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THE INFLUENCE OF DRIED BREWERY GRAIN IN BROILER DIETS ON PRODUCTION PERFORMANCE

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Supporting Information

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ABSTRACT: As a result of high feed costs in Lesotho the majority of farmers especially those producing under semi intensive are diluting commercial feeds with a non-conversional feeds such as dried brewery grain (DBG) in order to increase the quantity and to lower the costs of feeds. In most cases this practice resulted in poor broiler performance and low carcass yields because of high inclusion rates. A completely randomized study with four dietary treatments was undertaken at the National University of Lesotho farm. The aim of the study was to investigate the effect of DBG inclusion in broiler diets during growing and finishing and to determine the dilution or the inclusion rate that can maintain broiler performance and carcass yields like commercial feeds. Dietary treatments were made up of control represented by commercial feeds and three inclusion rates of DBG at 25, 50 and 75% respectively. A total of 360 day-old Ross 308 chicks were randomly assigned to four treatments replicated four times. A total of ten birds per replicate were used for carcass parameters determination. Feeds and water were provided on ad libitum basis. Light was provided for maximum of 20 hours per day. Performance data were collected on weekly basis as average feed intake, growth rate, body weight, feed conversion ratio and mortality while carcass parameters were collected at the end of finishing phase on carcass weight, dressing percentage, gizzard and intestinal weight. The feeding experiment lasted for four weeks. The dietary treatments had a significant ($P<0.05$) effect on average feed intake, growth rate, body weight, feed conversion ratio, carcass weight, dressing percentage, gizzard and intestinal weights whereby broilers under control and 25% DBG had similar and better performance than animals in other treatments except for gizzard and intestinal weight which were higher in 75% DBG. The higher fibre content of DBG was found to be the limiting factor in the utilization by broiler especially at inclusion rate beyond 25%. Cost benefit analysis indicated that there was a 21% reduction in feed costs when using 25% DBG in broiler diets. It was concluded that 25% DBG inclusion rate is the one giving similar production performance and carcass yield to the commercial feeds except for the visceral parts. Therefore farmers can include the DBG up to 25% in broiler feeds for optimum performance and carcass yield between growing and finishing stages and save 21% in feed costs.

Keywords: Dried brewery grain, Commercial feeds, Broiler performance, Carcass parameters, Feed costs.

INTRODUCTION

In Lesotho, the majority of broiler farmers are producing their chickens under semi intensive production system. One of the limitations to the expansion of poultry industry is the high cost of animal feeds. In order to reduce high cost, efforts are being directed to the use of non-conventional feed ingredients such as brewery by-products. The use of by-products in animal diets can reduce the incorrect disposal of these products into the environment. Also, their use as an alternative source in animal feed may replace or complement other ingredients of high added-value, which are used as food sources in human diets (Parpinelli et al., 2018). Maluti Mountain Brewery is the sole brewery company in Lesotho and is offering wet brewery grain at affordable prices to the farmers but primarily dairy farmers. Wet brewer's grains contain 75-80% water and deteriorate rapidly due to the growth of bacteria, yeasts and fungi (Asurmendi et al., 2013). The nutritional content of brewers' grains varies depending on the grain used (barley, wheat, rice, or corn), the extent of the fermentation, and the type of fermentation process used. According to National Research Council (NRC) (1994) standards brewer´s spent grain contain 25.3 % protein, 6.3 % fat, 92 % dry matter, approximately 2080 kcal/kg metabolizable energy (ME). The major problem limiting the use of dried brewers' grains in poultry rations is related to the grains' high fiber content (Levic et al., 2010).

Acceptable inclusion rates of DBG in poultry diets reported in the literature range from 10-20% in young birds and up to 30% in older poultry. Fasuyi et al. (2018) working with ensiled brewery grain in broiler chickens between starting and growing phase observed the highest weight gain at 30% inclusion rate. Parpinelli et al. (2018) reported that 10% inclusion rate of DBG in broiler chicken during the finishing phase maintained production performance very well. In broilers between twelve and thirty-three days the inclusion rate ranging between ten and twenty percent inclusion of DBG supported acceptable growth and feed utilization, and seemed to favor the development of a well-functioning gizzard (Denstadli et al., 2010).

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In Lesotho, the inclusion of brewery grain in poultry diets is not well document and therefore the main objective of this study was to determine the effect of including different levels of DBG in broiler diets on production performance, carcass quality and economic benefits.

MATERIALS AND METHODS

Ethical approval

The scientific and ethics committee of the Faculty of Agriculture, National University of Lesotho approved the study protocol.

Study area

The study was carried out at the National University of Lesotho, Faculty of Agriculture farm in Roma some 34 kilometers southeast of Maseru, the capital of Lesotho. The Roma valley is broad and is surrounded by a barrier of rugged mountains which provide magnificent scenery. The university enjoys a temperate climate with four distinct seasons.

Experimental design and treatments

A completely randomized design was used with four dietary treatments replicated three times. Four experimental diets were formulated at the farm in such a way that the control diet contained maize as the chief energy source while the other three diets had dried brewers grain (DBG) replacing maize at the rate of 25, 50 and 75% in diets 2, 3 and 4 respectively. Experimental diets were offered in a mash form. The composition and nutrients levels of the treated diet for growing phase are shown in Table 1.

A total of 180 day-old broilers were used in this study. The birds were randomly divided into 4 treatments of 45 birds each. Each treatment was replicated 3 times with 15 birds per replicate. The experiment lasted for six weeks. The birds were reared in deep litter system. Fresh water and treatment diets were supplied ad libitum throughout the period of the experiment. Routine management practices including vaccination and drug administration when necessary was duly observed.

Table 1 - Physical and chemical composition of experimental diets

Ingredients	Control	T1 (25%DBG)	T2 (50%DBG)	T3(75%DBG)
Maize	50	38	25	21
Soya bean	17	20	20	20
Fish meal	7	2	2	2
Sunflower	15	10	10	10
Hominy feed	10.5	17.5	17.5	17.5
BDG	0	12	25	29
Salt	0.25	0.25	0.25	0.25
Mineral Premix	0.25	0.25	0.25	0.25
Determined Analysis				
CP (%)	18	17	19	20
ME (Mcal)	3.04	2.94	2.88	2.87
Starch (%)	35.73	32.69	25.56	23.37
ADF (%)	7.05	8.86	11.36	12.13
Calcium (%)	0.44	0.22	.26	0.27
Phosphorus (%)	0.56	0.48	0.53	0.55

Data collection

Data was collected on proximate composition of experimental diets, production parameters, carcass parameters and economic analysis.

Proximate analysis of formulated diet

The chemical analysis of experimental diets were done using standard methods according to Association of Official Analytical Chemists(AOAC,1990) this included the following test; dry matter determination, crude protein, energy, crude fiber (ADF & NDF), ether extract, minerals (calcium and phosphorus).

Production parameters

Feed intake was determined as the difference between the quantity of feed offered and the leftovers. Weekly data was collected on the following parameters; growth rate, feed conversion ratio and body weight while mortality rate was collected daily.

Carcass parameters

Carcass parameters including, dressing weight, visceral weight, fat pad weight and gizzard weight were measured at the end of the finishing phase (end of the trial). The birds were fasted overnight, 5 birds per replicate were selected for each slaughtering phase and weighed the following morning prior to slaughtering to obtain their live weights. The birds were slaughtered by severing the jugular vein. The carcasses were allowed to bleed freely for 5 minutes, defeathered using warm water and then re-weighed to obtain plucked carcass weight. They were then be decapitated, eviscerated and weighed to obtain the dressed weights. Dressing percentage was expressed as dressed carcass weight over live weight, multiplied by 100. An electronic top loading scale with maximum weight of 3kg (sensitive at 0.1g) was used to weigh the birds, the carcasses.

Cost benefit analysis

The cost per kg of the diet was calculated by multiplying the percentage composition of the feedstuffs with the price per kg of each feedstuff and summing all. Total feed intake x cost per kg feed gave total feed cost. Feed cost per kg weight gain was calculated as FCR x cost per kg of diet.

Data analysis

The response variables were analyzed as one-way ANOVA with four dietary treatments as the main effects using the Social Science Statistical Tool (IBM SPSS version 20, 2011). Once differences were detected by ANOVA, means were separated using Least Significance Difference (LSD).

RESULTS AND DISCUSSIONS

Production Parameters

The influence of DBG in broiler diets results on production parameter are shown in Table 2. It is evident from these results that the dietary treatment had a significant (P<0.05) influence on feed intake, daily weight gain, feed conversion ratio (FCR) and final body weight, whereby birds that received the control diet performed significantly better than all birds in other treatments. It was also observed that the incremental inclusion of DBG resulted in an inverse relationship in all production parameters. Least significant difference result on the other hand revealed that there was no significant (P>0.05) difference in all production parameters between the control and 25% DBG inclusion. These results are in agreement with the findings of Anyanwu et al. (2008) who reported similar trends on final body weights and daily weight gains. Aghabeigi et al. (2013) observed similar trends for feed intake between day eleven and forty-two. On the other hand, Swain et al. (2012) reported that inclusion of DBG at 20% did not influence body weight of broilers but had a significant effect on feed intake and FCR whereby birds fed diets with DBG had higher feed intake and FCR than the control group. Anjola et al. (2016) used 0, 5, 8, 11 and 14%DBG inclusion in broiler diets and reported that there were no significant differences in feed intake, weight gain and FCR amongst the dietary treatments. The lower production parameters characterized by T2 and T3 could be a result of high fibre content associated with feeding of DBG which means that for inclusion level of 25% DBG, the diet was equally acceptable to the birds as they ate the same quantity feeds as the control group. The decrease in feed intake for T2 and T3 diets may be attributed to bulkiness and probably poor acceptability of the feed and this is supported by Denstadli et al. (2010) who observed that the inclusion rate of DBG in diets up to 40% decreased body weight gain and FCR.The researchers also concluded that birds cannot cope with the increased bulkiness of the diet when the inclusion rate is more than 40%.

Carcass parameters

The influence of DBG on carcass production results (Table 3) pointed out that dietary treatment had a significant (P<0.05) influence on all carcass parameters. The carcass parameters were also degreasing with an increase in DBG inclusion rate. The mean comparison test indicated that carcass parameters between control and 25% DBG groups were not statistically different however there was significant difference between control and 50 and 75%DBG. The results of the current study are similar to results of Okpanachi et al., (2014) who used a mixture of DBG and cassava tubers in broiler diets and observed that the incremental inclusion of DBG up to 45% reduced carcass weight, dressing percentage and gizzard weight. Contrary to observed results Swain et al., (2012) using maximum of 20% DBG in broiler diets reported significantly high meat yield and gizzard weight in broilers fed diets containing DBG than in control group. The results of the current study imply that DBG should not be included in broiler diets by more than 25% inclusion rate for optimum carcass yield.

Cost benefit analysis

The cost benefits analysis results (Table 4) confirmed that the inclusion of DBG in broiler diets can significantly (P<0.05) reduce the cost of feeds. However, cost of 50kg feeds were not statistically (P>0.05) different between

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control and 25% DBG treatment but cost of 25% DBG were lower by 10.00 Maluti which is good saving for the farmer. These findings are in agreement with the work of Swain et al., (2013) who found that the incremental inclusion of DBG reduced the cost per kg feeds. Fasuyi et al., (2018) added that the cost of feed was reduced as the inclusion levels of DBG in the diets increased. The researcher further indicated the control diet had the highest cost while 30%DBG inclusion had the lowest cost. Ndams (2008) found contrasting results with regard to cost per kg weight gain and cost per kg feed.

Table 2 - The influence of BDG on broiler production parameters

Parameters	Dietary treatments				Significance	
	Control	T1 (25%)	T2 (50%)	T3 (75%)	P[1]	CV[2]
Feed intake (g/week)	710.00[a]	643.00[b]	577.33[c]	510.00[d]	0.001	19.69
Daily weight gain (g)	91.41[a]	90.26[a]	81.99[b]	73.36[c]	0.002	26.32
FCR (g/g)	2.48[a]	2.47[a]	2.37[b]	1.91[c]	0.019	16.94
Live weight (g)	2325.67[a]	2230.00[a]	1943.53[b]	1400.20[c]	0.001	15.89

[a, b,c] Means in rows with different superscripts differ significantly ($P<0.05$); [1] Probability level at 0.05 percent; [2] Coefficient of Variation; [3] Feed Conversion Ratio (gram feed/gram weight gain)

Table 3 - The influence of DBR on broiler carcass parameters

Parameters	Dietary treatments				Significance	
	Control	T1 (25%)	T2 (50%)	T3 (75%)	P[1]	CV[2]
Carcass weight(kg)	1795[a]	1720[a]	1450[b]	1010[b]	0.001	6.45
Dressing percentage	77.2[a]	77.3[a]	75.0[a]	72.4[b]	0.010	10.2
Visceral weight(g)	321.67[a]	313.33[a]	275.00[b]	246.00[b]	0.001	11.4
Heart weight(g)	11.33[a]	10.67[a]	9.33[a]	6.67[b]	0.001	3.6
Liver weight (g)	50.00[a]	47.67[a]	39.67[b]	36.33[b]	0.001	2.3
Gizzard weight (g)	94.00[a]	92.33[a]	89.33[a]	78.33[b]	0.001	1.7

[a, b] Means in rows with different superscripts differ significantly ($P<0.05$); [1] Probability level at 0.05 percent; [2] Coefficient of Variation

Table 4 - The influence of DBG on feed costs savings

Parameters	Dietary treatments			
	Control	T1 (25%)	T2 (50%)	T3 (75%)
Cost of diets/50kg	260.00	250.00	220.00	180.00
Cost/kg weight gain	12.92	12.35	10.43	6.88
Cost/kg feed	5.21	5.00	4.40	3.60

CONCLUSION

Based on observed results for proximate analysis of DBG, production and carcass parameters as well as cost benefit analysis, it was evident that the use of DBG in broiler diets at rate of 25% during growing and finishing phases gave similar production performance to broiler fed diets containing convention feedstuffs such as soyabean, sunflower, fish meal and maize which are the main factors that push the price of feeds to its limit. The proximate analysis results also proved beyond doubt that DBG can be used in broiler diets to substitute conventional proteins sources used in broiler diets.

DECLARATIONS

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Authors' contribution

Kuleile NP, Adoko G and Nkheche M, contributed on the design of the experiment, data collection and the write up of the manuscript. NP Kuleile participated in data analysis.

Conflict of interests

The authors have not declared any conflict of interests.

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