Pellet Quality Effects on Broiler Growth and Efficiency

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Story in Brief

Two experiments were conducted concurrently to evaluate pelleting influences on broiler growth and feed efficiency. In both experiments, birds were reared to 42 d of age, and then feed conversion was measured in a sample of the population from 43 to 50 d of age in individual bird cages. Experiment 1 utilized 192 birds assigned to six graded levels of pellets and pellet fines, whereas Exp. 2 used 72 birds assigned to three graded levels of pellets and pellet fines and included measurement of water intake. In Exp.1, pelleting enhanced bird growth and feed efficiency compared to mash. Pelleted treatments with less than 40% pellets decreased weight gain and feed intake. In Exp. 2, birds fed either 40% or 20% pellets had reduced weight gains, reduced feed intake, and reduced water intake compared to birds fed the 80% pellets diet. Birds fed the 80% pellets had lower (better) feed conversion ratios than birds offered 40% pellets, with birds fed 20% pellets intermediate. The results of Exp. 2 indicate that pellet quality may reduce feed intake due to poor palatability.

Key Words: Pelleting, Broiler, Pellet Quality, Feed Efficiency, Palatability

Introduction

Though some controversy exists, the general mind-set is that a linear relationship exists between rate and efficiency of broiler growth and ratio of pellets to fines (pellet quality). Yet, the relationship between pellet quality and broiler performance remains largely unquantified. Runnels et al. (1976) stated that feeding poor quality pellets to broilers may negate some of the benefits of pelleting, but removing pellet fines via sifting is not warranted. However, neither pellet quality nor the quantity of pellet fines was reported, making it difficult to conclude that pellet quality is negligible. Proudfoot and Sefton (1978) evaluated the performance of birds fed mash or pelleted diets with 0, 5, 15, 25, 35, 45, and 100% reground pellets (fines). They reported no difference between birds fed mash and the diet made up from 100% reground pellets, and observed that all pellet treatments resulted in superior body weight and feed conversion compared to the mash control. Further, they reported that as the level of fines increased in the diets, performance decreased, however differences were not significant. The lack of significance most likely stems from insufficient experimental replication. Acar et al. (1991) evaluated the effect of improved pellet quality from using a calcium lignosulfonate (CaLS) binder on broilers. They reported that pellet quality was improved with the inclusion of CaLS in the diet (67% vs 43%) and that feed consumption (2600g vs 2515g) and feed conversion (2.10 vs 2.16) improved approximately 3.4 and 2.9%, respectively, when birds were fed the CaLS diet. Similarly, researchers at North Carolina State University (Zatari et al. 1990) evaluated the growth performance of broilers fed diets with 25 or 75% fines. They observed lower body weights as the level of fines increased, with minimal effects in feed efficiencies. Scheideler (1995) adjusted these data to account for days to market weight differences and reported a 2.4% improvement in feed conversions (2.08 vs 2.13) in birds fed lower amounts of fines. From this, she estimated a total savings of 0.021 cents per bird based on a feed cost of $140.00/ton.

Relationships between pellet quality and bird performance are yet to be illustrated in detail. Quantifying pellet quality influences on weight gain and feed efficiency would assist with establishing quality control guidelines and appraising feed value. Therefore, two experiments were conducted to define the impact of pellet quality on both the broiler population at large and broilers selected for superior rate and efficiency of gain.

Materials and Methods

Two concurrent experiments were conducted during which birds were reared to 42 d prior to the initiation of the experiment as part of a companion experiment (Skinner-Noble et al., 2001). Birds were reared from hatching in floor pens with wood shavings as litter. Water and feed were provided for ad libitum consumption throughout (except as noted). Feed was provided in mash form from hatching to 19 d, and was in pellet form from 19 to 42 d. All birds were weighed at 42 d of age. Following weighing, the birds were fasted overnight to promote appetite. In both experiments, a sample of the population was chosen for use in feed conversion testing. Feed conversion was measured in individual cages measuring 46 × 61 cm. Each cage was equipped with a stainless steel feeder and nipple waterer to allow ad libitum consumption of feed and water.

In Exp. 1, approximately 400 heavy-type broiler females were reared on a three-diet, declining-protein feeding program (Skinner-Noble et al., 2001). From these 400 birds, 192 birds were randomly selected for feed conversion testing. All treatments were derived from a common finisher diet, with treatments differing only in the ratio of pellets to pellet fines. The finisher diet included wheat and wheat middlings to promote pellet quality, and was manufactured at the OSU Animal Science Feedmill. A 900 kg batch was weighed and mixed, and from this batch, 45 kg were withdrawn for a non-pelleted control treatment. The remaining batch was conveyed to the pelleting system, steam conditioned to 83 °C, and pelleted through a 4 mm die opening. The pelleted feed was transported to the OSU Poultry Research Center and sifted to separate the pellet fines from the pellets. Sifted pellets and pellet fines were separately weighed and thoroughly blended together so that each bird was fed the correct ratio of pellets to pellet fines respective to the assigned treatment. Treatments used were: 80% pellets (20% pellet fines); 60% pellets (40% pellet fines); 40% pellets (60% pellet fines); 20% pellets (80% fines); 0% pellets (100% pellet fines); and unprocessed mash served as a negative control.

In Exp. 2, approximately 400 heavy-type broiler females were reared to 42 d of age fed a grower diet throughout (Skinner-Noble et al., 2001). Birds were chosen for feed conversion testing based on a combination of body weight, breast conformation, and freedom from defects. All birds were weighed and subjectively evaluated for breast conformation and leg defects. The subjective traits were scored from one to five, with one being extremely poor, and five being superior for the traits. An index was constructed which was the standardized deviation for body weight plus the standardized deviation for leg defects, plus twice the standardized deviation for breast conformation. This index was designed to simulate heavy-type selection in the broiler breeding industry. Using this index, the best 72 birds were selected for feed conversion testing, and equal numbers of birds were chosen from within each of 10 pens.

Figure 1. Watering system used in Experiment 2 for measuring water intake

The grower diet that birds had been fed from hatching was sifted as in Exp. 1. As only 72 cages were available, the number of treatments utilized was reduced to three, with 24 replicate cages per treatment. Three treatments were used in this experiment: 80% pellets (20% fines), 40% pellets (60% fines), and 20% pellets (80% fines). The cages used in this experiment are fitted with a nipple drinker attached to a 1 L graduated cylinder to measure individual bird water consumption to the nearest 5 mL (Figure 1).

In both experiments, data (feed intake, weight gain, feed conversion, and water intake in Exp. 2) were analyzed by analysis of variance with pellet treatment as the source of variation. Birds were subsequently classified as having a 'valid test' if they met three criteria: no evidence of feed wastage, weight gain over 100 g (Exp. 1) or 200 g (Exp. 2), and feed intake over 500 g (Exp. 1) or 600 g (Exp. 2). A score of either '1' or '0' was assigned for valid and invalid tests, respectively. When multiple means differed, they were separated using Duncan's procedure (SAS Inst. Inc., Cary, NC).

Results and Discussion

Preliminary analyses revealed that performance while birds were in feed conversion testing cages was more variable than in previous experiments in this laboratory due to the pellet treatments. As a result, data are presented both when all birds are included in the analysis and after removing the birds with invalid test results.

Experiment 1. When all birds were included in the analysis, differences among pellet treatments were significant (Table 1). Inclusion of birds with invalid tests resulted in feed conversion ratios, which were significantly higher or lower than expected values (data not shown). The percent valid test increased with increasing pellet quality. The reasons for invalid tests were

either poor feed intake or poor weight gain. Acar et al. (1991) observed that feed intake increased with increasing pellet quality. Similar results were observed in the current study. Reasons for the relatively poor performance of birds in this study may also include behavioral adaptation to pellets, and thus rejection of poor quality pellets.

Table 1. Means of traits measured in Experiment 1, when all birds were included

	Treatment (% Pellets)					
Trait	Mash	80	60	40	20	0
Weight gain, g	136.68^{bcd}	279.58^{ab}	315.75^{a}	159.78^{abc}	102.38^{cd}	-27.71^{d}
Feed intake, g	705.13^{bc}	937.46^{a}	943.75^{a}	766.11^{ab}	684.73^{bc}	549.50^{c}
Valid tests (%)	64.52^{ab}	76.92^{a}	85.71^{a}	62.96^{ab}	65.38^{ab}	46.43^{b}

^{a,b,c,d}Means within a row with no common superscripts differ (P<.05).

When birds with invalid tests were excluded, pellet quality still influenced broiler performance (Table 2). As the ratio of pellets to pellet fines increased, linear increases were observed for weight gain, feed intake, and efficiency of gain. Similarly, Proudfoot and Sefton (1978) demonstrated linearity between the level of pellet fines and the growth characteristics of broilers; however, they did not observe significant differences among the treatments. Analyses of these data indicate growth performance differences exist between diets with varying quantities of pellet fines. Birds fed the 80% pellets diet had an increased rate of gain and feed intake, and a decreased feed:gain compared to 0% pellets and mash. Acar et al. (1991) report that improving pellet quality from 43% to 67% resulted in increased feed intake and efficiency of gain. Zatari et al. (1990) reported that as the level of fines increase in a pelleted diet, bird weight gain is reduced. Though differences were found that parallel these reports, significant differences were not observed between 80%, 60%, and 40% pellet treatments.

These data indicate that broiler growth and feed intake are enhanced when diets are fed as pellets compared to mash, and that pellet fines have deleterious effects on the rate and efficiency of gain. Additionally, these data demonstrate that if pelleted diets are comprised of less than 40% pellets the benefits of pelleting are negated.

Table 2. Means of traits measured in Experiment 1, valid tests only

	Treatment (% Pellets)					
Trait	Mash	80	60	40	20	0
Weight gain, g	295^{b}	400^{a}	391^{a}	400^{a}	316^{ab}	258^{b}
Feed intake, g	897^{bc}	1060^{a}	1029^{ab}	1065^{a}	934^{abc}	854^{c}
Feed:gain, g:g	3.51^{ab}	3.08^{ab}	2.72^{b}	2.82^{b}	3.64^{ab}	3.85^{a}

^{a,b,c}Means within a row with no common superscript differ (P<.05).

Experiment 2. In Exp. 2, poor pellet quality reduced water intake, feed intake, and feed conversion (Table 3). Reductions in feed intake appeared to have an impact on the other traits, as changes in weight gains and water intake are known to be affected by changes in feed intake. Unlike the previous experiment, results appear to be less linear in Exp. 2. Both poor quality pellet treatments appeared to result in similar reductions in feed intake and growth.

Table 3. Means of traits measured in Experiment 2, when all birds were included

Treatment	Water intake (mL)	Feed intake (g)	Weight gain (g)	FCR[1] (g:g)	Valid Test (%)
80% Pellets	2284.6[a]	1195.1[a]	509.7[a]	2.39[b]	100.00[a]
40% Pellets	1534.0[b]	899.1[b]	320.9[b]	4.76[a]	58.33[b]
20% Pellets	1720.0[b]	1015.1[b]	370.8[b]	3.11[ab]	75.00[b]

[1]FCR=feed conversion ratio: grams of feed consumed/grams of weight gained

[a,b]Means within a column with no common superscripts differ (P<.05)

When birds with poor test results were excluded, treatment differences for weight gain and feed conversion were lacking (Table 4). This may be expected as the criterion for a 'valid' feed conversion test included poor weight gain. Nevertheless, treatment differences for water and feed intake remained.

Table 4. Means of traits measured in Experiment 2, using 'valid' tests only

Treatment	Water intake (mL)	Feed intake (g)	Weight gain (g)	FCR[1] (g:g)
80% Pellets	2284.6[a]	1195.13[a]	509.71	2.39
40% Pellets	1786.1[b]	1021.79[b]	439.86	2.38
20% Pellets	1932.5[b]	1082.17[ab]	447.11	2.48

[1]FCR=feed conversion ratio: grams of feed consumed/grams of weight gained

[a,b]Means within a column with no common superscripts differ (P<.05).

Differences between experiments may be attributed to several possible factors. In Exp.1, birds were from a random sample of the population, whereas birds in Exp. 2 were from a selected group that would be expected to have increased growth potential and improved feed conversion. Additionally, birds in Exp. 2 had been fed the same diet their entire life, whereas birds in Exp. 1 had been offered three diets prior to the initiation of this experiment. Finally, Exp. 2 was conducted in an air conditioned room, where Exp. 1 was exposed to ambient spring temperatures. Regardless of differences between these two experiments, poor quality pellets reduced broiler performance.

Implications

The results of these experiments emphasize the importance pellet quality has on palatability of feed. Regardless of the origin of the birds tested (a random sample in Exp. 1 and an 'elite' proportion in Exp. 2), poor quality pellets affected palatability. Expressions of feed conversion

should include considerations of the diet. If repeated measurements of feed conversion are to be compared, every effort should be made to have uniform pellet quality in each comparison. Variation in feed form that is not accounted for could result in unacceptably high levels of variation in estimates of broiler performance.

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