**The impact of soybean meal particle size on milling efficiency, poultry performance and digestibility**

**Research Report**

**Penn State University**

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(Summary)

In a series of five experiments the effects of various soybean meal (SBM) particle sizes on soybean milling efficiency, pullet and broiler performance, feed milling, and broiler digestibility were evaluated. The treatment particle sizes were generated with the screen sizes 3/32”, 7/32”, worn 7/32” and 10/32” at a soybean processing facility in Danville, PA. Results from Exp 1 demonstrated that electrical current draw and power usage of the hammermill motor were similar for the 7/32”, worn 7/32” and 10/32” screens. However, the 3/32” screen drew the most current and required more power to grind the SBM (P<0.0001). The particle analysis using the Ro-Tap tester demonstrated that particle size distribution was similar for the 7/32” (735.41 µm), worn 7/32” (861.12 µm), and 10/32” (891.85 µm) screens. However, the 3/32” screen did generate the smallest particle size at 463.88 µm (P=0.0163). Exp 2 was a 17-week pullet performance study using 400-day-old Hy-Line W36 pullets. Overall, there were pullet trending differences in FCR from 0-17 weeks (P<0.10) but LWG and FI were not different (P>0.05). Soybean particle size had little impact on pullet performance. Therefore, a 21d broiler digestibility study (Exp 3) was conducted to understand how varying SBM particle sizes affects broiler performance and apparent ileal amino acid digestibility (AIAAD). Day 1-20 feed intake (FI)/pen was affected by SBM particle size. The worn 7/32” and 10/32” screens had the highest FI and the 3/32” screen had the lowest. The 7/32” screen was intermediate for d1-20 FI (P=0.0494). However, when FI was adjusted to a per bird basis, FI differences were no longer apparent (P=0.10). The AIAAD % of all essential and nonessential amino acids demonstrated differences (P<0.05). For all essential amino acids, the 3/32” screen had the lowest AIAAD % with other treatments similar to each other except for threonine where the 3/32” and 7/32” screens were similar. All nonessential amino acids followed a similar pattern with the 3/32” screen having the lowest AIAAD % (P<0.0001). Exp 4 was a feed milling exp conducted at West Virginia University to study pelleting effects of various SBM particle sizes. Feed milling data showed no differences in hot pellet temperature or production rate (P>0.05). There were differences in pellet quality with the 3/32” screen having the highest pellet durability index (PDI) (P<0.05). The 7/32” and 10/32” screens reduced pellet quality parameters. An important consideration is the tendency for small SBM particles to cause the pellet die to plug. This phenomenon was apparent across all three replicate feed runs for the 3/32" particles. Exp 5 was a broiler study to evaluate effects of SBM particle size on performance and carcass yield of 1,152 Hubbard x Ross 708 male broilers. Results of the day 1-42 broiler performance demonstrated higher live weight gain (LWG) when the 3/32” screen was used to produce the SBM. The 7/32” screen resulted in the lowest LWG while the 10/32” screen was intermediate (P<0.0001). The 7/32” and 10/32” screens resulted in similar and less FI than birds consuming SBM produced with the 3/32” screen. Day 1-42 FCR was highest for the 3/32” screen and improved when the 7/32” and 10/32” screens were used to create the SBM (P=0.0002). Soybean meal particle size did not affect processing yields (P>0.05). These 5 experiments indicate that soybean meal particle size influences energy use and processing cost at the soybean plant, amino acid digestibility for broilers, feed milling and quality parameters, and broiler performance when provided in a pelleted diet.

A series of five experiments were conducted from March 2020 to November 2020 to evaluate the effects of various soybean meal (SBM) particle sizes on soybean milling efficiency, pullet and broiler performance, feed milling, and broiler digestibility. Experiment 1 was conducted at Boyd Station LLC, a soybean processing facility in Danville, PA, to calculate the electrical current draw (amps) and power usage (watts) of the hammermill motor when using various hammermill screen sizes. The treatment particle sizes were generated with the screen sizes 3/32”, 7/32”, worn 7/32” and 10/32”. The worn 7/32” screen was used to better understand particle size variability when using the standard 7/32” screen used at this specific processing facility. A two-ton allotment of expeller-extruded soybean meal per treatment was broken into three smaller allotments. The feed screw auger carrying feed to the hammermill was set to 20 RPM. Throughput was kept constant by passing feed through each hammermill screen for 4 minutes and 45 seconds. All SBM was stored in supersacks at the Penn State Poultry Education and Research Center. Particle size analysis of the SBM was conducted on 9 replicates per treatment using the Ro-Tap tester. The SBM used in these studies was analyzed for potassium hydroxide (KOH) solubility and trypsin inhibitor activity (TIA) at NP Analytical Laboratories. For all statistical analyses in the five experiments, the GLM procedure in SAS was used to determine analysis of variance. Means were separated using Fisher’s LSD test and the significance level was set at *P* ≤ 0.05. Results from experiment 1 demonstrated that electrical current draw and power usage of the hammermill motor were similar for the 7/32”, worn 7/32” and 10/32” screens. However, the 3/32” screen drew the most current and required more power to grind the SBM (*P*<0.0001). The particle analysis using the Ro-Tap tester demonstrated that particle size distribution was similar for the 7/32” (735.41 µm), worn 7/32” (861.12 µm), and 10/32” (891.85 µm) screens. However, the 3/32” screen did generate the smallest particle size at 463.88 µm (*P*=0.0163). Experiment 2 was a 17-week pullet performance study that began in March 2020 and ran until July 2020. A total of 400-day-old Hy-Line W36 pullets were housed in the top row of two-tier pullet cages for the first 6 weeks of life. Pullets were randomly distributed to the 16 cages and 25 pullets made up one experimental unit. On week 6, each pen was split so that 13 pullets remained in the top row and 12 pullets were moved to the bottom row for a total of 32 cages. This adjustment was to account for bird density. The pullets were raised using a five-phase feeding program and performance data including body weight (BW), live weight gain (LWG), feed intake (FI), and feed conversion ratio (FCR) were collected for each phase. Overall for the pullet performance, there were trending differences in FCR from 0-17 weeks (*P*<0.10) but LWG and FI were not different (*P*>0.05). Soybean particle size had little impact on pullet performance. Therefore, a 21d broiler digestibility study (experiment 3) was conducted in May 2020 to understand how varying SBM particle sizes affects broiler performance and apparent ileal amino acid digestibility (AIAAD). A total of 480-day-old Ross 708 male broilers were housed in battery cages with 12 replicate pens per treatment. Treatments were arranged in a randomized complete block design with a pen of 10 broilers serving as the experimental unit. To collect performance data, there was a starter phase from days 1-10 and a grower phase from days 11-20. The BW, LWG, FI, and FCR were collected for both feeding phases. To measure digestibility, 0.2% titanium dioxide (TiO2) was added into the grower diet on d11. On d21, birds were euthanized via cervical dislocation and contents of the distal ileum were flushed into a cup using distilled water. Ileal contents from approximately three birds per pen were pooled, frozen, and stored in a freezer until they were analyzed. Pancreas weights were recorded from 24 birds per treatment to consider possible effects from trypsin inhibitors. Ileal contents and grower diet samples were sent to the University of Missouri for amino acid concentrations and TiO2 analysis. For the broiler digestibility experiment, d1-20 FI/pen was affected by SBM particle size. The worn 7/32” and 10/32” screens had the highest FI and the 3/32” screen had the lowest. The 7/32” screen was intermediate for d1-20 FI (*P*=0.0494). However, when FI was adjusted to a per bird basis, FI differences were no longer apparent (*P*=0.10). The AIAAD % of all essential and nonessential amino acids demonstrated differences (*P*<0.05). For all essential amino acids, the 3/32” screen had the lowest AIAAD % with other treatments being similar to each other except for threonine where the 3/32” and 7/32” screens were similar. All nonessential amino acids followed a similar pattern with the 3/32” screen having the lowest AIAAD % (P<0.0001). Pancreas weights were not different among treatments (*P*=0.6542), indicating that trypsin inhibitors were not present in the SBM. Due to minimal performance differences and significant AIADD % differences in experiments 2 and 3, the worn 7/32” screen was removed in the remaining experiments. Therefore, experiments 4 and 5 considered three hammermill screen sizes (3/32”, 7/32”, and 10/32”). Experiments 4 and 5 were a feed milling and broiler performance study, respectively. Experiment 4 was conducted at the pilot feed mill at West Virginia University to study pelleting effects of various SBM particle sizes. This study was conducted using the finisher feed provided in Experiment 5. Experiment 4 was arranged in a 3 x 3 Latin Square design with three 1,000 lb replicates per manufacturing run in the feed mill. Hot pellet temperature and production rate were collected in duplicate and pellet quality analyses were ran for each replicate. Feed milling data for experiment 4 showed no differences in hot pellet temperature or production rate (*P*>0.05). There were differences in pellet quality with the 3/32” screen having the highest pellet durability index (PDI) (*P*<0.05). The 7/32” and 10/32” screens reduced pellet quality parameters. An important consideration is the tendency for small SBM particles to cause the pellet die to plug. This phenomenon was apparent across all three replicate feed runs. Experiment 5 was conducted at Penn State from October 12, 2020 to November 23, 2020 to evaluate effects of SBM particle size on performance and carcass yield of Hubbard x Ross 708 male broilers. A total of 1,152 birds were reared in floor pens with 12 replicate pens per treatment. Treatments were arranged in a randomized complete block design with one pen of 32 birds serving as the experimental unit. Birds were fed one of three treatment diets from day of hatch to 42 days and were fed a starter, grower, and finisher diet. At the end of each feeding phase, birds and feed were weighed to calculate FI, LWG, and mortality corrected FCR. On d42, two birds from each pen were randomly selected, weighed, and slaughtered for processing yields and gizzard weights. D1-42 broiler performance demonstrated higher LWG when the 3/32” screen was used to produce the SBM. The 7/32” screen resulted in the lowest LWG while the 10/32” screen was intermediate (*P*<0.0001). The 7/32” and 10/32” screens resulted in similar and less FI than birds consuming SBM produced with the 3/32” screen. D1-42 FCR was highest for the 3/32” screen and improved when the 7/32” and 10/32” screens were used to create the SBM (*P*=0.0002). Soybean meal particle size did not affect processing yields (*P*>0.05). These 5 experiments indicate that soybean meal particle size influences energy use at the soybean processing plant, amino acid digestibility of broilers, feed milling and quality parameters, and broiler performance when provided in a pelleted diet.

**Table 1: (Exp 1) Energy usage of various hammermill screen sizes and soybean meal particle size1**

|  |  |  |  |
| --- | --- | --- | --- |
| **Screen Size** | Motor Load | Power Usage | Particle Size |
| Amps | Watts | µm |
| 3/32” | 26.2273a | 12.1695a | 463.88b |
| 7/32” | 16.0842b | 7.4631b | 735.41a |
| Worn 7/32” | 16.3101b | 7.5679b | 861.12a |
| 10/32” | 16.0081b | 7.4278b | 891.85a |
|  |  |  |  |
| *P*-Value | **<0.0001** | **<0.0001** | **0.0163** |
| LSD | 1.2339 | 0.5725 | 239.1400 |
| SEM | 0.3566 | 0.1654 | 69.1077 |

a-b Means within a column with different superscripts differ (*P*<0.05)

1 Particle size was determined using a Ro-Tap tester, Model RX-29 (WS Tyler company, Mentor, Ohio).

**Soybean processing observations:**

* The amp and watt usage at the soybean processing facility were significantly different when comparing the 3/32” screen to all other screens. The 3/32” screen had higher amp and watt usage. All other screens had similar amp and watt usage.
* Particle sizes generated were not different among the 7/32”, worn 7/32”, and 10/32” screens. The smallest screen size (3/32”) did have a significantly smaller particle size as shown in figure 1.

**Figure 1. Particle sizes generated**

Data from the soybean processing experiment indicates that a smaller hammermill screen size requires more energy use compared to larger screens. Larger screens are more variable in particle size compared to smaller screens.

**Table 2: Pullet trial (Exp 2): Diet formulations and calculated nutrients1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Ingredients** | **Starter 1**(0-3 wk) | **Starter 2**(3-6 wk) | **Grower**(6-12 wk) | **Developer**(12-15 wk) | **Pre-Lay**(15-17 wk) |
| **(%)** |
| Corn | 60.39 | 65.68 | 59.32 | 63.12 | 63.27 |
| Expeller Extruded Soybean Meal | 32.42 | 27.73 | 18.20 | 17.75 | 19.02 |
| DDGS | - | - | 10.00 | - | 8.85 |
| Wheat Midds | - | - | 8.04 | 14.62 | - |
| Soybean Oil | 2.59 | 1.87 | - | - | - |
| MonoCalcium Phosphate | 2.30 | 2.30 | 1.86 | 2.03 | 2.07 |
| Limestone | 1.17 | 1.21 | 1.46 | 1.43 | 5.78 |
| Vit/Min Premix2 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| Salt | 0.44 | 0.41 | 0.37 | 0.44 | 0.38 |
| L-Lysine | 0.07 | 0.12 | 0.16 | 0.06 | 0.07 |
| DL-Methionine | 0.19 | 0.23 | 0.14 | 0.13 | 0.15 |
| L-Threonine | 0.03 | 0.06 | 0.05 | 0.02 | 0.02 |
| **Calculated Nutrients** |
| ME (kcal/lb) | 1,375.00 | 1,375.00 | 1,365.00 | 1,345.00 | 1,355.00 |
| CP (%) | 20.00 | 18.25 | 17.79 | 16.06 | 16.57 |
| Crude Fiber (%) | - | - | 3.56 | 3.56 | 2.42 |
| Calcium (%) | 1.00 | 1.00 | 1.00 | 1.00 | 2.50 |
| Available Phosphorus (%) | 0.50 | 0.49 | 0.47 | 0.45 | 0.48 |
| Sodium (%) | 0.18 | 0.17 | 0.17 | 0.18 | 0.17 |
| Dig. Lys (%) | 1.05 | 0.98 | 0.88 | 0.76 | 0.78 |
| Dig. Meth (%) | 0.47 | 0.48 | 0.40 | 0.36 | 0.39 |
| Dig. TSAA (%) | 0.74 | 0.74 | 0.66 | 0.60 | 0.62 |
| Dig. Threonine (%) | 0.69 | 0.66 | 0.60 | 0.52 | 0.55 |

1 Diets formulated using Hy-Line W36 recommendations

2 Supplied per kg of diet: 0.022% iodine; 1.1023% iron; 0.1764% copper; 0.006% selenium; 2.6455% manganese; 2.2046% zinc; 2,643,172 IU vitamin A; 881,057 IU vitamin D-3; 6,608 IU vitamin E; 440 mg of thiamin; 1,762 mg of riboflavin; 13,216 mg of niacin; 3,084 mg of pantothenic acid; 133,678 mg of choline; 220 mg of folacin; 22 mg of biotin; 3,524 mcg of vitamin B12; 660 mg of menadione; and 24,948 mg of ethoxyquin

**Table 3: Pullet trial (Exp 2): Analyzed nutrient values**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Diet Phase** | **TRT** | Crude Protein | Crude Fat | Crude Fiber | Ash | Moisture | Gross Energy |
| % | % | % | % | % | kcal/lb |
| Starter 1 (0-3 wk) | 7/32” | 19.75 | 7.06 | 2.50 | 6.79 | 8.38 | 1,890 |
| Worn 7/32” | 20.06 | 7.54 | 2.60 | 7.42 | 8.18 | 1,900 |
| 10/32” | 19.81 | 6.79 | 2.40 | 6.80 | 8.47 | 1,880 |
| 3/32” | 20.13 | 7.05 | 2.40 | 6.96 | 7.96 | 1,880 |
| Starter 2 (3-6 wk) | 7/32” | 17.81 | 6.45 | 2.20 | 5.78 | 8.87 | 1,840 |
| Worn 7/32” | 18.31 | 6.31 | 2.30 | 6.18 | 8.58 | 1,840 |
| 10/32” | 18.44 | 5.62 | 2.50 | 5.65 | 8.74 | 1,830 |
| 3/32” | 18.31 | 5.59 | 2.40 | 6.30 | 8.77 | 1,820 |
| Grower(6-12 wk) | 7/32” | 17.06 | 4.36 | 3.30 | 6.50 | 11.08 | 1,800 |
| Worn 7/32” | 17.56 | 4.31 | 3.30 | 5.33 | 10.36 | 1,790 |
| 10/32” | 16.88 | 4.24 | 3.20 | 6.13 | 10.22 | 1,790 |
| 3/32” | 17.31 | 4.31 | 3.60 | 5.51 | 10.21 | 1,780 |
| Developer(12-15 wk) | 7/32” | 15.38 | 3.96 | 3.10 | 5.99 | 10.38 | 1,740 |
| Worn 7/32” | 15.94 | 3.69 | 2.90 | 5.58 | 10.38 | 1,760 |
| 10/32” | 15.94 | 3.74 | 3.00 | 5.67 | 10.20 | 1,760 |
| 3/32” | 15.94 | 3.73 | 2.90 | 5.73 | 10.19 | 1,750 |
| Prelay(15-17 wk) | 7/32” | 16.38 | 4.21 | 2.50 | 9.08 | 9.44 | 1,690 |
| Worn 7/32” | 16.25 | 3.94 | 2.50 | 9.48 | 9.21 | 1,700 |
| 10/32” | 16.19 | 3.96 | 2.50 | 10.07 | 9.02 | 1,690 |
| 3/32” | 15.75 | 3.94 | 2.60 | 9.70 | 9.46 | 1,705 |

Nutrient analysis conducted by Eurofins Nutrition Analysis Center in Des Moines, IA.

**Table 4: Pullet trial (Exp 2): Weeks 0-3 Performance**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Screen Size** | Feed Intake | Feed Intake | Live Weight Gain | Initial Bird Weight | Bird Weight | Feed Conversion Ratio1 |
| kg | kg/bd | kg | g/bd | g/bd | kg/kg |
| 3/32” | 8.910 | 0.358 | 3.765 | 39.025 | 189.675 | 2.369 |
| 7/32” | 8.730 | 0.350 | 3.775 | 38.975 | 189.950 | 2.312 |
| Worn 7/32” | 8.698 | 0.348 | 3.805 | 38.925 | 191.125 | 2.285 |
| 10/32” | 8.793 | 0.350 | 3.778 | 38.450 | 189.650 | 2.324 |
|  |  |  |  |  |  |  |
| *P*-Value | 0.8824 | 0.8365 | 0.9344 | 0.1858 | 0.9276 | 0.7129 |
| LSD | 0.6440 | 0.0263 | 0.1469 | 0.6022 | 5.7713 | 0.1628 |
| SEM | 0.2013 | 0.0082 | 0.0459 | 0.1882 | 1.8040 | 0.0509 |

1Mortality corrected FCR: mcFCR = FI/(LWG + Wt of Mortality)

**Weeks 0-3 performance observations:**

* No significant differences in performance from 0-3 weeks.

**Table 5: Pullet trial (Exp 2): Weeks 3-6 Performance**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Screen Size** | Feed Intake | Feed Intake | Live Weight Gain | Live Weight Gain | Bird Weight 6 wk1 | Feed Conversion Ratio1 |
| kg | kg/bd | kg | kg/bd | g/bd | kg/kg |
| 3/32” | 16.433 | 0.663a | 5.598 | 0.229 | 417.700 | 2.901 |
| 7/32” | 16.245 | 0.648b | 5.743 | 0.230 | 419.625 | 2.829 |
| Worn 7/32” | 16.475 | 0.673a | 5.540 | 0.231 | 421.150 | 2.917 |
| 10/32” | 16.503 | 0.668a | 5.548 | 0.227 | 415.675 | 2.940 |
|  |  |  |  |  |  |  |
| *P*-Value | 0.8113 | **0.0127** | 0.7009 | 0.8393 | 0.8301 | 0.0942 |
| LSD | 0.6574 | 0.0136 | 0.4315 | 0.0089 | 14.0480 | 0.0898 |
| SEM | 0.2055 | 0.0042 | 0.1349 | 0.0028 | 4.3910 | 0.0281 |

1Mortality corrected FCR: mcFCR = FI/(LWG + Wt of Mortality)

2 6 wk bird weights are the 16 pens before cages were split.

a-b Means within a column with different superscripts differ (*P*<0.05).

**Weeks 3-6 performance observations:**

* Feed intake (FI) differences were apparent on a per bird basis. The 7/32” screen had lower FI when compared to all other screen sizes.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Screen Size** | Feed Intake | Feed Intake | Live Weight Gain | Live Weight Gain | Feed Conversion Ratio1 |
| kg | kg/bd | kg | kg/bd | kg/kg |
| 3/32” | 25.340 | 1.025 | 9.365 | 0.381 | 2.688 |
| 7/32” | 24.975 | 0.998 | 9.518 | 0.381 | 2.624 |
| Worn 7/32” | 25.175 | 1.025 | 9.348 | 0.386 | 2.662 |
| 10/32” | 25.295 | 1.023 | 9.328 | 0.380 | 2.692 |
|  |  |  |  |  |  |
| *P*-Value | 0.8841 | 0.1273 | 0.8594 | 0.6274 | 0.1857 |
| LSD | 1.1275 | 0.0272 | 0.5553 | 0.0116 | 0.0707 |
| SEM | 0.3524 | 0.0085 | 0.1736 | 0.0036 | 0.0221 |

**Table 6: Pullet trial (Exp 2): Weeks 0-6 Performance**

1Mortality corrected FCR: mcFCR = FI/(LWG + Wt of Mortality)

**Weeks 0-6 performance observations:**

* No significant differences in performance from 0-6 weeks.

**Table 7: Pullet trial (Exp 2): Weeks 6-12 Performance**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Screen Size** | Feed Intake | Feed Intake | Live Weight Gain | Live Weight Gain | Bird Weight 6 wk1 | Bird Weight 12 wk | Feed Conversion Ratio1 |
| kg | kg/bd | kg | kg/bd | g/bd | g/bd | kg/kg |
| 3/32” | 27.175 | 2.244 | 6.479 | 0.536 | 414.954 | 949.814 | 4.198 |
| 7/32” | 27.534 | 2.228 | 6.541 | 0.529 | 419.735 | 947.134 | 4.267 |
| Worn 7/32” | 27.491 | 2.269 | 6.374 | 0.526 | 420.246 | 946.130 | 4.317 |
| 10/32” | 27.875 | 2.253 | 6.504 | 0.525 | 411.860 | 937.984 | 4.285 |
|  |  |  |  |  |  |  |  |
| *P*-Value | 0.5227 | 0.7033 | 0.4850 | 0.2532 | 0.0989 | 0.4720 | 0.4414 |
| LSD | 0.9591 | 0.0731 | 0.2299 | 0.0123 | 7.6521 | 16.068 | 0.1522 |
| SEM | 0.3261 | 0.0249 | 0.0782 | 0.0042 | 2.6019 | 5.4633 | 0.0518 |

1Mortality corrected FCR: mcFCR = FI/(LWG + Wt of Mortality)

2 6 wk BW are the 32 pens after cages were split.

**Weeks 6-12 performance observations:**

* No significant differences in performance from 6-12 weeks.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Screen Size** | Feed Intake | Feed Intake | Live Weight Gain | Live Weight Gain | Bird Weight | Feed Conversion Ratio1 |
| kg | kg/bd | kg | kg/bd | g/bd | kg/kg |
| 3/32” | 16.795 | 1.388 | 2.734 | 0.225 | 1175.423 | 6.154 |
| 7/32” | 16.890 | 1.367 | 2.773 | 0.225 | 1171.236 | 6.103 |
| Worn 7/32” | 16.750 | 1.383 | 2.715 | 0.223 | 1169.800 | 6.195 |
| 10/32” | 16.889 | 1.366 | 2.575 | 0.209 | 1158.308 | 6.711 |
|  |  |  |  |  |  |  |
| *P*-Value | 0.8936 | 0.6555 | 0.2687 | 0.0708 | 0.3012 | 0.2573 |
| LSD | 0.4587 | 0.0443 | 0.2135 | 0.0139 | 18.899 | 0.6908 |
| SEM | 0.1560 | 0.0151 | 0.0726 | 0.0047 | 6.4261 | 0.2349 |

**Table 8: Pullet trial (Exp 2): Weeks 12-15 Performance**

1Mortality corrected FCR: mcFCR = FI/(LWG + Wt of Mortality)

**Weeks 12-15 performance observations:**

* No significant differences in performance from 12-15 weeks.

**Table 9: Pullet trial (Exp 2): Weeks 15-17 Performance**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Screen Size** | Feed Intake | Feed Intake | Live Weight Gain | Live Weight Gain | Bird Weight | Feed Conversion Ratio1 |
| kg | kg/bd | kg | kg/bd | g/bd | kg/kg |
| 3/32” | 10.024 | 0.828 | 1.135 | 0.093 | 1268.819 | 8.957 |
| 7/32” | 10.265 | 0.830 | 1.135 | 0.090 | 1262.895 | 9.130 |
| Worn 7/32” | 10.176 | 0.848 | 1.123 | 0.095 | 1262.458 | 9.133 |
| 10/32” | 10.275 | 0.831 | 1.178 | 0.096 | 1254.571 | 8.751 |
|  |  |  |  |  |  |  |
| *P*-Value | 0.4345 | 0.5099 | 0.7566 | 0.5828 | 0.5134 | 0.7078 |
| LSD | 0.3500 | 0.0309 | 0.1123 | 0.0100 | 19.356 | 0.7781 |
| SEM | 0.1190 | 0.0105 | 0.0382 | 0.0034 | 6.5814 | 0.2646 |

1Mortality corrected FCR: mcFCR = FI/(LWG + Wt of Mortality)

**Weeks 15-17 performance observations:**

* No significant differences in performance from 15-17 weeks.

**Table 10: Pullet trial (Exp 2): Weeks 6-17 Performance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Screen Size** | Feed Intake | Feed Intake | Live Weight Gain | Live Weight Gain | Feed Conversion Ratio1 |
| kg | kg/bd | kg | kg/bd | kg/kg |
| 3/32” | 53.994 | 4.460 | 10.440 | 0.863 | 5.225b |
| 7/32” | 54.688 | 4.425 | 10.448 | 0.844 | 5.280b |
| Worn 7/32” | 54.416 | 4.535 | 10.114 | 0.851 | 5.510a |
| 10/32” | 55.040 | 4.450 | 10.436 | 0.854 | 5.373ab |
|  |  |  |  |  |  |
| *P*-Value | 0.6020 | 0.3697 | 0.1732 | 0.6881 | **0.0361** |
| LSD | 1.6322 | 0.1324 | 0.3564 | 0.0322 | 0.1987 |
| SEM | 0.5550 | 0.0450 | 0.1212 | 0.0110 | 0.0676 |

1Mortality corrected FCR: mcFCR = FI/(LWG + Wt of Mortality)

a-b Means within a column with different superscripts differ (*P*<0.05)

**Weeks 6-17 performance observations:**

* FCR differences were apparent across treatments. The worn 7/32” screen had the highest FCR and the 7/32” and 3/32” screens had similar FCR. 10/32” screen had intermediate FCR.

**Table 11: Pullet trial (Exp 2): Weeks 0-17 Performance**

|  |  |  |  |
| --- | --- | --- | --- |
| **Screen Size** | Feed Intake | Live Weight Gain | Feed Conversion Ratio1 |
| kg/bd | kg/bd | kg/kg |
| 3/32” | 5.484 | 1.230 | 4.460 |
| 7/32” | 5.424 | 1.224 | 4.431 |
| Worn 7/32” | 5.562 | 1.224 | 4.547 |
| 10/32” | 5.472 | 1.216 | 4.501 |
|  |  |  |  |
| *P*-Value | 0.2265 | 0.5584 | 0.0505 |
| LSD | 0.1346 | 0.0197 | 0.0845 |
| SEM | 0.0458 | 0.0067 | 0.0287 |

1Mortality corrected FCR: mcFCR = FI/(LWG + Wt of Mortality)

**Weeks 0-17 performance observations:**

* No significant differences in performance from 0-17 weeks.

Data from the pullet performance experiment indicates that soybean meal particle size does not affect performance.

**Table 12: Broiler digestibility trial (Exp 3): Diet formulations and calculated nutrients**

|  |  |  |
| --- | --- | --- |
| **Ingredients** | **Starter**(1-10 d) | **Grower**(11-20 d) |
| **%** |
| Corn | 47.31 | 50.30 |
| Expeller Extruded Soybean Meal | 28.82 | 25.33 |
| Wheat Midds | 10.00 | 10.00 |
| DDGS | 8.95 | 8.50 |
| Limestone | 1.53 | 1.39 |
| Soybean Oil | 0.32 | 1.82 |
| MonoCalcium Phosphate | 1.46 | 1.28 |
| DL-Methionine | 0.50 | 0.38 |
| Salt | 0.35 | 0.35 |
| L-Threonine | 0.32 | 0.20 |
| Vit/Min Premix1 | 0.25 | 0.25 |
| L-Lysine | 0.00 | 0.20 |
| TiO2 | 0.00 | 0.20 |
| **Calculated Nutrients** |
| ME (kcal/lb)2 | 1,361.00 | 1,407.00 |
| CP (%) | 22.42 | 20.58 |
| Calcium (%) | 0.96 | 0.87 |
| Available Phosphorus (%) | 0.48 | 0.44 |
| Sodium (%) | 0.16 | 0.16 |
| Dig. Lysine (%)3 | 1.20 | 1.10 |
| Dig. Methionine (%)3 | 0.79 | 0.65 |
| Dig. TSAA (%)3 | 1.08 | 0.92 |
| Dig. Threonine (%)3 | 1.01 | 0.84 |
| Dig. Tryptophan (%)3 | 0.23 | 0.21 |

1 Supplied per kilogram of diet: 0.02% manganese; 0.02% zinc; 0.01% iron; 0.0025% copper; 0.0003% iodine; 0.00003% selenium; 0.69 mg of folic acid; 386 mg of choline; 6.61 mg of riboflavin; 0.03 mg of biotin; 1.38 mg of vitamin B6; 27.56 mg of niacin; 6.61 mg of pantothenic acid; 2.20 mg of thiamine; 0.83 mg of menadione; 0.01 mg of vitamin B12; 16.53 IU of vitamin E; 2,133 IU of vitamin D3; and 7,716 of vitamin A.

2 Metabolizable Energy values are based on Ross 708 recommendations.

3 Digestible amino acids were based on the digestible lysine value (1.2%) suggested by P. B. Tillman and W.A. Dozier. 2013. Digestible amino acid to digestible lysine ratios followed further recommendations of this communication (45 methionine, 70 threonine, 16 tryptophan)

**Table 13: Broiler digestibility trial (Exp 3): Analyzed nutrient values**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Diet Phase** | **TRT** | Crude Protein | Crude Fat | Crude Fiber | Ash | Moisture | Gross Energy |
| % | % | % | % | % | kcal/lb |
| Starter(1-10 d) | 3/32” | 22.19 | 5.04 | 3.40 | 5.99 | 9.22 | 1,850 |
| 7/32” | 21.38 | 5.27 | 3.40 | 6.25 | 9.19 | 1,860 |
| Worn 7/32” | 21.94 | 4.96 | 3.50 | 6.41 | 8.94 | 1,850 |
| 10/32” | 21.31 | 4.87 | 3.30 | 6.14 | 8.94 | 1,840 |
| Grower (11-20 d) | 3/32” | 20.38 | 6.08 | 3.10 | 5.80 | 9.38 | 1,870 |
| 7/32” | 20.31 | 6.35 | 3.70 | 5.90 | 9.05 | 1,880 |
| Worn 7/32” | 20.69 | 6.21 | 3.70 | 5.94 | 9.25 | 1,880 |
| 10/32” | 20.75 | 5.92 | 3.10 | 6.42 | 9.66 | 1,870 |

Nutrient analysis conducted by Eurofins Nutrition Analysis Center in Des Moines, IA.

**Table 14: Broiler digestibility trial (Exp 3): Days 1-10 Performance**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Screen Size** | Feed Intake | Feed Intake | Live Weight Gain | Live Weight Gain | Initial Bird Weight | Bird Weight | Feed Conversion Ratio1 |
| kg | kg/bd | kg | kg/bd | g/bd | g/bd | kg/kg |
| 3/32” | 1.733 | 0.177 | 1.342 | 0.138 | 44.433 | 183.175 | 1.290 |
| 7/32” | 1.718 | 0.176 | 1.383 | 0.139 | 44.317 | 184.600 | 1.244 |
| Worn 7/32” | 1.876 | 0.188 | 1.500 | 0.150 | 44.075 | 193.417 | 1.256 |
| 10/32” | 1.849 | 0.185 | 1.442 | 0.144 | 44.425 | 187.775 | 1.291 |
|  |  |  |  |  |  |  |  |
| *P*-Value | 0.0820 | 0.1284 | 0.0903 | 0.1199 | 0.4410 | 0.1537 | 0.1920 |
| LSD | 0.1477 | 0.0117 | 0.1296 | 0.0112 | 0.5005 | 9.5573 | 0.0535 |
| SEM | 0.0513 | 0.0041 | 0.0450 | 0.0039 | 0.1739 | 3.3217 | 0.0186 |

1Mortality corrected FCR: mcFCR = FI/(LWG + Wt of Mortality)

**Days 1-10 performance observations:**

* No significant differences in performance from 1-10 days.

**Table 15: Broiler digestibility trial (Exp 3): Days 11-20 Performance**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Screen Size** | Feed Intake | Feed Intake | Live Weight Gain | Live Weight Gain | Bird Weight | Feed Conversion Ratio1 |
| kg | kg/bd | kg | kg/bd | g/bd | kg/kg |
| 3/32” | 5.822 | 0.582 | 4.042 | 0.418 | 600.940 | 1.442 |
| 7/32” | 5.985 | 0.599 | 4.142 | 0.421 | 605.000 | 1.448 |
| Worn 7/32” | 6.255 | 0.626 | 4.308 | 0.431 | 625.960 | 1.447 |
| 10/32” | 6.275 | 0.628 | 4.325 | 0.433 | 620.760 | 1.450 |
|  |  |  |  |  |  |  |
| *P*-Value | 0.0527 | 0.0532 | 0.1526 | 0.2470 | 0.1295 | 0.8926 |
| LSD | 0.3738 | 0.0374 | 0.2863 | 0.0176 | 24.4170 | 0.0225 |
| SEM | 0.1299 | 0.0130 | 0.0995 | 0.0061 | 8.4863 | 0.0078 |

1Mortality corrected FCR: mcFCR = FI/(LWG + Wt of Mortality)

**Days 11-20 performance observations:**

* No significant differences in performance from 11-20 days.

**Table 16: Broiler digestibility trial (Exp 3): Days 1-20 Performance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Screen Size** | Feed Intake | Feed Intake | Live Weight Gain | Live Weight Gain | Feed Conversion Ratio1 |
| kg | kg/bd | kg | kg/bd | kg/kg |
| 3/32” | 7.555b | 0.774 | 5.392 | 0.557 | 1.403 |
| 7/32” | 7.703ab | 0.790 | 5.525 | 0.562 | 1.396 |
| Worn 7/32” | 8.131a | 0.813 | 5.825 | 0.583 | 1.398 |
| 10/32” | 8.123a | 0.813 | 5.775 | 0.578 | 1.410 |
|  |  |  |  |  |  |
| *P*-Value | **0.0494** | 0.0761 | 0.1046 | 0.1243 | 0.5664 |
| LSD | 0.4965 | 0.0346 | 0.3974 | 0.0248 | 0.0204 |
| SEM | 0.1726 | 0.0120 | 0.1381 | 0.0086 | 0.0071 |

1Mortality corrected FCR: mcFCR = FI/(LWG + Wt of Mortality)

a-b Means within a column with different superscripts differ (*P*<0.05)

**Days 1-20 performance observations:**

* FI differences are apparent from 1-20 days
	+ The worn 7/32” and 10/32” screens had similar FI and 3/32” had the lowest FI. The 7/32” screen was intermediate.

**Table 17: Broiler digestibility trial (Exp 3): Apparent Ileal Amino Acid Digestibility1 (%) of Essential Amino Acids**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Screen Size** | Histidine | Isoleucine | Leucine | Lysine | Methionine | Phenylalanine | Threonine | Tryptophan | Valine |
| % | % | % | % | % | % | % | % | % |
| 3/32” | 79.88b | 79.07c | 80.51b | 83.98c | 91.43c | 81.55c | 75.33c | 80.10b | 76.29b |
| 7/32” | 82.16a | 80.81b | 83.30a | 85.39b | 93.23a | 83.92b | 76.51c | 82.68a | 77.95a |
| Worn 7/32” | 82.21a | 80.96ab | 83.27a | 85.70b | 92.18b | 83.98ab | 78.56b | 83.71a | 78.06a |
| 10/32” | 83.24a | 82.23a | 84.07a | 86.85a | 93.19a | 85.12a | 79.91a | 83.45a | 79.30a |
|  |  |  |  |  |  |  |  |  |  |
| *P*-Value | **<0.0001** | **0.0004** | **<0.0001** | **<0.0001** | **<0.0001** | **<0.0001** | **<0.0001** | **<0.0001** | **0.0025** |
| LSD | 1.2422 | 1.3135 | 1.2561 | 1.0539 | 0.6373 | 1.1729 | 1.2880 | 1.3687 | 1.4702 |
| SEM | 0.4317 | 0.4565 | 0.4365 | 0.3663 | 0.2215 | 0.4077 | 0.4476 | 0.4757 | 0.5110 |

1AIAAD (%) = (AAdiet/Tidiet – AAdigesta/Tidigesta)(AAdiet/Tidiet)x100

a-c Means within a column with different superscripts differ (*P*<0.05)

**AIAAD (%) essential amino acids observations:**

* Significant differences for AIAAD % are apparent across treatments.
* The 3/32” screen had the lowest AIAAD % for all essential amino acids, except it was similar to the 7/32” screen for threonine.
* For histidine, leucine, tryptophan, and valine, the 10/32”, 7/32”, and worn 7/32” screens had similar AIAAD %.
* For methionine, the 10/32” and 7/32” screens had similar AIAAD % and the worn 7/32” screen was intermediate.
* Visual representation of lysine and methionine, shown in figure 2 and figure 3.

**Figure 2. Lysine AIAAD %**

P<0.0001

a

b

b

c

**Figure 3. Methionine AIAAD (%)**

P<0.0001

a

b

a

c

**Table 18: Broiler digestibility trial (Exp 3): Apparent Ileal Amino Acid Digestibility1 (%) of Non-Essential Amino Acids**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Screen Size** | Aspartic Acid | Serine | Glutamic Acid | Proline | Glycine | Alanine | Cysteine | Arginine |
| % | % | % | % | % | % | % | % |
| 3/32” | 78.82c | 74.69c | 86.02c | 78.65b | 71.69c | 77.42b | 64.87c | 87.48c |
| 7/32” | 81.19b | 78.79b | 87.69b | 81.45a | 74.21b | 80.56a | 68.36b | 88.50b |
| Worn 7/32” | 81.50b | 79.20b | 87.79ab | 81.73a | 74.68b | 80.18a | 68.81b | 88.82b |
| 10/32” | 82.89a | 80.60a | 88.64a | 82.34a | 76.33a | 81.40a | 72.39a | 89.68a |
|  |  |  |  |  |  |  |  |  |
| *P*-Value | **<0.0001** | **<0.0001** | **<0.0001** | **<0.0001** | **<0.0001** | **<0.0001** | **<0.0001** | **<0.0001** |
| LSD | 1.1284 | 1.3710 | 0.8476 | 1.2183 | 1.5358 | 1.4388 | 1.8134 | 0.8147 |
| SEM | 0.3922 | 0.4765 | 0.2946 | 0.4234 | 0.5338 | 0.5000 | 0.6303 | 0.2832 |

1AIAAD (%) = (AAdiet/Tidiet – AAdigesta/Tidigesta)(AAdiet/Tidiet)x100

a-c Means within a column with different superscripts differ (*P*<0.05)

**AIAAD (%) nonessential amino acids observations:**

* AIAAD % differences are apparent across treatments.
* The 3/32” screen had the lowest AIAAD % for all non-essential amino acids.
* The 10/32” screen had the highest AIAAD % for almost all non-essential amino acids. For proline and alanine, it was similar to the 7/32” and worn 7/32” screens.

**Table 19: Descriptive data for KOH solubility (%) and trypsin inhibitor activity**

|  |  |  |
| --- | --- | --- |
| **Screen Size** | KOH | TIA |
| % | units/g |
| 3/32” | 79.3 | 30,508 |
| 7/32” | 75.9 | 29,314 |
| Worn 7/32” | 78.1 | 29,483 |
| 10/32” | 79.1 | 29,265 |

**Trypsin inhibitor observations:**

* Values for KOH solubility and trypsin inhibitor activity (TIA) are within the accepted ranges of 70-85% (Leeson and Summers 2005) and TIA values of 25,000-40,000 units (Serrano et al., 2013), respectively. These results indicate that the soybean meal did not have trypsin inhibitors present and the soybean meal was adequately processed.

**Table 20: Broiler digestibility trial (Exp 3): Pancreas weights expressed per 100 g of body weight**

|  |  |
| --- | --- |
| **Screen Size** | Pancreas weight |
| (g) |
| 3/32” | 0.436 |
| 7/32” | 0.444 |
| Worn 7/32” | 0.432 |
| 10/32” | 0.425 |
|  |  |
| *P*-Value | 0.6542 |
| LSD | 0.0318 |
| SEM | 0.0111 |

**Pancreas observations:**

* No significant differences in pancreas weights across treatments.

Data from the broiler digestibility experiment indicates that fine soybean meal particle size decreases AIAAD % in broilers while also maintaining the performance.

**Table 21: Feed milling study (Exp 4): Descriptive feed milling data of starter and grower diets**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Diet Phase** | **Screen Size** | HPT | NHPT | Production Rate |
| °C | % | lbs/hr |
| Starter | 3/32”  | 85.3 | 37.7 | 2,082 |
| 7/32” | 86.2 | 33.8 | 2,079 |
| 10/32”  | 83.3 | 34.4 | 2,058 |
| Grower | 3/32”  |  83.0 | 27.1 | 2,088 |
| 7/32” | 83.9 | 23.5 | 2,073 |
| 10/32”  | 84.0 | 29.1 | 1,971 |

**Table 22: Feed milling study (Exp 4): Hot pellet temperature and production rate of finisher feed**

|  |  |  |  |
| --- | --- | --- | --- |
| **Screen Size** | Hygienizer Temperature1 | HPT  | Production Rate |
| °F | °C  | lbs/hr |
| 3/32”  | 164 | 86.7 | 2,092 |
| 7/32”  | 168 | 86.4 | 2,148 |
| 10/32”  | 161 | 86.6 | 2,104 |
|   |  |   |   |
| *P*-Value  | -- | 0.9127 | 0.4276 |
| LSD  | -- | 1.5773 | 113.6100 |
| SEM | -- | 0.4017 | 28.9346 |

1Descriptive data

**Observations based on milling data:**

* No significant differences in hot pellet temperature or production rate.

**Table 23: Feed milling study (Exp 4): Pellet quality data of finisher feed**

|  |  |  |  |
| --- | --- | --- | --- |
| **Screen Size** |  NHPT | PDI | MPDI |
| % | % | % |
| 3/32”  | 86.9a | 91.8a | 84.7a |
| 7/32” | 82.0b | 88.3b | 79.8b |
| 10/32”  | 81.8b | 88.2b | 79.4b |
|   |   |   |  |
| *P*-Value  | **0.0087** | **0.0290** | **0.0261** |
| LSD  | 2.5984 | 2.5470 | 3.5990 |
| SEM | 0.6618 | 0.6487 | 0.9166 |

a-b Means within a column with different superscripts differ (*P*<0.05)

**Observations based on pellet quality data:**

* The 3/32” screen had the highest NHPT, PDI, and MPDI compared to all other screens.

Data from the feed milling experiment indicates that fine soybean meal will improve the pellet quality. However, the 3/32” soybean meal diet plugged the pellet die every time, as shown in figure 4.

**Figure 4. Plugged pellet die**



The 3/32” soybean meal diet plugged the pellet die every time

|  |  |  |  |
| --- | --- | --- | --- |
| **Ingredients** | **Starter**(1-14 d) | **Grower**(15-28 d) | **Finisher**(29-42 d) |
| **(%)** |
| Corn | 53.10 | 53.05 | 57.45 |
| Expeller Extruded Soybean Meal | 35.01 | 34.21 | 29.37 |
| DDGS | 5.00 | 5.00 | 5.00 |
| Soybean Oil | 2.60 | 4.04 | 4.82 |
| Dicalcium Phosphate | 1.74 | 1.51 | 1.33 |
| Limestone | 1.17 | 1.07 | 0.98 |
| DL-Methionine | 0.37 | 0.37 | 0.37 |
| Salt | 0.36 | 0.30 | 0.28 |
| Vit/Min Premix | 0.25 | 0.25 | 0.25 |
| Lysine | 0.23 | 0.12 | 0.10 |
| Threonine | 0.15 | 0.08 | 0.05 |
| **Calculated Nutrients** |
| ME (kcal/lb) | 1,361.00 | 1,407.00 | 1,451.00 |
| CP (%) | 22.00 | 21.50 | 19.50 |
| Dig. Lysine (%) | 1.28 | 1.15 | 1.02 |
| Dig. Methionine (%) | 0.66 | 0.59 | 0.54 |
| Dig. TSAA (%) | 0.95 | 0.87 | 0.80 |
| Dig. Threonine (%) | 0.86 | 0.77 | 0.68 |
| Dig. Tryptophan (%) | 0.23 | 0.23 | 0.20 |
| Calcium | 0.96 | 0.87 | 0.78 |
| Available P (%) | 0.48 | 0.44 | 0.39 |
| Sodium (%) | 0.16 | 0.16 | 0.16 |

**Table 24: Broiler performance trial (Exp 5): Diet formulations and calculated nutrients**

1 Supplied per kilogram of diet: 0.02% manganese; 0.02% zinc; 0.01% iron; 0.0025% copper; 0.0003% iodine; 0.00003% selenium; 0.69 mg of folic acid; 386 mg of choline; 6.61 mg of riboflavin; 0.03 mg of biotin; 1.38 mg of vitamin B6; 27.56 mg of niacin; 6.61 mg of pantothenic acid; 2.20 mg of thiamine; 0.83 mg of menadione; 0.01 mg of vitamin B12; 16.53 IU of vitamin E; 2,133 IU of vitamin D3; and 7,716 of vitamin A.

2 Metabolizable Energy values are based on Ross 708 recommendations.

3 Digestible amino acids were based on the digestible lysine value (1.2%) suggested by P. B. Tillman and W.A. Dozier. 2013. Digestible amino acid to digestible lysine ratios followed further recommendations of this communication (45 methionine, 70 threonine, 16 tryptophan

**Table 25: Broiler performance trial (Exp 5): Analyzed nutrient values**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Diet Phase** | **TRT** | Protein | Crude Fat | Crude Fiber | Ash | Moisture | Gross Energy |
| % | % | % | % | % | kcal/lb |
| Starter(1-14 d) | 3/32” | 18.38 | 6.04 | 6.70 | 5.24 | 12.33 | 1,810 |
| 7/32” | 22.69 | 6.49 | 2.50 | 5.88 | 12.47 | 1,860 |
| 10/32” | 23.06 | 6.29 | 2.50 | 5.45 | 12.47 | 1,850 |
| Grower(15-28 d) | 3/32” | 21.25 | 7.87 | 2.30 | 4.97 | 13.84 | 1,890 |
| 7/32” | 23.38 | 7.82 | 2.50 | 4.73 | 11.90 | 1,920 |
| 10/32” | 21.94 | 7.71 | 2.20 | 4.86 | 12.61 | 1,880 |
| Finisher(29-42 d) | 3/32” | 19.75 | 8.48 | 2.20 | 4.93 | 12.45 | 1,890 |
| 7/32” | 19.75 | 7.89 | 2.30 | 4.92 | 12.28 | 1,880 |
| 10/32” | 19.56 | 8.31 | 2.20 | 4.60 | 12.24 | 1,900 |

Nutrient analysis conducted by Eurofins Nutrition Analysis Center in Des Moines, IA.

**Table 26: Broiler performance trial (Exp 5): D1-14 Performance**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Screen Size** | Feed Intake | Feed Intake | Live Weight Gain | Live Weight Gain | Initial Body Weight | Bird Weight | Bird Weight | Mortality | Feed Conversion Ratio1 |
| kg | kg/bd | kg | kg/bd | g | kg | kg/bd | % | kg/kg |
| 3/32”  | 14.975a | 0.474a | 11.100 | 0.352 | 41.817 | 12.438 | 0.394 | 1.302 | 1.389a |
| 7/32” | 14.426b | 0.454b | 11.491 | 0.362 | 41.817 | 12.829 | 0.404 | 0.781 | 1.256b |
| 10/32”  | 14.817a | 0.464ab | 11.945 | 0.374 | 41.842 | 13.284 | 0.416 | 0.260 | 1.241b |
|   |  |  |  |  |  |  |  |  |  |
| *P*-Value  | **0.0086** | **0.0032** | 0.2112 | 0.3168 | 0.9796 | 0.2114 | 0.3364 | 0.2302 | **0.0462** |
| LSD  | 0.3395 | 0.0107 | 0.9592 | 0.0303 | 0.2949 | 0.9614 | 0.0305 | 1.2186 | 0.1267 |
| SEM | 0.1158 | 0.0036 | 0.3271 | 0.0103 | 0.1005 | 0.3278 | 0.0104 | 0.4155 | 0.0432 |

1Mortality corrected FCR: mcFCR = FI/(LWG + Wt of Mortality)

a-b Means within a column with different superscripts differ (*P*<0.05)

**D1-14 observations based on performance data:**

* Feed intake (FI) differences are apparent on a pen basis and per bird. On a pen basis, the 7/32” screen had the lowest FI. Per bird, the 3/32” screen had the highest FI, 7/32” had the lowest, and 10/32” was intermediate.
* Feed conversion ratio (FCR) was significantly different with the 3/32” having the highest FCR.

**Table 27: Broiler performance trial (Exp 5): D15-28 Performance**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Screen Size** | Feed Intake | Feed Intake | Live Weight Gain | Live Weight Gain | Bird Weight | Bird Weight | Feed Conversion Ratio1 |
| kg | kg/bd | kg | kg/bd | kg | kg/bd | kg/kg |
| 3/32”  | 48.441a | 1.550a | 34.373a | 1.103a | 46.631a | 1.497a | 1.409b |
| 7/32” | 34.830c | 1.175c | 23.658c | 0.814c | 35.100c | 1.207c | 1.473a |
| 10/32”  | 38.115b | 1.286b | 26.075b | 0.886b | 38.159b | 1.297b | 1.466a |
|   |  |  |  |  |  |  |  |
| *P*-Value  | **<0.0001** | **<0.0001** | **<0.0001** | **<0.0001** | **<0.0001** | **<0.0001** | **<0.0001** |
| LSD  | 2.4545 | 0.0589 | 2.0277 | 0.0476 | 2.7045 | 0.0615 | 0.0268 |
| SEM | 0.8369 | 0.0201 | 0.6913 | 0.0162 | 0.9221 | 0.0210 | 0.0091 |

1Mortality corrected FCR: mcFCR = FI/(LWG + Wt of Mortality)

a-c Means within a column with different superscripts differ (*P*<0.05)

**D15-28 observations based on performance data:**

* There were significant differences in BW, LWG, FI, and FCR.
* The 3/32” screen had the highest BW, LWG, and FI and the 7/32” screen had the lowest.
* The 3/32” screen had the lowest FCR while the 7/32” and 10/32” screens had the highest.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Screen Size** | Feed Intake | Feed Intake | Live Weight Gain | Live Weight Gain | Feed Conversion Ratio1 |
| kg | kg/bd | kg | kg/bd | kg/kg |
| 3/32”  | 81.818a | 2.647a | 48.403a | 1.565a | 1.692a |
| 7/32” | 69.411b | 2.401b | 42.735b | 1.479b | 1.624b |
| 10/32”  | 70.369b | 2.417b | 42.960b | 1.477b | 1.637b |
|   |  |  |  |  |  |
| *P*-Value  | **<0.0001** | **<0.0001** | **<0.0001** | **0.0002** | **<0.0001** |
| LSD  | 4.0137 | 0.0708 | 2.3810 | 0.0403 | 0.0272 |
| SEM | 1.3685 | 0.0241 | 0.8118 | 0.0138 | 0.0093 |

 **Table 28: Broiler performance trial (Exp 5): D29-42 Performance**

1Mortality corrected FCR: mcFCR = FI/(LWG + Wt of Mortality)

a-b Means within a column with different superscripts differ (*P*<0.05).

**D29-42 observations based on performance data:**

* There were significant differences in LWG, FI, and FCR.
* The 3/32” screen had the highest LWG, FI, and FCR while the 7/32” and 10/32” screens had the lowest.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Screen Size** | Feed Intake | Feed Intake | Live Weight Gain | Live Weight Gain | Bird Weight | Mortality | Feed Conversion Ratio1 |
| kg | kg/bd | kg/bd | kg | kg/bd | % | kg/kg |
| 3/32”  | 145.234a | 4.700a | 3.038a | 94.364a | 3.052a | 3.385b | 1.547a |
| 7/32”  | 118.668b | 4.107b | 2.697c | 77.678b | 2.687b | 9.635a | 1.523b |
| 10/32”  | 123.302b | 4.237b | 2.784b | 80.818b | 2.774b | 9.115a | 1.522b |
|   |  |  |  |  |  |  |  |
| *P*-Value  | **<0.0001** | **<0.0001** | **<0.0001** | **<0.0001** | **<0.0001** | **0.0093** | **0.0002** |
| LSD  | 6.4515 | 0.1308 | 0.0859 | 5.0048 | 0.0890 | 4.2128 | 0.0115 |
| SEM | 2.1997 | 0.0446 | 0.0293 | 1.7064 | 0.0304 | 1.4364 | 0.0039 |

 **Table 29: Broiler Performance trial (Exp 5): Overall 1-42d Performance**

1Mortality corrected FCR: mcFCR = FI/(LWG + Wt of Mortality)

a-b Means within a column with different superscripts differ (*P*<0.05)

**D1-42 observations based on performance data:**

* There were apparent differences in BW, LWG, FI, FCR, and mortality percentage.
* The 3/32” screen had the highest LWG while the 7/32” had the lowest.
* The 3/32” screen had the highest BW, FI and FCR with other treatments being similar to each other.
* The 7/32” and 10/32” screens had a higher mortality compared to the 3/32” screen.

**Table 30: Broiler performance trial (Exp 5): Carcass and parts weights of 42d broilers**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Screen Size** | Live Wt. | Hot Carcass Wt. | Chilled Carcass Wt. | Breast Wt. | Thigh Wt. | Drum Wt. | Wing Wt. | Tenderloin Wt. | Total Breast Wt. | Gizzard Wt. |
| kg | kg | kg | kg | kg | kg | kg | kg | kg | g |
| 3/32”  | 2.999a | 2.276a | 2.383a | 0.570a | 0.374a | 0.333a | 0.267a | 0.101 | 0.671a | 31.846 |
| 7/32” | 2.680b | 2.043b | 2.129b | 0.511b | 0.325b | 0.300b | 0.246b | 0.089 | 0.599b | 29.604 |
| 10/32”  | 2.742b | 2.083b | 2.179b | 0.512b | 0.348ab | 0.309ab | 0.247b | 0.095 | 0.608b | 30.025 |
|   |  |  |  |  |  |  |  |  |  |  |
| *P*-Value  | **0.0006** | **0.0019** | **0.0012** | **0.0258** | **0.0059** | **0.0353** | **0.0177** | 0.1915 | **0.0222** | 0.1934 |
| LSD  | 0.1649 | 0.1340 | 0.1383 | 0.0485 | 0.0293 | 0.0255 | 0.0163 | 0.0135 | 0.0550 | 2.5940 |
| SEM | 0.0583 | 0.0473 | 0.0488 | 0.0171 | 0.0103 | 0.0090 | 0.0057 | 0.0048 | 0.0194 | 0.9163 |

a-b Means within a column with different superscripts differ (*P*<0.05)

**Carcass and parts weight observations based on processing data:**

* 24 birds per treatment were used in statistical analysis of processing data
* There were apparent differences in all carcass weights except the tenderloin.
* The 3/32” screen had significantly higher weights than other treatments except for the thigh and drum weights where it was similar to the 10/32” screen.
* Gizzard weights were not significantly different across treatments.

**Table 31: Broiler performance trial (Exp 5): Carcass and parts yield of 42d broilers**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Screen Size** | Hot Carcass | Chilled Carcass | Breast | Thigh | Drum | Wing | Tenderloin | Total Breast | Gizzard |
| % | % | % | % | % | % | % | % | % |
| 3/32”  | 75.90 | 79.46 | 23.89 | 15.65 | 13.95 | 11.25 | 4.25 | 28.15 | 1.07 |
| 7/32” | 76.21 | 79.47 | 23.88 | 15.32 | 14.08 | 11.58 | 4.16 | 28.03 | 1.11 |
| 10/32”  | 75.94 | 79.45 | 23.44 | 15.97 | 14.19 | 11.35 | 4.36 | 27.81 | 1.10 |
|   |  |  |  |  |  |  |  |  |  |
| *P*-Value  | 0.8807 | 0.9997 | 0.6709 | 0.4069 | 0.8194 | 0.3019 | 0.7446 | 0.8591 | 0.6606 |
| LSD  | 1.3490 | 1.4563 | 1.1374 | 0.9704 | 0.7607 | 0.4351 | 0.5373 | 1.2588 | 0.1034 |
| SEM | 0.4765 | 0.5144 | 0.4018 | 0.3428 | 0.2687 | 0.1537 | 0.1898 | 0.4447 | 0.0365 |

**Carcass and parts yield observations based on processing data:**

* 24 birds per treatment were used in statistical analysis of processing data
* No significant differences in yield data across treatments.

Data from the broiler performance experiment indicates that broilers fed finely ground soybean meal will have a higher feed intake and weight gain compared to those fed coarse ground soybean meal to compensate for nutrient digestibility. However, broilers fed finely ground soybean meal will have a worse FCR compared to those fed medium or coarse ground soybean meal.