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# Effect of Feed Texture on Growth Performance and Litter Moisture When Fed to Growing-Finishing Commercial Toms

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**Abstract:** Large White male turkeys were fed diets with similar nutrient content using either a corn-soybean meal-wheat middlings based diet fed as pellets or mash or a corn-soybean meal based mash diet. The pelleted diets were processed either with or without a commercial pellet binder. Each treatment was assigned to four pens of 25 toms from 6 to 18 wk of age. Body weight and feed consumption were determined at 21 d intervals during the trial. Turkeys fed pelleted diets were heavier at 9 and 12 wk of age only. However, this effect was due to reduced growth performance of birds fed the corn-soybean meal mash diet which had less energy from added fat compared to the other diets. Cumulative feed conversion (feed:gain) was improved when pelleted diets were fed throughout the trial. Pellet quality was fair up to 12 wk of age and poor during the latter part of the study when high added fat was included in the diets. Litter moisture was increased at the end of the trial when pelleted diets were fed. However, leg problems were not evident in this study.

**Key words:** Growth, litter, mash, pellet, turkey

## Introduction

The use of pelleted feed in turkey production is commonly used to improve growth and feed efficiency (Dymsza *et al*., 1955; Pepper, 1960; Owen *et al*., 1981). Noll *et al*. (19991) found that 20 wk body weight of male turkeys was increased by about 5% and cumulative feed conversion (feed:gain) was improved by about 3% when a corn-soybean meal based diet was fed as pellets compared to a mash form. Proudfoot *et al*. (1982) tested feeding a mash form of feed compared to a crumbled pellet (starter) pellet form program with turkey broilers (male turkeys grown to 14 wk of age). Although body weight was decreased and feed conversion was increased when mash feed was provided, there was no significant difference in monetary returns. When various levels of fines (partially or fully disintegrated pellets) were mixed with intact pellets, the authors observed similar body weight for turkeys fed 60% fines as turkeys given feed in the mash form. Hamilton and Kennie (1997) reported that turkeys grown to 14 wk of age on mash or pelleted feed were heavier due to higher feed intake when mash feed was provided. Feed conversion was improved when the turkeys consumed pellets illustrating that improvement in feed conversion was due to less time spent eating feed (Jensen *et al*., 1962).

A common problem identified in the turkey industry with feeding pellets is an increase in litter moisture (H. Punter, Sietsema Farms, Allendale, MI, USA, personal communication). Noll *et al*. (1991) observed an increase in litter moisture when male turkeys were fed pellets compared to mash. However, there was no significant difference at the end of the 20-wk trial. Wet litter is believed to result in an increase in leg problems of turkeys.

The cost of pelletizing feed needs to be considered to evaluate the most economical way to raise turkeys commercially. If a turkey grower owns a feed mill but does not have a pellet mill, the extra cost of paying a company to transport pelleted feed to a producer may not be worth the potential improvements in growth and feed conversion. The use of a pellet binder would increase this cost further. This is a reason why some turkeys in the U.S. are still raised on mash feed.

The objectives of this trial are to evaluate growth performance of turkeys in a controlled environment fed mash or pellets and the influence feed form has on litter moisture. Mash feed was provided with or without the inclusion of wheat middlings. Wheat middlings were used to aid in pellet quality. However, different levels of this ingredient would be expected in a mash feed fed to poultry. Because turkey rations for late growth are difficult to pellet due to high fat inclusion used in the U.S., pellet quality was also monitored.

## Materials and Methods

Eight hundred male turkeys of a commercial Large White strain[1] were grown from day of hatch to 6 wk of age for a separate trial. At 6 wk, the poults were redistributed to ensure equal starting body weight and bird count at the beginning of the experiment. The

[1]B. U. T. A. Big 6, British United Turkeys of America, Duluth, GA 30096

Table 1: Composition (%) and calculated nutrient content[1] of experimental diets fed either in pelleted or mash (Diets 3 and 4) form to growing-finishing male turkeys

| Ingredient | 6-9 wk | | 9-12 wk | | 12-15 wk | | 15-18 wk | |
|---|---|---|---|---|---|---|---|---|
| | Diets 1-3 | Diet 4 | Diets 1-3 | Diet 4 | Diets 1-3 | Diet 4 | Diets 1-3 | Diet 4 |
| Ground yellow corn | 49.80 | 57.75 | 55.70 | 64.20 | 57.50 | 66.00 | 58.15 | 66.65 |
| Soybean meal (48%) | 32.45 | 33.40 | 26.15 | 27.20 | 22.90 | 24.00 | 21.00 | 22.05 |
| Wheat middlings | 7.00 | 0.00 | 7.50 | 0.00 | 7.50 | 0.00 | 7.50 | 0.00 |
| Porcine meat/bone meal | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 |
| Animal/vegetable fat | 4.00 | 2.10 | 4.58 | 2.49 | 6.35 | 4.23 | 8.02 | 5.94 |
| Dicalcium phosphate | 1.35 | 1.37 | 0.95 | 0.98 | 0.76 | 0.80 | 0.57 | 0.60 |
| Limestone | 0.80 | 0.78 | 0.65 | 0.63 | 0.58 | 0.55 | 0.50 | 0.48 |
| Salt | 0.27 | 0.28 | 0.25 | 0.27 | 0.28 | 0.30 | 0.31 | 0.33 |
| Methionine-HA (88%)[2] | 0.33 | 0.32 | 0.25 | 0.24 | 0.26 | 0.25 | 0.18 | 0.18 |
| L-Lysine-HCl | 0.20 | 0.20 | 0.20 | 0.20 | 0.10 | 0.10 | 0.00 | 0.00 |
| Vitamin premix[3] | 0.15 | 0.15 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 |
| Trace mineral premix[4] | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Sodium bicarbonate | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Crude Protein | 23.00 | 23.00 | 20.50 | 20.50 | 19.00 | 19.00 | 18.00 | 18.00 |
| ME, kcal/kg | 3025 | 3025 | 3120 | 3120 | 3245 | 3245 | 3355 | 3355 |
| Lysine | 1.45 | 1.45 | 1.27 | 1.27 | 1.10 | 1.10 | 0.96 | 0.96 |
| Methionine + Cystine | 1.02 | 1.02 | 0.91 | 0.91 | 0.88 | 0.88 | 0.78 | 0.78 |
| Calcium | 1.08 | 1.08 | 0.92 | 0.92 | 0.84 | 0.84 | 0.76 | 0.76 |
| Total phosphorus | 0.81 | 0.81 | 0.72 | 0.72 | 0.66 | 0.66 | 0.62 | 0.62 |
| Nonphytate phosphorus | 0.54 | 0.54 | 0.46 | 0.46 | 0.42 | 0.42 | 0.38 | 0.38 |

[1]Calculated from analyzed values of corn, soybean meal, wheat middlings, meat and bone meal for crude protein, calcium and phosphorus. Analyzed ME value for fat source provided. Other values based upon NRC (1994) tables. [2]Methionine Hydroxy analogue (Alimet®), Novus International, St. Charles, MO 63304. [3] Vitamin premix provided per kilogram of diet during 6-9 wk phase: vitamin A (all-trans-retinyl acetate), 11,000 IU; cholecalciferol, 5,000 ICU; vitamin E (all-rac-$\alpha$-tocopheryl acetate), 35 IU; menadione (as menadione sodium bisulfite), 2.75 mg; riboflavin, 10 mg; Ca pantothenate, 20 mg; nicotinic acid, 80 mg; vitamin $B_{12}$, 0.025 mg; vitamin $B_6$, 4.3 mg; thiamin (as thiamin mononitrate), 2.9 mg; folic acid, 2.2 mg; biotin, 0.2 mg; vitamin C, 0.10 g; selenium, 0.275 mg; and ethoxyquin, 125 mg. [4]Mineral premix supplied per kilogram of diet: manganese, 100 mg; zinc, 100 mg; iron, 50 mg; copper, 10 mg; iodine, 1 mg.

average beginning body weight at 6 wk of age was 2.52 kg. Each pen was equipped with a hanging feeder and waterer and pine shavings were used as bedding over a concrete floor. Four dietary treatments were fed to 4 pens of 25 birds per pen. Temperature, ventilation and lighting (16 hr light:8 hr dark) were completely controlled within the house.

The same nutrient specifications were formulated for each diet (Table 1) and diets were mixed and delivered from a commercial feed mill[2]. Diet formulations were conducted after the feed manufacturer supplied nutrient analysis information of key feed ingredients. Diet 1 was a corn-soybean meal-wheat middlings based diet and was fed in pellet form. Diet 2 was also pelleted and formulated the same as Diet 1 except lignin sulfonate was used as a pellet binder at 0.50% of the diet per standard practice by the feed manufacturer. Diet 3 was formulated with the same ingredients as Diets 1 and 2 but fed in mash form. Diet 4 was formulated to provide the same nutrient content as the other diets, but consisted of a simple corn-soybean meal based diet. No medication was used in the feed for this study. Nutrient specifications changed every 3 wk to match industry practices in the U.S. turkey industry. Feed intake per pen and individual body weights were measured at the end of each 3 wk phase to calculate feed conversion (kg feed:kg gain) throughout the experiment. Feed conversion was corrected for weight loss due to mortality during the experiment.

Pellet quality was tested in a tumbler[3] using the pellet durability index as described by Moritz *et al.* (2002). Due to the high percentage of fines (>80 %) in the last two phases, pellet quality was only tested in the 6-9 wk and 9-12 wk feeding phases. The pelleted diets in the 12-15 and 15-18 wk periods were assumed to be ground pellets for feeding purposes.

Litter samples were taken from each pen at the end of the trial. The samples were taken the next day after the turkeys had been loaded out of the building. Five sub-samples were taken from each pen. Sub-samples were taken from the middle of the pen and in each corner of the pen using a post-hole type shovel (ca. 10 cm width).

[2]Hamilton Farm Bureau, Hamilton, MI 49419. [3]Seedboro Equipment Company, Chicago, IL 60607.

Table 2: Effect of feed form and composition on body weight (kg) of Large White male turkeys

| Treatment | | Age (weeks) | | | |
|---|---|---|---|---|---|
| | | 9 | 12 | 15 | 18 |
| pellet | | 6.01[a] | 9.66[a] | 13.10 | 16.72 |
| pellet + binder[1] | | 5.85[ab] | 9.46[ab] | 13.04 | 16.91 |
| mash (midds[2]) | | 5.84[ab] | 9.51[ab] | 12.86 | 16.92 |
| mash (no midds) | | 5.66[b] | 9.31[b] | 12.84 | 16.84 |
| Mean | | 5.84 | 9.49 | 12.96 | 16.85 |
| SEM | | 0.06 | 0.08 | 0.20 | 0.24 |
| | df | Probabilities | | | |
| Analysis of Variance | | | | | |
| Treatment | 3 | 0.020 | 0.044 | 0.752 | 0.926 |
| Contrasts[3] | 1 | 0.016 | 0.065 | 0.304 | 0.784 |
| pellets vs. mash (midds) | 1 | 0.253 | 0.566 | 0.425 | 0.723 |
| pellets vs. mash (no midds) | 1 | 0.005 | 0.018 | 0.372 | 0.925 |

[1]lignin sulfonate, [2]midds=wheat middlings, [3]pellets= pellet and pellet + binder treatments combined

Table 3: Effect of feed form and composition on cumulative feed conversion (kg feed:kg gain) and litter moisture (%) when fed to growing-finishing Large White male turkeys

| Treatment | | Feed Conversion Age (weeks) | | | | Litter moisture |
|---|---|---|---|---|---|---|
| | | 9 | 12 | 15 | 18 | |
| Pellet | | 1.79[bc] | 2.09[ab] | 2.39[ab] | 2.60[ab] | 54.7 |
| Pellet + binder[1] | | 1.74[c] | 2.06[b] | 2.33[b] | 2.54[b] | 54.3 |
| Mash (midds[2]) | | 1.82[b] | 2.13[ab] | 2.47[a] | 2.62[a] | 51.3 |
| Mash (no midds) | | 1.90[a] | 2.18[a] | 2.46[a] | 2.65[a] | 52.0 |
| Mean | | 1.82 | 2.11 | 2.42 | 2.60 | 53.1 |
| SEM | | 0.02 | 0.03 | 0.03 | 0.02 | 1.3 |
| Source of variation | df | Probabilities | | | | |
| Treatment | 3 | 0.005 | 0.082 | 0.027 | 0.031 | 0.219 |
| Contrasts[3] | | | | | | |
| pellets vs. mash | 1 | 0.003 | 0.022 | 0.006 | 0.015 | 0.047 |
| pellets vs. mash (midds) | 1 | 0.100 | 0.154 | 0.013 | 0.088 | 0.064 |
| pellets vs. mash (no midds) | 1 | 0.008 | 0.017 | 0.023 | 0.014 | 0.141 |

[1]lignin sulfonate, [2]midds=wheat middlings, [3]pellets= pellet and pellet + binder treatments combined

Corner sub-samples were taken approximately 30 cm from the wall at the back of the pen and the wall or netting at the side of the pen. The sub-samples were of various depths depending on the site in the pen (ca. 15 cm deep in middle, but usually more shallow in the corners). The 5 sub-samples were mixed together to result in one composite sample (ca. 500 g) per pen for analysis for moisture. Litter moisture was determined by placing litter samples in a forced-air drying oven at 60 °C for 24 hr.

The data were analyzed using the General Linear Models procedure of SAS (SAS Institute, 2000). Separations of individual treatment mean differences were determined by Duncan's Multiple Range test. Because the pelleted diets were so similar and there were no significant differences between Diets 1 and 2 for any parameter, orthogonal contrasts were also used to determine differences between the pelleted diets and the mash feeds either combined or individually.

## Results and Discussion

Body weight data for the end of each 3 wk phase is shown in Table 2. Although there was a feed form effect ($p<0.016$) at 9 wk, the lower body weight of mash fed turkeys was primarily due to a significantly lower body weight of birds fed the simple corn-soybean meal diet. The difference in the level of added fat in the corn-soybean meal mash diet compared to the other diets

could have resulted in an "extra caloric" effect (Kagan, 1981) since the turkeys fed the corn-soybean meal-wheat middlings mash diet grew just as well as the birds fed pellets. The pellet durability index (PDI) was 81% for Diet 1 and 72% for Diet 2 during the 6 to 9 wk feeding phase. The amount of fines was 12% for Diet 1 and 36% for Diet 2 in the feed received for this phase. The feed manufacturer had initially screened out fines from the pellets before delivery for Diet 1, but did not screen Diet 2.

Mash fed turkeys had a lower ($p<0.065$) 12 wk body weight compared to pellet fed turkeys. The response was less significant compared to 9 wk body weight because growth was not different between treatments from 9 to 12 wk of age. The amount of fines was about 35% in both pelleted diets. The PDI for both Diets 1 and 2 was approximately 82%. Hence, there was no improvement in pellet quality when the pellet binder was used in this study. Acar *et al.* (1991) observed a 56% improvement in pellet quality when calcium lignosulfonate was used in broiler rations at 1.25%. In addition to the level of pellet binder used being 2.5 times as high as in the current study, the trial reported by Acar *et al.* (1991) utilized a large amount (3,000) of birds and therefore larger batches of feed were needed. In the current study, 1-2 ton batches were manufactured for early to late feeding phases which is a challenge for a commercial feed mill attempting to pelletize feed.

There were no significant treatment differences for 15 or 18 wk body weights. Plavnik *et al.* (1997) observed that when ground pellets were fed either to turkeys or broilers, benefits in growth and feed conversion that had been observed when feeding pellets were abolished. Due to the poor pellet quality in 12-15 and 15-18 wk feeding phases, the pelleted diets were basically fed as ground processed feed. Total oil content of the feed of 7.5% is known to reduce pellet quality (Briggs *et al.*, 1999). Added fat levels in the 12-15 and 15-18 wk feeding phases were approximately 6.5 and 8.0%, respectively. Spray addition of fat onto the formed pellet is not an option at the feed facility used for this study. Although wheat middlings was included to improve pellet quality, other factors made it difficult to process intact pellets during the last two feeding phases. Noll *et al.* (1991) observed an increase in body weight at 8, 12, 16 and 20 wk of age when pellets were fed in place of mash using a low (1%) fat, corn-soybean meal diet. When the same corn-soybean meal based mash diet was fed with increasing levels of fat as the birds aged, body weight was lower only at 12 and 16 wk of age compared to pellet fed birds, but was not different at 20 wk.

Cumulative feed conversion was improved when pellets were fed compared to mash feed throughout the experiment (Table 3). Feed conversion was higher for turkeys fed the simple corn-soybean meal diet compared to the mash diet also containing wheat middlings at 9 wk of age (6 to 9 wk feeding period). However, the two mash type diets yielded similar feed conversions during the remainder of the experiment. Differences in cumulative feed conversion between pellet and mash fed birds after 9 wk of age was due to a carryover effect from the treatment differences observed at the end of the first feeding phase.

Although there were no significant differences between individual dietary treatments for litter moisture due to pen variation, contrasting the two feed forms showed that litter moisture was higher ($p<0.047$) when pelleted diets were fed. This effect is commonly observed under commercial conditions and associated coincidentally with leg problems. However, no leg problems were observed in this experiment. The litter moisture was high for all treatments due to the confined nature of housing. Litter moisture of 50-55% would represent "caked" litter in the turkey industry. Darker spots within the pens of pellet fed turkeys were noticed at the end of the study indicating a higher level of moisture in that area.

The results of this experiment showed that pelleted feed improves feed conversion of growing-finishing male turkeys when fed pellets of good quality (low fines). Body weight was only improved at earlier ages (6 to 12 wk) and was sensitive to pellet quality as feed intake was about 300 g per bird higher for Diet 1 than other treatments during the 6 to 9 wk phase. Overall, turkeys fed mash feed consumed about 1 kg more feed during the 12 wk study than birds fed heat processed feed. The short run-time for the small amount (1 to 2 tons/diet) of feed needed for each phase in addition to the lack of equipment to spray on fat onto the pellets made pelleting a difficult task for the manufacturer supplying feed in this study. The increase in litter moisture when turkeys are fed pelleted feed has been reported in the field to be due to an increase in water consumption that corresponds with typically higher feed intake when pellets are fed.

The cost of pelleting the feed was about 5 U.S. dollars per ton of feed. The use of a pellet binder was an additional 2.25 U.S. dollars per ton. The average cost per ton of feed was 140 U.S. dollars (0.15 dollars per kg). The difference in feed conversion between birds fed pelleted or mash diets was 5.5 points (0.055 kg feed:kg gain). By multiplying the final body weight by the feed conversion to get feed intake per bird and multiplying that number by feed cost, the result was a cost savings of 0.04 U.S. dollars per bird when mash was fed. When good quality pellets are fed, turkeys will typically have higher body weights at market and improved feed conversion will be observed. Some turkey producers in the U.S. feed mash to turkeys because their farm is large enough that they own their own feed mill and the savings in transportation (and pelleting) costs make feeding mash more profitable in their operations.

Concern over the possibility of leg problems due to higher litter moisture is also a factor in deciding which feed form to use. The process of heating and conditioning the feed still improved the ability of turkeys to convert feed to meat. However, the results of this experiment did not show an economic advantage for feeding pelleted feed to growing-finishing male turkeys which demonstrates the importance of pellet quality.

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