Effects of Corn Grinding Particle Size on Pellet Feed Processing Quality and Growth Performance of Finishing Pigs (Postprint)

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Date: 2017-10-11T00:00:00+00:00

Abstract

This experiment aimed to investigate the effects of different corn grinding particle sizes on pellet feed processing quality and growth performance of finishing pigs under the same formula. Corn was ground using screens with aperture sizes of 1.5/2.0, 2.0/2.0, 2.0/2.5, 2.5/2.5, 2.5/3.0, and 3.0/3.0 mm, yielding corn materials with geometric mean particle sizes of 303.91, 346.08, 356.81, 358.51, 373.29, and 387.7 m, respectively. Diets containing corn of different grinding particle sizes were processed using the same formula and identical processing parameters (screen aperture size of 2 mm for other raw materials, conditioning temperature of 80 °C for pelleting, die hole diameter of 3 mm, and length-to-diameter ratio of 9:1). A total of 108 Duroc × Landrace × Yorkshire crossbred pigs with an average body weight of (62.68$±$5.59) kg were selected and randomly allocated to 6 groups (3 replicates per group, 6 pigs per replicate, with equal numbers of barrows and gilts), and fed diets containing corn of different grinding particle sizes for an experimental period of 8 weeks. The results showed that: as screen aperture size increased, grinding energy consumption decreased from 9.02 kW · h/t to 6.86 kW · h/t, while pelleting energy consumption increased from 19.06 kW · h/t to 22.30 kW · h/t; in vitro crude protein digestibility exhibited an increasing trend with increasing corn grinding particle size, with the 2.5/2.5 mm group being the highest and significantly higher than the 1.5/2.0 mm group ($P<0.05$); pellet hardness in the 2.5/3.0 and 3.0/3.0 mm groups was significantly higher than in other groups ($P<0.05$); apparent dry matter digestibility of diets decreased with increasing grinding particle size, with values of 84.43% and 80.62% in the 1.5/2.0 and 3.0/3.0 mm groups, respectively, the latter being 4.5% lower than the former with a significant difference ($P<0.05$); apparent crude protein digestibility of diets showed an overall decreasing trend with increasing corn grinding particle size, with the apparent crude protein digestibility in the 1.5/2.0 mm group being 86.14%, which was significantly different from all other groups (P<0.05); there were no significant differences in average daily gain or feed-to-gain ratio among all groups (P>0.05), and the 2.5/2.5 mm group had the highest average daily feed intake, but without significant differences among groups (P>0.05). Based on the results of this experiment, it is recommended to use a screen aperture size of 2.5/2.5 mm for corn grinding in finishing pig diets.

Full Text

Effects of Corn Grinding Particle Size on Pellet Feed Processing Quality and Growth Performance of Growing-Finishing Pigs

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Abstract

This experiment was conducted to investigate the effects of different corn grinding particle sizes on pellet feed processing quality and the growth performance of finishing pigs under identical formulation conditions. Corn was ground using screen sizes of 1.5/2.0, 2.0/2.0, 2.0/2.5, 2.5/2.5, 2.5/3.0, and 3.0/3.0 mm, yielding corn materials with geometric mean particle sizes of 303.91, 346.08, 356.81, 358.51, 373.29, and 387.7 m, respectively. Diets containing corn of different particle sizes were processed using the same formulation and processing parameters (2 mm screen size for other ingredients, conditioning temperature of 80°C, die hole diameter of 3 mm, and length-to-diameter ratio of 9:1). One hundred eight "Duroc × Landrace × Large White" crossbred pigs with an average initial body weight of (62.68$±$5.59) kg were randomly assigned to 6 groups (3 replicates per group, 6 pigs per replicate, half male and half female) and fed diets containing corn of different grinding particle sizes for an 8-week period.

The results showed that as screen aperture increased, grinding energy consumption decreased from 9.02 to 6.86 kW · h/t, while pelleting energy consumption increased from 19.06 to 22.30 kW · h/t. In vitro crude protein digestibility exhibited an upward trend with increasing corn particle size, with the 2.5/2.5 mm group showing the highest value, significantly greater than the 1.5/2.0 mm group (P<0.05). Pellet hardness in the 2.5/3.0 and 3.0/3.0 mm groups was significantly higher than in other groups (P<0.05). Dietary dry matter apparent digestibility decreased with increasing particle size, with values of 84.43% and 80.62% in the 1.5/2.0 and 3.0/3.0 mm groups, respectively—a 4.5% reduction that was statistically significant (P<0.05). Crude protein apparent digestibility showed an overall decreasing trend with increasing corn particle size, with the

1.5/2.0 mm group achieving 86.14%, significantly different from all other groups (P<0.05). No significant differences were observed in average daily gain or feed-to-gain ratio among groups (P>0.05). The 2.5/2.5 mm group exhibited the highest average daily feed intake, though this did not differ significantly from other groups (P>0.05). Based on these results, a screen aperture of 2.5/2.5 mm is recommended for grinding corn in finishing pig diets.

Keywords: corn; grinding particle size; finishing pigs; pellet quality; growth performance

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Introduction

Livestock researchers have long been particularly concerned with the optimal grinding particle size of feed ingredients for different animals. The quality of a feed product depends not only on formulation quality and raw material superiority but also significantly on processing technology. Feed grinding particle size represents a crucial processing parameter that affects not only the expression of feed nutritional value, animal health status, and production performance but also pellet feed processing quality and efficiency—thereby influencing the economic benefits and market competitiveness of feed products.

Mavromichalis et al. [?] demonstrated that reducing particle size increases contact opportunities between feed nutrients and digestive enzymes, thereby improving nutrient digestibility, though grinding energy consumption increases significantly as particle size decreases. Grinding particle size accounts for approximately 20% of the factors affecting pellet quality [?]. Generally, fine particle size facilitates conditioning and effectively improves pellet feed quality [?], whereas excessively coarse grinding can cause cracks in pellets [?]. Xie et al. [?] used three feed types with grinding particle sizes of 356, 397, and 561 m for pelleting and found that pellet durability decreased significantly as material particle size increased. However, some researchers have concluded that material particle size has no significant effect on pelleting performance [?, ?]. Hedde et al. [?] reported that when feeding corn-based diets to finishing pigs, changing corn from coarse grinding (less than 20% of particles passing through a 1.2 mm sieve) to fine grinding (more than 80% passing through a 1.2 mm sieve) improved weight gain by 8%. Wondra et al. [?] summarized data from several particle size trials and concluded that for growing-finishing pig diets, reducing average corn particle size from 1,200 m to 400 m improved growth efficiency by 1.0%–1.5% for every 100 m reduction.

Nevertheless, these foreign studies were limited to grinding particle sizes above 400 m, with few investigations examining particle sizes below 400 m for finishing pigs. Domestically, research on grinding particle size has primarily focused on piglets, with limited studies on finishing pig feed. Therefore, this study aimed to investigate the effects of corn grinding particle size on pellet feed processing quality and finishing pig growth performance, determine the optimal corn grinding particle size for finishing pig diets, and provide data to support quality improvement in finishing pig feed production and guide livestock feeding practices.

Materials and Methods

Experimental Diets

The composition and nutrient levels of the experimental diets are presented in Table 1 .

Table 1 Composition and nutrient levels of the experimental diet (air-dry basis), %

Ingredients and nutrient levels are shown in the original table format

Notes:
1) Premix provided the following per kg of diet: VA 5,512 IU, VD_3 2,250 IU, VE 24 mg, VK_3 3 mg, VB_1 3 mg, VB_2 6 mg, VB_6 3 mg, VB_{12} 24 g, pantothenate 15 mg, folic acid 1.2 mg, biotin 150 g, Fe 70 mg, Cu 5 mg, Zn 70 mg, Mn 15 mg, I 0.3 mg, Se 0.3 mg.
2) DE and CP were measured values, while others were calculated values.

Diet Processing

Corn was ground using screen combinations with aperture sizes of 1.5/2.0, 2.0/2.0, 2.0/2.5, 2.5/2.5, 2.5/3.0, and 3.0/3.0 mm to produce corn of different particle sizes, with grinding time, output, and power consumption recorded. Other ingredients requiring grinding were processed using a 2.0 mm screen. After preparing all raw materials, six diets containing corn of different grinding particle sizes were formulated according to the formula proportions and then pelleted under conditions of 3.0 mm ring die hole diameter, 9:1 length-to-diameter ratio, and 80°C conditioning temperature, with pelleting time, output, and power consumption recorded.

Experimental Animals and Management

One hundred eight healthy commercial crossbred finishing pigs (Duroc × Landrace × Large White) with an average body weight of (62.68$±$5.59) kg were randomly divided into 6 groups, with 3 replicates per group and 6 pigs per replicate (half male and half female), for an 8-week feeding trial. The experiment was conducted at the Nankou Pilot Base of the Chinese Academy of Agricultural Sciences. Pigs were housed in mixed-gender pens with ad libitum access to feed and water. Pens were kept clean and well-ventilated, with strict temperature control and regular disinfection. Pigs were weighed after overnight fasting at 08:00 on the final day of week 8.

Measurements

Pellet Feed Processing Indices **Grinding Particle Size:** Samples were collected three times per group at each sampling point. Geometric mean particle size was determined using the fourteen-layer sieve method specified in National Standard GB 6971–1986 "Test Methods for Feed Grinders" [?].

Durability: Samples were collected three times per group at each sampling point. Durability was measured using the rotary box method according to the American Society of Agricultural Engineers standard method [?].

Pellet Hardness: Pellet hardness was determined according to the method specified in NY/T 2806–2015 "Feed Inspection and Testing Personnel" [?].

In Vitro Crude Protein Digestibility: Crude protein content was determined using the Kjeldahl method. In vitro crude protein digestibility was measured according to the method of Wang et al. [?].

Energy Consumption Calculation: Energy consumption was calculated using the formula:
Power consumption (kW · h) = Equipment operating current (A) × 220 V × Operating time (h).

Growth Performance of Finishing Pigs Growth performance indices were calculated on a replicate basis, including final body weight, average daily feed intake (ADFI), average daily gain (ADG), and feed-to-gain ratio (F/G).

Dietary Nutrient Digestibility During the final week of the feeding trial, fresh feces were collected daily from each group, mixed, and weighed. Every 100 g of feces was treated with 20 mL of 5% HCl, then dried at 65°C for 72 h, naturally rehydrated at room temperature for 24 h, ground to pass through a 40-mesh sieve, and prepared as air-dried samples for storage and analysis. Crude protein, dry matter, and acid-insoluble ash contents in diets and feces were determined according to national standard methods to calculate apparent digestibility of crude protein and dry matter.

Data Processing

Experimental data were expressed as mean ± standard deviation and analyzed using SAS 9.2 software for covariance analysis and one-way ANOVA. Duncan' s multiple range test was used to examine significant differences, with significance level set at $P<0.05$.

Results

Effects of Corn Grinding Particle Size on Energy Consumption

Grinding Energy Consumption The effects of different screen apertures on grinding energy consumption are shown in Figure 1 [Figure 1: see original paper]. During corn grinding, power consumption per ton of material decreased as screen aperture increased. When screen aperture increased from 1.5/2.0 mm to 3.0/3.0 mm, grinding energy consumption per ton of corn decreased from 9.02 kW・h to 6.86 kW・h, representing a 23.95% reduction. Linear regression (n=6) between screen aperture (X) and grinding energy consumption (Y) yielded the equation: $Y = -0.438X + 9.400$, with $R^2 = 0.990$ and $P<0.01$ by F-test, indicating a strong linear relationship between screen aperture and corn grinding energy consumption.

Figure 1 Effects of different grinding particle sizes on grinding energy consumption

Pelleting Energy Consumption The effects of different screen apertures on pelleting energy consumption are shown in Figure 2 [Figure 2: see original paper]. Power consumption per ton of feed during pelleting increased with increasing grinding particle size. As screen aperture increased from 1.5/2.0 mm to 3.0/3.0 mm, pelleting energy consumption per ton of feed increased from 19.06 kW・h to 22.30 kW・h, a 17.00% increase. Linear regression (n=6) between screen aperture (X) and pelleting energy consumption (Y) produced the equation: $Y = 0.625X + 18.27$, with $R^2 = 0.959$ and $P<0.01$ by F-test, demonstrating a strong linear relationship between screen aperture and feed pelleting energy consumption.

Figure 2 Effects of different grinding particle sizes on pelleting energy consumption

Combined Grinding and Pelleting Energy Consumption The effects of different screen apertures on combined grinding and pelleting energy consumption (grinding energy × 60% + pelleting energy) are shown in Figure 3 [Figure 3: see original paper]. When screen aperture increased from 1.5/2.0 mm to 2.5/2.5 mm, combined energy consumption per ton of feed ranged from 24.48 to 25.10 kW・h, showing minimal variation. However, when screen aperture exceeded 2.5/2.5 mm, combined energy consumption increased with screen aperture. Therefore, excessively coarse corn grinding particle size is not recommended for pelleting, as coarser particle sizes actually increase processing energy consumption.

Figure 3 Effects of different grinding particle sizes on combined grinding and pelleting energy consumption

Effects of Corn Grinding Particle Size on Pellet Feed Processing Quality

Pellet feed processing quality for different corn grinding particle size groups is presented in Table 2 . Different screen apertures significantly affected corn geometric mean particle size and pellet durability, hardness, and in vitro crude protein digestibility. As screen aperture increased from 1.5/2.0 mm to 3.0/3.0 mm, corn geometric mean particle size increased linearly from 303.91 m to 387.70 m, with significant differences among all groups ($P<0.05$) except between the 2.0/2.5 and 2.5/2.5 mm groups ($P>0.05$). Pellet hardness showed an overall increasing trend with corn grinding particle size ($P<0.05$). Pellet durability decreased with increasing particle size, though no significant difference was observed when screen aperture increased from 1.5/2.0 mm to 3.0/3.0 mm; however, the 2.5/3.0 and 3.0/3.0 mm groups were significantly lower than other groups ($P<0.05$). In vitro crude protein digestibility increased initially then decreased with particle size, with the 1.5/2.0 mm group significantly higher than other groups ($P<0.05$).

Table 2 Effects of different grinding particle sizes on pellet feed processing quality in growing-finishing pigs

Table data showing geometric mean particle size, pellet hardness, durability, and in vitro crude protein digestibility across screen aperture groups

Note: Values in the same row with different small letter superscripts differ significantly ($P<0.05$). The same applies below.

Effects of Corn Grinding Particle Size on Growth Performance of Finishing Pigs

Growth performance of finishing pigs in different corn grinding particle size groups is presented in Table 3 . After using covariance analysis to exclude the effect of initial body weight as a covariate, results showed that final body weight was highest in the 2.5/2.5 mm group at 120.93 kg, representing increases of 18.45% and 24.75% compared to the 2.0/2.5 and 3.0/3.0 mm groups, respectively ($P<0.05$). Average daily feed intake was highest in the 1.5/2.0 mm group, which differed significantly from some groups ($P<0.05$) but not from the 2.0/2.0, 2.0/2.5, and 2.5/2.5 mm groups ($P>0.05$). No significant differences were observed in average daily gain among groups ($P>0.05$), though the 2.5/2.5 mm group showed the highest value. The 2.5/3.0 mm group had the lowest feed-to-gain ratio, but differences among groups were not significant ($P>0.05$).

Table 3 Effects of different grinding particle sizes on growth performance of growing-finishing pigs

Table data showing initial body weight, final body weight, ADFI, ADG, and F/G across screen aperture groups

Effects of Corn Grinding Particle Size on Dietary Nutrient Digestibility in Finishing Pigs

Apparent digestibility of dietary nutrients in different corn grinding particle size groups is presented in Table 4 . Corn grinding particle size significantly affected apparent crude protein digestibility in finishing pig diets. As corn grinding particle size increased, apparent crude protein digestibility decreased significantly, with the remaining five groups showing reductions of 3.9%, 3.3%, 2.9%, 3.7%, and 6.2% compared to the 1.5/2.0 mm group (P<0.05). Dry matter apparent digestibility showed a decreasing trend with increasing particle size, with significant differences among groups (P<0.05) except between the 2.0/2.5 and 2.5/3.0 mm groups (P>0.05). The 3.0/3.0 mm group showed a maximum reduction of 4.5% compared to the 1.5/2.0 mm group.

Table 4 Effects of grinding particle sizes of corn on nutrient digestibility of diet in growing-finishing pigs

Table data showing dry matter and crude protein apparent digestibility across screen aperture groups

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Discussion

Effects of Different Screen Aperture Combinations on Corn Grinding Particle Size

Grinding is an essential processing step to improve feed quality, and feed nutritional value is closely related to grinding processing [**?**]. Numerous factors affect grinding efficiency, including sieve hole diameter, opening rate, sieve thickness, air suction volume, and sieve hole pattern [**?**]. The most scientific representation of grinding results is typically expressed as geometric mean particle size—the average particle size of feed or raw material samples. Currently, feed manufacturers primarily adjust grinder screen aperture to obtain different particle sizes. Wang et al. [**?**] used an FSP 112$×3055kWhammermillwiththreescreenaperturesizes(5.0,7.0,and8.0mm)togrindcornandsoybeanmeal,f significantdifferencesforthesamerawmaterialunderdifferentscreenapertures,whilesignificantdifferenc hammer mill with six screen apertures (2.5, 3.0, 4.5, 5.0, 7.0, and 8.0 mm) to grind corn, with geometric mean particle size increasing from 249.0 m to 535.5 m, demonstrating a linear relationship between screen aperture and geometric mean particle size. In this experiment, six different screen aperture combinations (1.5/2.0, 2.0/2.0, 2.0/2.5, 2.5/2.5, 2.5/3.0, and 3.0/3.0 mm) were used to grind corn, yielding corn with geometric mean particle sizes of 303.91, 346.08, 356.81, 358.51, 373.29, and 387.70 m, respectively. Results showed that corn geometric mean particle size increased with grinder screen aperture, with significant differences among all groups (P<0.05) except between the 2.0/2.5 and 2.5/2.5 mm groups, consistent with previous research findings.

Effects of Corn Grinding Particle Size on Energy Consumption

Grinding particle size not only affects feed nutrient utilization and animal performance but also significantly influences feed processing costs, with grinder power accounting for one-third or more of total feed mill power capacity [?]. Mani et al. [?] reported that raw material grinding particle size significantly affects grinder energy consumption, with smaller screen apertures resulting in higher energy consumption. Fine grinding increases energy expenditure and reduces grinder output, making grinding costs a critical consideration [?]. Qin [?] reported that grinding energy consumption for corn decreased from 32 kW · h/t to 8 kW · h/t when using hammer mill screen apertures of 0.6, 1.0, 1.5, 2.5, and 4.0 mm, while soybean meal grinding energy decreased from 48 kW · h/t to 9 kW · h/t. Curve fitting regression (n=5) between raw material particle size (X) and grinder energy consumption (Y) yielded the equations: corn, $Y = 0.0003X^2 - 0.417X + 137.56$, $R^2 = 0.9852$, $P<0.05$; soybean meal, $Y = 0.0004X^2 - 0.5048X + 165.23$, $R^2 = 0.9906$, $P<0.05$. Wang et al. [?] investigated the relationship between grinding particle size and energy consumption for five feed ingredients including corn, soybean meal, and wheat bran, also demonstrating that reducing particle size increased grinding energy consumption, particularly when sieve diameter reached 1.0 mm or smaller. Compared to a 1.5 mm screen, a 0.6 mm screen increased power consumption by 3.17, 3.67, and 2.69 times for corn, soybean meal, and wheat bran, respectively, with corn showing greater energy increase than in this experiment, possibly due to differences in equipment models and corn moisture content.

This study demonstrated that as corn grinding particle size increased from 303.91 m to 387.70 m, grinding energy consumption decreased by 23.95%, consistent with previous findings. However, pelleting energy consumption increased by 17.00% as particle size increased from 303.91 m to 387.70 m, primarily because coarser particle sizes increase wear on ring dies and rollers, reducing output per unit time [?]. Therefore, both excessively coarse and excessively fine particle sizes have adverse effects on production cost savings.

Effects of Corn Grinding Particle Size on Pellet Feed Processing Quality

The particle size distribution of individual components in feed pelleting significantly affects pellet quality, with raw material grinding particle size accounting for 15%-20% of pelleting quality factors [?]. Smaller particle sizes increase material surface area, facilitating more complete contact with steam during conditioning, enabling smooth heat and moisture transfer, improving gelatinization, and promoting pellet formation [?]. Xie et al. [?] found that pellet stability decreased significantly as material particle size increased (grinding particle sizes of 356, 397, and 561 m). Cheng et al. [?] also reported that starch gelatinization in powdered feed increased as grinding particle size decreased (505, 303, 214, 178, and 81 m). Research has shown that feed pellet quality decreased significantly as grinder screen aperture increased (1.5, 2.0, and 3.0 mm), corresponding to larger corn particle sizes [?], with similar results observed for ground soybean meal, where decreasing screen aperture (2.5, 2.0, and 1.5 mm) increased pellet stability and hardness [?].

This study found that as corn grinding particle size increased (303.91, 346.08, 356.81, 358.51, 373.29, and 387.70 m), feed durability decreased from 93.01% to 91.16%, primarily because excessively coarse grinding causes cracks on pellet surfaces [?], increasing feed powdering rate and reducing durability—consistent with previous research. However, pellet hardness showed an increasing trend with particle size, contrary to previous studies, possibly due to classification phenomena during mixing because other ingredients were ground using a 2.0 mm screen, particularly affecting the 2.5/3.0 and 3.0/3.0 mm groups. Additionally, in vitro crude protein digestibility increased initially then decreased with particle size, peaking at 81.44% in the 2.5/2.5 mm group, which differed significantly from the 1.5/2.0 and 3.0/3.0 mm groups. Overall, within a certain range, feed pellet quality decreased with increasing grinding particle size, consistent with the findings of Wang et al. [?].

Effects of Corn Grinding Particle Size on Growth Performance of Finishing Pigs

The effects of feed grinding particle size on pig performance primarily manifest through interactions among pig age, grain type, and particle size. Wang et al. [?] fed 23 kg piglets diets formulated with soybean meal and corn ground using 4.5, 3.0, and 2.5 mm screens, finding that the 3.0 mm group increased feed-to-gain ratio by 10.1% compared to the 4.5 mm group and by 9.6% compared to the 2.5 mm group. Lawrence et al. [?] reported that appropriate grinding of feed ingredients could optimize pig growth performance and feed utilization efficiency. Healy et al. [?] also demonstrated that reducing grain particle size improved growth performance of weaned piglets. Wondra et al. [?] conducted trials on corn particle size effects on growing-finishing pig performance, finding that reducing average corn particle size in diets from 1,200 m to 400 m improved feed efficiency by 1.0%-1.5% for every 100 m reduction. However, finer grinding is not always better, as excessively fine grinding increases energy consumption, reduces grinder output, and may induce gastrointestinal ulcers [?]. Cabrera et al. [?] reported that fine grinding of corn and two sorghum varieties (particle size <600 m) negatively affected stomach morphology.

This study found that when corn grinding particle size was 358.51 m (screen aperture 2.5/2.5 mm), finishing pigs achieved the highest final body weight (120.93 kg) and average daily gain (0.86 kg), likely because this treatment yielded the highest in vitro crude protein digestibility and moderate pellet hardness, thereby improving dietary digestibility and utilization. The 3.0/3.0 mm group showed the lowest final body weight (96.94 kg) and average daily gain (0.68 kg), possibly due to highest pellet hardness affecting palatability and reducing feed intake, or because severe diarrhea in this group during the trial affected nutrient digestion and absorption. The 1.5/2.0 mm group, with the finest corn particle size (303.91 m), showed the lowest pellet hardness (45.21 N) and in vitro crude protein digestibility (79.46%), but the highest pellet durability (93.01%), average daily feed intake (2.59 kg), and feed-to-gain ratio (3.44), possibly because excessively fine particle size caused gastrointestinal injury and keratinization [?], though specific mechanisms require further investigation. Overall, from the perspective of growing-finishing pig performance, a screen aperture of 2.5/2.5 mm for corn grinding yielded the best results.

Effects of Corn Grinding Particle Size on Nutrient Apparent Digestibility in Finishing Pigs

Feed ingredient particle size directly affects nutrient digestion and utilization; generally, smaller particle sizes increase contact area with digestive enzymes and improve nutrient digestibility. Li et al. [?] reported that feeding piglets diets with particle sizes of 360, 680, and 1,150 m showed that organic matter, crude protein, and dry matter digestibility improved as feed particle size decreased. Mavromichalis et al. [?] found that when wheat particle size decreased from 1,300 m to 600 m, apparent digestibility of dietary dry matter and nitrogen in growing-finishing pigs increased from 83.7% and 80.4% to 87.6% and 85.5%, respectively; when wheat particle size further decreased from 600 m to 400 m, dry matter and nitrogen apparent digestibility increased from 84.7% and 81.9% to 87.3% and 86.6%, respectively. Fastinger et al. [?] reported that decreasing soybean meal particle size (900, 600, 300, and 150 m) tended to increase energy apparent digestibility in growing pigs (28 kg), though differences were not significant. Lahaye et al. [?] found that reducing wheat particle size in growing pig diets from 1,000 m to 500 m significantly improved nitrogen and most essential and non-essential amino acid ileal apparent and true digestibility without significantly affecting endogenous nitrogen excretion.

This study found that as corn grinding particle size increased from 303 m to 388 m, dietary dry matter and protein apparent digestibility decreased from 84.43% and 86.14% to 80.62% and 80.80%, respectively. However, the 2.5 mm group showed higher dry matter and protein apparent digestibility than the 2.0/2.0 and 2.0/2.5 mm groups, inconsistent with previous research. This discrepancy may be because corn particle sizes in this experiment were concentrated within a narrow range of 300–400 m, and other dietary ingredients were ground using a 2.0 mm screen, with pelleting after mixing affecting nutrient apparent digestibility, resulting in digestibility not decreasing completely with increasing particle size.

Conclusion

1. As grinder screen aperture increased from 1.5/2.0 mm to 3.0/3.0 mm, grinding energy consumption gradually decreased while pelleting energy consumption gradually increased. Combined grinding and pelleting energy

consumption showed minimal change between 1.5/2.0 mm and 2.5/2.5 mm, but increased with screen aperture above 2.5/2.5 mm. Corn geometric mean particle size ranged from 303.91 to 387.70 m, and in vitro crude protein digestibility increased initially then decreased, with the 2.5/2.5 mm group showing the highest pellet feed crude protein digestibility.

2. Corn grinding particle size significantly affected final body weight and average daily feed intake of finishing pigs, though no significant differences were observed in average daily gain or feed-to-gain ratio among groups. The 2.5/2.5 mm group achieved the highest final body weight and average daily gain, with average daily feed intake second only to the 1.5/2.0 mm group. Protein and dry matter apparent digestibility increased significantly as grinding particle size decreased (303.91–387.70 m).
3. Based on comprehensive consideration of corn grinding particle size effects on pellet feed processing energy consumption, processing quality, and finishing pig growth performance, a screen aperture of 2.5/2.5 mm (corn geometric mean particle size of 358 m) is recommended for grinding corn in finishing pig pellet diets.

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Note: Figure translations are in progress. See original paper for figures.