BRIEF COMMUNICATION: Influence of whole maize feeding on the performance of broiler starters

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INTRODUCTION

Feed represents the major cost of poultry production, constituting up to 70% of the total. Feeding of whole grains to poultry has received much attention in recent years as an alternative management practice to reduce the feed cost through savings in the cost of grinding and handling and processing of grains. This mode of feeding has not only shown positive effects on the performance but it also meets the consumer demands for a "natural" feeding system and improved animal welfare (Gabriel *et al*., 2007).

Studies pertaining to whole grain feeding have primarily involved the inclusion of whole wheat in poultry diets. The use of other grains has received only limited attention. Published data on the effect of whole wheat feeding on the performance of broilers have been contradictory, with several recent report showing beneficial effects (Wu *et al*., 2004; Ravindran *et al*., 2006), whereas others have failed to show any advantage (Bennett *et al*., 2002; Amerah & Ravindran 2008). Dietary factors such as cereal type and grain hardness may be contributing, in part, to the variable responses achieved with whole grain feeding but this aspect has received only limited attention (Amerah *et al*., 2009). The aim of the present study was to study the interaction between maize hardness and whole maize inclusion on the performance parameters of broiler starters.

MATERIALS AND METHODS

The experimental design was a completely randomised with a 3 x 2 factorial arrangement of treatments, which included three maize cultivars differing in hardness (hard, semi-hard and soft) and two diet types (a basal diet based on ground maize and a diet based on the same basal diet with 20% of ground maize replaced by whole maize). The basal diets were formulated to meet, or exceed, the Ross 308 strain recommendations for major nutrients for broiler starters. The ingredient composition and calculated analysis of the basal diets are shown in Table 1. A portion of each maize type was ground in a hammer mill to pass through a 4 mm sieve whilst the remaining maize was left as whole kernels. Six diets were prepared; each of three maize cultivars (soft, semi-hard and hard) with and without whole maize inclusion (3 x 2). Following mixing, the diets were cold pelleted (65 to 70°C). Diets were pelleted after inclusion of whole maize to take into account of commercial developments in the use of whole cereals.

Day-old male broiler (Ross 308) chicks were obtained from a commercial hatchery, individually weighed and assigned to 36 cages with eight birds per cage, in battery brooders housed in an evironmentally controlled room. Each of the six dietary treatments were randomly allocated to six cages of eight chicks each from Day 1 to Day 21 post-hatch. At 14 days of age, birds were transferred to colony cages in an environmentally controlled room. Room temperature was maintained at 32 ± 1°C during the first week and gradually reduced to 24°C by the end of the third week.

TABLE 1: The composition and calculated analysis of the basal diet (g/100g on an as-fed basis). In the treatment diets, 20% of the ground maize was replaced with whole maize kernels.

Component	Basel diet
Composition	
Maize	57.60
Soybean meal	35.99
Vegetable oil	1.85
Dicalcium phosphates	1.75
Limestone	1.57
L-lysine	0.02
DL-methionine	0.37
Salt	0.25
Titanium oxide	0.30
Mineral premix	0.25
Vitamin premix	0.05
Calculated analysis	
Apparent metabolizable energy (kcal/kg)	3010
Crude protein	22.1
Lysine	1.15
Methionine + Cystine	0.94
Calcium	1.09
Total Phosphorus	0.71
Non-phytate Phosphorus	0.45

TABLE 2: Influence of maize hardness and whole maize inclusion on weight gain, feed intake, feed per unit gain for broilers from one to 21 days post-hatch. Each value represents the mean of six replicates of eight birds per replicate. SEM = Standard error of the mean.

Treatment	Inclusion of whole maize	Feed intake (g/bird)	Weight gain (g/bird)	Feed per unit gain (g/g)
Hard	-	1,304	988	1.132
	+	1,289	983	1.312
Semi hard	-	1,282	959	1.336
	+	1,285	976	1.328
Soft	-	1,271	993	1.301
	+	1,256	952	1.320
Pooled SEM		14	13	0.008
Main effects				
Maize hardness				
Hard		1,296	986	1.316[ab]
Semi-hard		1,284	972	1.332[a]
Soft		1,264	968	1.311[b]
Whole maize				
-		1,286	980	1.319
+		1,277	970	1.320
Significance				
Maize hardness		0.080	0.349	0.043
Whole maize		0.449	0.338	0.881
Whole maize x maize hardness		0.795	0.090	0.221

[a,b] Means in a column not sharing a common superscript are significantly different (P <0.05).

Twenty hours of fluorescent lighting per day was provided throughout the trial. Diets were offered *ad libitum* and water was available at all the times.

Live weight and feed intake were recorded on a cage basis at weekly intervals. Mortalities were recorded daily and adjustments to feed intake and weekly weight gain made where necessary. Each cage served as the experimental unit for statistical analysis. All data were analysed by two-way analysis of variance using the general linear model procedure of SAS (2004) to determine the main effects of maize hardness and whole maize inclusion, and their interaction. Significant differences were considered at P <0.05.

RESULTS

The influence of treatments on the performance of broiler starters is summarised in Table 2. Whole maize inclusion had no effect (P >0.05) on weight gain, feed intake or feed per unit gain. Maize hardness had no effect on (P >0.05) on weight gain, however feed intake tended (P = 0.08) to increase with increasing maize hardness, with birds fed on hard maize based diet tended to consume more feed than those fed on soft maize based diet. Maize hardness had a significant effect (P <0.05) on feed per unit gain, with birds fed the soft maize based diets having lower feed per gain than those fed the semi-hard maize based diet. Feed per unit gain of birds fed diets based on hard-maize was similar (P >0.05) to those fed diets based on semi-hard and soft-maize. No interactions (P >0.05) were observed between maize hardness and whole maize inclusion for any of the performance parameters but there was a tendency (P = 0.09) for interaction to be seen for weight gain. Weight gain tended to be lowered by whole maize inclusion in birds fed the soft-maize diet and increased in those fed the semi-hard maize based diet, but had no effect on those fed the hard-maize diet.

DISCUSSION

The majority of previous studies have examined the inclusion of whole wheat incorporated into the diet prior to pelleting. The main aim of the present study was to examine the effects of whole maize inclusion in broilers fed on maize–based diets. In general, birds fed diets containing 20% whole maize had similar weight gain, feed intake and feed per unit gain as those fed diets containing only ground maize. This is in agreement with the findings of Clark *et al*. (2009) who fed 0, 25, 50, 75 or 100% levels of cracked corn to broilers and found that up to 25 % inclusion of cracked corn in broiler diets has no negative effects on performance parameters. Taylor and Jones (2001) also reported that pre-pelleting inclusion of whole wheat had no effect on weight gain and feed efficiency. However, Wu *et al*. (2004) reported that pre-pelletting inclusion of 20% whole wheat improved weight gain and feed efficiency.

It was hypothesized that whole- and/or hard-maize would require greater grinding activity in the gizzard, stimulating the size of this organ and bird performance. A more developed gizzard may enhance the grinding and mixing of feed leading to increased exposure of dietary nutrients to enzymes, therefore improving the feed efficiency. It was anticipated that harder maize would improve feed per unit gain due to a greater proportion of coarser particles and greater gizzard development. However, in the present study, feed per unit gain of birds fed hard-maize diets was similar to those fed soft-maize

diets. The present study's results concur with those of Salah Uddin *et al*. (1996) who compared two wheat cultivars selected to be similar in nutrient composition but differing in grain hardness. They found no effect of wheat hardness on the growth or feed per gain of broilers either in ground or whole grain form. Similarly, Hetland *et al*. (2007) and Amerah *et al.* (2009) found no relationship between wheat hardness and broiler performance. But, it should be noted that the feed per unit gain of birds fed semi -hard maize diets were higher than those fed soft-maize diets. This unexpected result is difficult to explain. Maize may have had a different binding capacity to that of wheat, affecting the quality of pellet. Broiler performance benefits associated with pellet quality have been well documented (Nir *et al.*, 1995).

In summary, the present data showed that 20% replacement of ground maize used in broiler starter diets, with whole maize, had no adverse effects on growth performance parameters. Therefore this strategy could potentially be used to reduce the cost of manufacturing feed in the chicken meat industry.

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