Research Advances in the Application of Sunflower Seed Meal in Broiler Diets: Postprint

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Abstract

Sunflower seed meal is a by-product of sunflower seed oil processing, characterized by high protein content, and can be utilized as an unconventional protein source in broiler feed production. Research on the nutritional aspects of sunflower seed meal in poultry feed is limited domestically, whereas it has received considerable attention internationally. This article collected and analyzed international literature on the application of sunflower seed meal in broilers, providing a systematic review of its physicochemical properties, nutritional value for broilers, amino acid digestibility, anti-nutritional factors, and appropriate dietary inclusion levels, thereby offering a reference for the practical utilization of sunflower seed meal in broiler production.

Full Text

Research Advances on Application of Sunflower Seed Meal in Broiler Diets

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Abstract

Sunflower seed meal is a by-product of sunflower oil processing with high protein content, which can be used as an unconventional protein source in broiler feed production. While domestic research on the nutritional value of sunflower seed meal in poultry feed remains limited, it has received considerable attention internationally. This article systematically reviews international studies on the application of sunflower seed meal in broilers, covering its physicochemical properties, nutritional value, amino acid digestibility, anti-nutritional factors, and

appropriate inclusion levels, providing a reference for the practical application of sunflower seed meal in broiler production.

Keywords: sunflower seed meal; broilers; nutritive value; anti-nutritional factors

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The continuously rising price of conventional protein feed ingredients (soybean) has imposed serious constraints on the livestock industry, particularly on poultry production in developing countries. Identifying cost-effective agricultural by-products that can meet the protein and amino acid requirements of poultry represents a key research focus in industrial and animal nutrition science. Sunflower seed, the fruit of the sunflower (*Helianthus annuus*), consists of pericarp (hull) and seed. Native to southwestern North America and now cultivated worldwide, global sunflower seed production reaches 37.08 million tons annually. Like soybean and cotton, sunflower is a major oilseed crop, producing 15.22 million tons of sunflower oil per year. The expanding development of sunflower and widespread application of sunflower oil have made it an important source of protein for animal feed. Sunflower seed meal is produced after oil extraction through pre-pressing or direct solvent extraction, typically containing 60–65% sunflower seed kernel and 35–40% hull, with a crude protein content of 30–34%. In recent years, sunflower seed meal has been recognized as an effective alternative to soybean meal for broilers and has been extensively studied abroad. However, its low energy value, high fiber content, and low lysine level are the main factors limiting its high-level application in broiler diets. This article systematically reviews the physicochemical properties, effective energy values, amino acid digestibility, anti-nutritional factors, appropriate inclusion levels, and effects on growth performance and carcass traits of sunflower seed meal in broilers to provide a reference for its scientific application in broiler feed formulation.

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1. Conventional Nutrient Composition of Sunflower Seed Meal

Sunflower seed meal is a high-quality protein feed ingredient. Through comprehensive analysis of composition studies by various researchers (Table 1), sunflower seed meal contains 88.00–93.80% dry matter (mean 90.90%), 26.41–40.30% crude protein (mean 32.00%), 0.40–18.78% crude fat (mean 8.09%), 11.54–29.68% crude fiber (mean 20.80%), and 5.91–7.75% crude ash (mean 6.38%). Notably, compared with conventional soybean meal, sunflower seed meal has significantly higher crude fiber (20.80% vs. 6.21%) and crude fat content (8.09% vs. 0.55%). The substantial variation in reported composition values among researchers can be attributed to differences in sunflower variety and growing region, processing technology during production, and the number of oil

extraction cycles. Repeated oil extraction reduces crude fat content, while micronization and air classification can decrease crude fiber content. Additionally, processing with or without hulls significantly affects fiber and fat content, with hulled sunflower seeds yielding higher crude fat and fiber levels.

Table 1 Conventional nutrient composition of sunflower seed meal

2. Nutritional Value of Sunflower Seed Meal for Broilers

Feed energy value is crucial for evaluating nutritional value in broiler production. Sunflower seed meal and soybean meal have similar gross energy values at approximately 18.84 MJ/kg. However, reported metabolizable energy values for sunflower seed meal vary considerably among studies: Lautner reported 7.97 MJ/kg; Rose et al. found digestible energy values of 8.79–9.21 MJ/kg; Rad et al. reported metabolizable energy of 7.53–8.79 MJ/kg; Samy determined a value of 10.41 MJ/kg; Valdivie et al. reported 6.28–9.21 MJ/kg; and Dessouky suggested 6.91 MJ/kg. Overall, the metabolizable energy of sunflower seed meal ranges from 6.28 to 10.46 MJ/kg, with a typical average of 7.95–8.19 MJ/kg, which is lower than that of soybean meal. Apparent metabolizable energy is closely related to inclusion level, showing a quadratic relationship where energy decreases then increases with higher inclusion rates (7.87, 7.06, and 7.65 MJ/kg at 7%, 14%, and 28% inclusion, respectively).

Essential amino acid content is a determining factor in evaluating protein quality. Soybean meal is rich in well-balanced essential amino acids. Recent analyses of sunflower seed meal amino acid composition (Table 2) show methionine at 0.64%, cysteine at 0.59%, lysine at 1.16%, threonine at 1.20%, tryptophan at 0.39%, arginine at 2.48%, isoleucine at 1.39%, leucine at 2.20%, and valine at 1.49%. Compared with soybean meal, sunflower seed meal has higher methionine and cysteine but lower lysine, leucine, isoleucine, threonine, tryptophan, arginine, and valine. Rutkowski reported that broilers digest crude protein from soybean meal and sunflower seed meal at 90% and 94%, respectively, showing little difference. However, Green et al. found that broilers' true digestibility of essential amino acids from sunflower seed meal was equal to or greater than that from soybean meal, except for lysine (72.2% vs. 87.9%). Therefore, amino acid balance must be considered when substituting soybean meal with sunflower seed meal, with lysine being the first limiting amino acid. Processing temperature significantly affects protein quality: Zhang et al. showed that heating sunflower seed meal at 100 °C for 0, 30, 60, and 90 min reduced lysine digestibility from 86% to 54%, 43%, and 35%, respectively. Heating at 144 °C in a conditioner caused significant losses of tryptophan, lysine, and arginine compared with 122 °C. Rad et al. also noted that increasing conditioner temperature from 80 °C to 130 °C decreased net protein utilization and lysine availability. Thus, conditioner temperature should be appropriately reduced in diets containing sunflower seed meal to preserve its nutritional value.

Table 2 Analysis of amino acid composition of sunflower seed meal

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3. Effects of Sunflower Seed Meal on Broiler Growth Performance

A review of studies from the past decade on varying inclusion levels of sunflower seed meal reveals substantial variation among published results. However, clear patterns emerge regarding its effects on growth performance, which are closely related to inclusion level. When inclusion remains below the upper limit for broilers, partial replacement of soybean meal with sunflower seed meal improves average daily feed intake, increases average daily gain, and enhances feed utilization efficiency, demonstrating positive effects. However, when inclusion exceeds the digestible limit, significant negative effects occur on average daily gain and feed efficiency.

Sunflower seed meal contains 20–25% cellulose and 8–10% lignin due to its composition of 60–65% kernel and 35–40% hull, resulting in markedly higher crude fiber than soybean meal. Research indicates that crude fiber is the primary anti-nutritional factor in broiler diets—levels below 7% have no significant effect on feed utilization, but levels above 7.7% reduce feed efficiency. High fiber and non-starch polysaccharides decrease nutritional value by increasing intestinal viscosity, delaying gastric emptying, and reducing digestibility of dry matter, crude protein, and crude fat. Laudadio et al. used low-fiber sunflower seed meal (2.9% crude fiber) at up to 18% inclusion across all growth stages with positive effects on performance, demonstrating that the restrictive effect of high inclusion levels depends on fiber content. Additionally, chlorogenic acid, the main polyphenolic compound in sunflower seed meal at 2.7% (70% of total polyphenols), can significantly reduce protein bioavailability despite being non-toxic and having antioxidant properties. This explains why low inclusion levels promote growth while high levels inhibit it. Notably, because sunflower seed meal lysine content (1.16%) is substantially lower than soybean meal (2.79%), crystalline lysine is typically supplemented in formulations, which may also contribute to improved performance at higher inclusion levels.

To mitigate the negative effects of high fiber and improve utilization, researchers often supplement sunflower seed meal diets with exogenous enzymes including amylase, protease, cellulase, pectinase, β-glucanase, and xylanase. While these enzymes have shown some efficacy in improving utilization and performance, results vary widely among studies, likely due to differences in enzyme type, activity, and use of enzyme cocktails. Overall, when inclusion remains below the upper limit, higher sunflower seed meal levels benefit broiler performance, but fiber utilization, enzyme supplementation, and dietary fiber levels must be considered. Based on literature synthesis, inclusion levels of 10–15% generally have no negative effects on growth performance without enzyme supplementation. Future research should focus on processing methods, development of low-fiber varieties, efficient exogenous enzymes, and optimal inclusion levels for different

broiler strains and growth stages.

Table 3 Effects of sunflower seed meal on growth performance of broilers

In terms of carcass traits (Table 4), sunflower seed meal has no significant effect on slaughter yield, breast muscle rate, or leg muscle rate. However, increasing inclusion levels reduces abdominal fat and heart weight while promoting gizzard and intestinal development. These effects on fat reduction and digestive organ development are clearly attributable to high fiber content. The promotion of intestinal development may also explain why low-level sunflower seed meal inclusion improves growth performance.

Table 4 Effects of sunflower seed meal on carcass traits of broilers

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4. Summary

Sunflower seed meal is a high-quality protein feed ingredient characterized by high protein content and digestibility, serving as an effective protein resource in broiler nutrition, particularly given current high soybean prices. However, its substantially higher crude fiber content compared with soybean meal limits its inclusion level. A maximum inclusion of 10–15% is recommended, though this can be increased when using low-fiber sunflower seed meal supplemented with appropriate fiber-degrading and non-starch polysaccharide enzymes.

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