Influence of varying kudzu leaf meal particle sizes added to a broiler diet

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INTRODUCTION

Cost-effective strategies for rearing broilers to maintain chicken meat affordability is a priority. Poultry feed is expensive, with protein feedstuffs contributing the greatest expense (Reyes et al., 2018). A potentially viable alternative proteinaceous feed ingredient is kudzu (*Pueraria montana* var. *lobata*) leaf meal (KLM). Because of its nutrient content, digestibility, and palatability, kudzu has been used as a leaf meal to supplement livestock (Gulizia and Downs, 2019). Its nutritional value is comparable to alfalfa meal, which has been used historically as a leaf meal in poultry and livestock feeds (Duke, 1983).

Kudzu is an invasive, semi-woody perennial vine native to Asia. It was originally introduced to the U.S. in the late 1800s for erosion control and soil improvements. By the 1970s, kudzu had been placed on the USDA common weed list (Loewenstein et al., 2018). Kudzu is well known across the Southern U.S. for its ability to grow excessively in areas with hot and humid conditions. Kudzu grows abundantly in tropical regions and could be used as a more affordable, alternative protein source in poultry feeds, particularly in world regions with limited availability of typical proteinaceous feedstuffs but an abundance of kudzu. There is limited data on the use of KLM and its impact on poultry production as an alternative protein substitute. Gulizia and Downs (2020) compared KLM to alfalfa meal in a broiler starter diet during a 21-d study. The results indicated a similar performance response between KLM and alfalfa meal when added at similar rates. These researchers also showed KLM to be safe as an alternative protein feedstuff in poultry diets.

The objective of this study was to assess how variations in KLM particle size impacted performance, breast weight, and organ parameters of broilers grown to 21 days of age.

MATERIALS AND METHODS

Kudzu sample preparation: Kudzu used in this research was collected from the middle Tennessee area. Sample collection occurred in June. The method of collection used a 30.5 cm^2 PVC square randomly tossed into clusters of kudzu. Kudzu leaves within the clusters were removed and subsequently dried at 60°C for 48 h. Once dried, kudzu leaves were ground to pass through either a 1.00, 2.00, or 3.35 mm sieve to create the three kudzu leaf meal (KLM) particle size dietary treatments. Prior to grinding, all kudzu leaf samples were compiled into one composite sample. Table 1 outlines the analyzed nutrient composition of KLM used in this study.

Diet preparation: Kudzu leaf meal was incorporated (2.5% SBM replacement) into a basal broiler starter diet (mash form) at one of three KLM particle sizes (1.00, 2.00, or 3.35 mm) to create three treated diets. The basal diet represented a typical broiler starter diet and was used as the control in this experiment. All diets were prepared at the Auburn University Animal Nutrition Center.

Bird management and data collection: All animal handling procedures were approved by the MTSU IACUC and conformed to established practices (FASS, 2020). Two-hundred and forty day-old male Cobb 500 broilers were randomly assigned to 16 battery cages (15 birds per cage) and treatment was randomly assigned to each cage (4 treatments; 4 replicate cages/treatment). Birds were reared for 21 days. Birds were brooded at approximately 35°C and reduced approximately 3°C every 7 d. Continuous light was provided (24 L:0 D) with feed and water offered *ad libitum*. Total bird weight per cage was recorded at 7 day intervals to determine average body weight and body weight gain. Cumulative feed consumption was calculated and used in determination of feed conversion. Mortality was monitored daily and used to adjust feed conversion. At study termination (d 21), 5 birds per cage were randomly selected and euthanized for determination of breast yield and organ weights (gizzard, ceca, and small intestine; data not shown).

Statistical analysis: Data were analyzed as a completely randomized design with battery cage as experimental unit. Treatment main effect significance for average body weight, body weight gain, cumulative feed consumption, adjusted feed conversion, mortality, and carcass/organ parameters were determined using the GLM procedure of SAS. Means were separated using Tukey's HSD. All data were analyzed for normality using the Shapiro-Wilk test. Significance was established at alpha ≤ 0.05 and a tendency > 0.05 and ≤ 0.10.

RESULTS

- When compared to control, kudzu particle size (PS) did not influence body weight on d 7, 14, or 21 or body weight gain for any periods during this study (P>0.05) (Table 3).
- There were no kudzu PS treatment differences for feed consumption among control, 1.00, 2.00, and 3.35 mm PS (P>0.05) (Table 3).
- There were no significant kudzu PS treatment effects for adjusted feed conversion ratio between d 0 to 7 (P=0.4387); however, d 0 to 14 adjusted FCR tended to differ among treatments (P=0.0521). More pronounced treatment differences in adjusted FCR were observed for d 0 to 21 (P=0.0017), with kudzu addition at 1.00 mm depressing adjusted FCR compared with control. Dietary incorporation of larger PS kudzu (2.00 and 3.35 mm) resulted in similar adjusted FCR to birds on control diet (Table 3).
- Throughout the entire study, there were no treatment effects on bird mortality (P>0.05) (data not shown).
- There were no significant PS treatment effects for breast, gizzard, ceca, and small intestine data (P>0.05) (data not shown).

CONCLUSIONS

- Kudzu PS influenced FCR with the control treatment being lower than 1.00 and 3.35 mm PS treatments between d 0 to 14.
- Kudzu addition at all particle sizes did not substantially influence body weight, body weight gain, feed consumption, or mortality during this 21-day growing period.
- There were no observed kudzu PS treatment effects for breast, gizzard, ceca, and small intestine data.
- Results demonstrate that varying KLM particle sizes did not dramatically influence broiler performance, breast weight, or organ parameters when compared to a typical corn-SBM control diet.
- Overall, KLM added in replacement of some SBM in the broiler starter diet did not substantially depress most bird performance parameters compared to control. However, the increased FCR associated with the 1.00 mm kudzu PS observed in this study would justify recommendations for KLM supplementation at greater than 1 mm particle size.
- Further research should focus on higher KLM/SBM replacement rates and potential treatment effects during a longer growing period.

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TABLE 1.
Analyzed nutrient composition of experimental kudzu

ANALYSIS (DM Basis)	
Dry matter, %	88.5
Crude protein, %	28.8
Lysine, %	1.35
Methionine, %	0.43
Acid detergent fiber, %	22.0
Neutral detergent fiber, %	33.4
Lignin, %	5.3
Metabolizable energy, kcal/kg	2,680
Ca, %	1.92
Total P, %	0.34
Mg, %	0.18
K, %	1.68

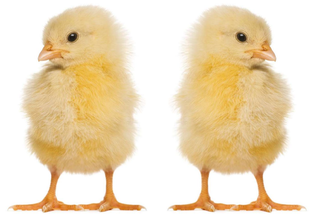

TABLE 2.
Nutrient analysis of experimental diets

	Control	KLM1	KLM2	KLM3
Crude protein, %	23.1	21.9	22.0	22.2
ME, kcal/kg	3,510	3,470	3,470	3,480

Kudzu vine

TABLE 3.
Live performance influences from varying kudzu leaf meal (KLM) particle size added to a broiler starter diet fed d 0 to 21.

Item	Control	KLM1[A]	KLM2[A]	KLM3[A]	$P_r > F$	SEM[B]
AVERAGE BW, g/bird						
Day 0	43.1	42.1	42.8	43.1	0.5531	0.5687
Day 7	142.5	133.8	139.0	137.3	0.6732	4.9906
Day 14	390.7	361.4	374.2	365.5	0.4722	13.7473
Day 21	882.1	784.8	785.8	795.5	0.2040	25.4629
BODY WEIGHT GAIN, g/bird						
Day 0 to 7	99.4	91.8	96.3	94.2	0.7326	4.9147
Day 0 to 14	347.7	319.3	331.4	322.4	0.4859	13.6719
Day 0 to 21	839.1	742.8	743.0	752.4	0.2049	25.3778
CUMULATIVE FEED CONSUMPTION, g/bird						
Day 0 to 7	124.13	113.10	111.90	116.08	0.5982	6.8290
Day 0 to 14	561.63	556.20	536.30	525.28	0.4890	18.3455
Day 0 to 21	1156.68	1114.18	1084.85	1080.68	0.2449	27.8564
ADJUSTED FEED CONVERSION[C], g:g						
Day 0 to 7	0.87	0.84	0.80	0.84	0.4387	0.0323
Day 0 to 14	1.43	1.53	1.43	1.44	0.0521	0.0275
Day 0 to 21	1.32[b]	1.42[a]	1.38[ab]	1.36[b]	0.0017	0.0139

[A]Kudzu leaf meal (KLM) particle size; KLM ground to pass 1.00 (KLM1), 2.00 (KLM2), or 3.35 (KLM3) mm sieve
[B]Standard error of the mean
[C]Adjusted for mortality
[a,b] Means in the same row with different superscripts are significantly different (P < 0.05)

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