extracts in feed rations contributes to the improvement of the average daily increase and to the optimization of the feed conversion index (FCR), effects attributed to the stimulation of enzyme secretions and the improvement of the integrity of intestinal villi [1]. Furthermore, the antioxidant properties of sea buckthorn reduce oxidative stress at the cellular level, strengthening the birds' immune systems and increasing their resistance to pathogens, which translates into a low mortality rate among herds [2].

In addition to livestock performance, natural pigments in sea buckthorn (especially zeaxanthin and b-carotene) have been observed to improve the sensory quality of the carcass, providing a more intense coloration to the skin and subcutaneous fat, which is preferred by consumers [3].

The present study aims to analyze the impact of supplementing the diet with different forms of sea buckthorn on growth performance, providing insight into its potential to improve economic efficiency and nutritional value in poultry meat production.

MATERIAL AND METHOD

To carry out this review, scientific articles, specialized books and official reports published between 2009 and 2025 were consulted, available in databases such as Google Scholar, Scopus and on the websites of recognized institutions (EFSA, USDA, ISO). The keywords used in the

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search included: "carotenoids", "broiler", "additives".

The selection of papers was based on their relevance to the proposed theme, considering both experimental studies and synthesis articles. Only materials that directly analysed the importance of carotenoids and their effect on chickens (health effects, effects on meat and egg quality, general welfare) and food safety aspects were included. The extracted information was then grouped and synthesized according to the categories of factors presented in the text, to provide a clearer and more accessible picture of the main conclusions in the literature.

RESULTS AND DISCUSSIONS

Sea buckthorn (Hippophae rhamnoides L.) is a shrubby species with a rich content of bioactive compounds (vitamins, carotenoids, essential fatty acids and polyphenols), which has led to the interest of researchers in evaluating its potential as a functional ingredient in bird nutrition (*Tab.1*) [4]. Due to the antioxidant, anti-inflammatory and hepatoprotective properties of its constituents, the use of sea buckthorn in poultry rations can positively influence the health and productive performance of birds [3].

Table 1. Chemical composition of sea buckthorn

Component	Fruit %	Leaves %	Biological Role	Reference
Crude protein	1-2%	12-20%	Protein synthesis and muscle mass development;	[5]
Fatty Acids and Lipids	5-12%	2-5%	Energy sources; plumage development; prevention of oxidative stress;	[6]
Vitamins (A,B,C,E)	A: 0.5–0.8 mg/100g B: 0.1–0.2 mg/100g C: 200–600 mg/100g E: 15–25 mg/100g	A: 1 mg/100g B: 0.2–0.5 mg/100g C: 400–1000 mg/100g E: 20–40 mg/100g	Antioxidants; support the immune system; increase resistance to stress;	[7]
Minerals (K, ca. Mg, P, Fe, Zn, Cu)	K: 500–800 mg/100g Ca: 50–70 mg/100g Mg: 30–50 mg/100g P: 40–60 mg/100g Fe: 2–3 mg/100g Zn: 0.5–1 mg/100g Cu: 0.1–0.2 mg/100g	K: 1500–3000 mg/100g Ca: 200–400 mg/100g Mg: 100–200 mg/100g P: 80–150 mg/100g Fe: 15–25 mg/100g Zn: 2–5 mg/100g Cu: 0.5–1 mg/100g	Support bone development; enzymatic regulation; increases productive performance;	[5]
Carotenoids	10-15 mg/100g	20-40 mg/100g	Natural color of the yolk; antioxidant protection;	[6]
Polyphenols and Flavonoids	150-300 mg/100g	500-900 mg/100g	Antioxidant, anti-inflammatory; reduce oxidative stress; liver protection;	[8]
Carbohydrates	5-15%	10-25%	Energy sources; influences digestibility;	[5]

The results of research on the inclusion of sea buckthorn in the nutrition of chicken broilers are variable and dependent on the form of administration (Fig. 1), levels of inclusion (Tab. 2) and duration of administration.

According to the study conducted by [5], the addition of sea buckthorn to the diet of the chicken broiler leads to a reduction in liver damage and lipid peroxidation markers. This effect is attributed to the high content of natural antioxidants.

According to research conducted by [9], supplementation of the sea buckthorn leaf diet was associated with improved oxidative stability of meat and favorable alteration of the fatty acid profile (Fig. 1).

Expresstenal studies have demonstrated that sea buckthorn seed powder or extracts can have beneficial effects on production and qualitative parameters in poultry production systems [10,11]. Sea buckthorn supplementation has been associated with improved egg quality and lower yolk cholesterol, suggesting a favorable impact on the health profile of poultry products intended for human consumption [6].

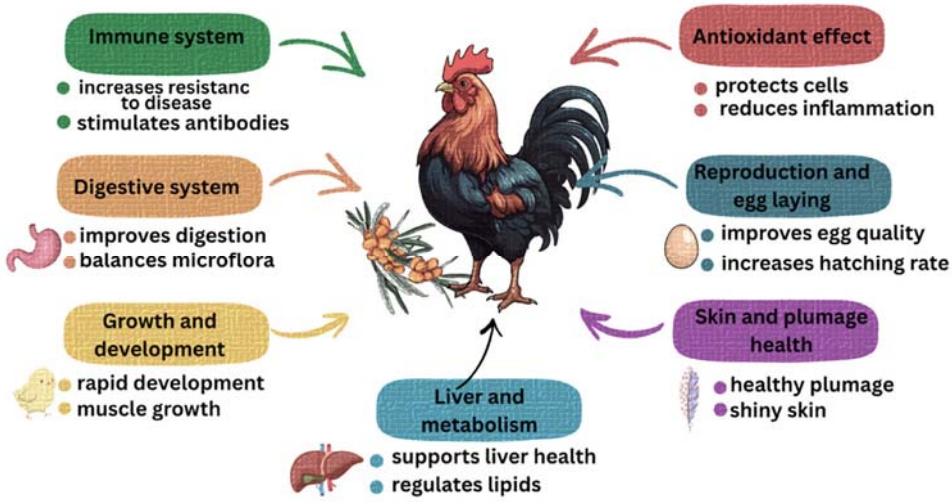

Fig. 1. The effect of sea buckthorn on the chicken broiler

A study by [12] evaluated the effect of partially replacing wheat with sea buckthorn fruit residues in the diet of Ross 308 chickens. The substitution of 15% of wheat resulted in a significant reduction in body weight and feed conversion index, but improved skin pigmentation. Similarly, [13] investigated the effects of flavonoids on production performance and carcass quality. The results showed that flavone supplementation in concentrations of 0.05%-0.10% resulted in a significant increase in average daily gain and an improvement in the fat deposition profile (*Table 2*). Compliance with the doses is the most important factor to obtain the best possible result. Thus, in the starter phase (0-10 days), which is essential for stabilizing the immune system, small doses (0.5%) are recommended so as not to hinder digestion by excess fiber. In the growe phase (11-28 days) increase the dose by 05-1% is recommended. And the finisher phase (29 days-slaughter), the decisive stage for carcass quality, a maximum concentration of 2% is recommended to ensure the storage of antioxidants and carotenoids in the muscles and skin [3].

Table 2. Doses-effect of sea buckthorn administration in the diet of the chicken broiler

Shape of Administration	Dosage	Effect	Reference
Dried fruits	10-15g/kg	Improved skin pigmentation; maintained average daily increase; minor effect on weight at high doses;	[12]
Fruit flavonomy	0,05-0,10%	Increase in average daily increase; improving fat deposition; case quality;	[13]
Leaves	2%	Increased antioxidant capacity in meat; higher oxidative stability; increased xanthophyll content;	[8]
Concentrated extract	5-8%	High concentrations of polyphenols and carotenoids; antioxidant and immunostimulating effect;	[7]
Sea buckthorn juice	50–400 mg/100 mL vitamin C/E	Immunity support; prevention of oxidative stress; increasing the resistance of birds;	[7]
Sea buckthorn oil	0,5-1%	Hepatoprotective activity; reduction of liver necrosis; protection of the liver and immune system;	[14]
Flavonoids and antioxidants	400-800 ppm	Reduction of oxidative stress; protection of the liver and immune system;	[15]
Sea buckthorn dried fruit	12 g/kg	Metabolizable energy value 14.29 MJ/kg DM; no adverse effect on performance;	[7]

In terms of the protection of vital organs, studies have revealed the ability of sea buckthorn oil to reduce the toxic effects of aflatoxin B1 on the liver, by decreasing liver necrosis and fat accumulation [16, 17]. This indicates a hepatoprotective potential of this nutritional supplement in poultry diets exposed to toxic stressors [5].

The administration of sea buckthorn in doses of 1%-1.5% has been correlated with better development of the Fabricius bursa and the spleen, key organs for lymphocyte maturation [4].

Recent research has also shown that sea buckthorn leaves, used as a natural source of antioxidants, can help improve the fatty acid composition and oxidative stability of chicken when used in conjunction with other nutrients [8].

The antioxidant effect of sea buckthorn is not only direct (neutralization of free radicals) but also indirectly, by modulating the gene expression of protective enzymes [18].

Studies indicate that the optimal dose of sea buckthorn improves the digestibility of proteins and lipids. By stabilizing the intestinal microflora (increasing the population of *Lactobacilus),* chickens capitalize more efficiently on feed, reducing metabolic losses [1]. Additional batches of sea buckthorn extracts frequently have delivery weights 3-5% higher than control batches under conditions of environmental stress.

The immunomodulatory effect of sea buckthorn is closely related to the high concentration of flavonoids and polysaccharides, which actively intervene in cell communication and antibody protection [19].

Studies have shown that chicken broilers receiving sea buckthorn extracts have higher titers of antibodies (IgA, IgG and IgM) in serum. Increasing the level of Immunoglobulin A (IgA) in the intestinal mucosa is crucial, as it represents the first line of defense against pathogens such as *Salmonella or E.coli* [2].

The bioactive compound *isoramnetin* in sea buckthorn inhibits the release of pro-inflammatory cytokines. This prevents the "waste" of energy from the puppy's body to inflammatory processes, redirecting nutritional resources to the deposition of muscle mass [2].

Table 3. Comparing the effects of *Hippophae rhamnoides* with other natural additives in broiler nutrition

Natural additives	Dose (mg/day)	Effect	References
Hippophae rhamnoides	50-400	-Immunity support; - prevention of oxidative stress; - increasing the resistance of birds;	[7]
Calendula Officinalis	50-60	-antioxidant - enhances growth performance - enhances the color of the meat	[20]
Peppermint essential oil	1000	-increases egg production	[21]
Oregano	100	- enhances growth performance	[22]
Black pepper	1000	-antioxidant -antimicrobial	[23]
Eucalyptus	100-200	- enhances growth performance	[24]
Ginger	100-150	- increases egg production	[25]
Sun	100-200	-enhances the form index and yolk index	[26]
Game	20-40	- antioxidant - enhances growth performance	[27]
Common chicory	300-500	-strengthening the integrity of the microbiota	[28]
Turmeric	1000	- antioxidant	[29]
chili pepper	100-200	-antioxidant - enhances the color of the meat	[30]
Moringa	150-200	- antioxidant -antibacterial	[31]
Tomato	250-300	- improve significantly egg traits;	[32]

Analyzing the data presented in Table 3, some fundamental differences can be observed between sea buckthorn and the rest of the natural sources of carotenoids. While some sources have a strictly defined role - for example marigolds and peppers focus on the pigmentation of the meat, and ginger and tomatoes on the quality of the eggs - sea buckthorn represents a much broader spectrum of action. It combines immune support with antioxidant protection and increased overall resistance of birds, being a holistic additive.

Sea buckthorn represents a flexible dose range (50-400 mg/day) and is located in an intermediate area of administration. It is more effective at low doses compared to turmeric, mint or black pepper, which requires concentrations of up to 1000 mg/day to exert its antioxidant or production-boosting effects. Unlike eucalyptus, oregano, chicory, or ginger, sea buckthorn acts as a resistance agent. By preventing oxidative stress at doses of up to 40 mg, it prepares the bird's body for periods of heat or immunological stress, which is essential in industrial broiler breeding.

CONCLUSION

The present paper highlighted the essential role that sea buckthorn (*Hippophae rhamnoides*) plays in the modern nutrition of broiler chickens, providing a natural and sustainable alternative to synthetic additives. Following the analysis of the literature and the comparison with other phytogenic additives, the following conclusions can be drawn:

Sea buckthorn is distinguished by a holistic action, providing immune support and prevention of oxidative stress at moderate doses (50-400 mg/day). It outperforms the effectiveness of other additives such as turmeric or black pepper, which require doses up to three times higher for similar effects.

The administration of sea buckthorn significantly improves the average daily increase (SMZ) and optimizes the feed conversion index (FCR). This productive success is the direct result of improved gut health and microbiota integrity, effects comparable to those of oregano or chicory.

Unlike additives specialized only on pigmentation (such as marigolds or chili peppers), sea buckthorn not only intensifies the color of the carcass, but also actively improves the fatty acid profile (through the intake of Omega-7) and increases the oxidative stability of the meat during storage.

Although dosages vary, sea buckthorn's versatility (ability to simultaneously replace antioxidants, immunostimulators, and synthetic pigments) makes it a cost-effective solution for farms targeting premium meat production.

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