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IMPACT OF BREWER' S SPENT GRAIN INCLUSION AND REPLACEMENT OF CORN GLUTEN MEAL ON THE ECONOMICAL GROWTH PERFORMANCE, CARCASS CHARACTERISTICS OF BROILER CHICKS

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Abstract

Poultry diets are mainly prepared from conventional protein and cereal grain sources. Inclusion of non-conventional agro-industrial by-products not only improve feed efficiency but may economize feed. The existingtrial was executed to access the effect of brewer spent grain(BSG) by replacing corn gluten 30% on growth performance, carcass parametersand economic of feed for broiler chickens.The (n=120) d old broiler chicks were randomly divided into four treatment with three replicates of ten chicks each. The control diet contained 12% CG whilst other diets T_1, T_2 and T_3 contained 33.3, 66.6 and 100% BSG instead of corn gluten. The ME and CP of the experimental diets were 2850 kcal/kg 21%, and the trial lasted for 35 days. Replacement of CG30 with BGS exhibited ($p>0.05$) changeon the FI and mortality trait. The BWG and FCR were significantly better in T_2 diet ($p<0.05$). Average dressing percentage was significantly improved with T_1 and T_2 diets which contained 4 and 8% BSG. In conclusion replacement of corn gluten 30% with BSG up to 7.3% reflected positive impacts on the growth indices, carcass traits and with an economical feed production.

Keywords: *Carcass, Corn gluten, Economical, Growth, Spent grain*

INTRODUCTION

The world population has quadrupled since the beginning of the twentieth century and food security have become a great concern for nutritionists. Provision of animal protein in South East Asia is worst, where population is relatively high and competition between men and livestock is continuously rising for available feed ingredients (1). In poultry production feed alone contributes about 70% of the total cost of production. Apart from high price of compound feed, the irregular supply of key ingredients has become a challenge (2). So need of the time to search alternative approaches which may serve the purpose successfully. One probable option may be through in the inclusion of non-conventional feed resources (NCFR) as a supplement or as replacement in avian diets. The published literature on NCFR highlights its

best features for the economical and efficient poultry feed production. The potentially available NCFR may contain leaf meals, common tropical browse plants and agro-industrial by-products. The by-products derived from these sources have different nutritional contents due to many factors. The rational utilization of adding co-products from brewing, milling, and processing have also gained attention as NCFR source (2).

Brewers' spent grain (BSG) is non-conventional feedstuff which is abundantly generated during brewery process (3). This novel ingredient is used in human nutrition mainly due to its health-related bioactive compounds. Moreover, the trend is increasing to utilize BSG as protein energy source for poultry birds. To make economical and efficient feed industrialist are including this ingredient as a substitute of costly feedstuffs such as corn, soybean and canola meal (4). Therefore, present project was aimed to evaluate the nutritive status of BSG and its rational inclusion by the replacement of corn gluten 30% in broilers chicks.

MATERIALS AND METHODS

SAMPLE COLLECTION, PROCESSING AND INCUBATION

This study was executed at the Institute of Animal Nutrition and Feed Technology Raja Muhammad Akram Nutrition Research Centre, University of Agriculture, Faisalabad (UAF), Pakistan. The study was conducted under the principals of Animal Ethics Committee of UAF.

EXPERIMENTAL DIETS AND TREATMENT

Nearly four *iso-caloric* (2850 kcal/kg, ME) and *iso-nitrogenous* (21% CP) experimental diets were formulated (Table I). The control diet T_0 was without dried brewery spent grain (0%) whilst other diets contained 4, 8 and 12% BSG were designated as T_1, T_2, and T_3 (Table II). The experiment continued for 35 days and treatment diets were prepared by replacing 30 % corn gluten on protein equivalent basis with BSG. The BSG was obtained from the Murree Brewery, Rawalpindi, Pakistan and rests of the feed ingredients were purchased from the local market. For a period of 4 consecutive days the wet brewery grains were sun dried by spreading a thick polythene sheet. The BGS samples were tilted 4-5 times in each day to attain uniform drying and stored in bags. All the experimental diets were subjected to chemical analysis before and after formulation and (5) recommendations were followed while preparing diets.

Table I. Chemical composition of brewer's spent grain (on dry matter basis)

Nutrients	Composition
Dry matter %	90.0
Crude protein %	29.5
Ether extract%	09.0
Crude fiber%	13.7
Ash%	4.3
Metabolizable energy Kcal/kg	2600

BIRDS MANAGEMENT AND EXPERIMENTAL DESIGN

Broilers were reared on deep litter pens measuring 5 x 3 x 2.5 and covered with 10 cm exclusively chopped bedding litter material. All the equipment's were thoroughly cleaned, disinfected and sprayed against external parasites before the commencement of trail. Equal managemental (vaccination) and environmental conditions were provided to all birds. A total of 120 day-old (Arbor Acres) un-sexed broiler chicks with almost similar body weight were subjected to a complete randomized experimental design with 4 treatments and 3 chicks per replicate (4*3*10).The proximate analysis of diets was performed to find out the values of crude protein (CP), crude fiber (CF), ether extract (EE) and ash contents (6).

STATISTICAL ANALYSIS

The data was computerized and analyzed by applying Completely Randomized Design. The differences among the groups mean value were assessed as described by Steel and Torrie 1989 (7).

DATA COLLECTION AND MEASUREMENTS

Weekly feed intake (FI), bodyweight gain (BWG) was noted to determine the feed conversion ratio (FCR) and daily orts were measured to find out average FI. Three birds per replicate were selected randomly to monitor carcass characteristics. The weights of the carcass were recorded in kg. The relative organ weight for, gizzard, liver, heart, drumstick and breast yield were measured as g/kg of the slaughter weight. Following formula: {dressed weight = (carcass weight (CW) +giblets weight) / live body weight} was used to find out the dressed weight. The budget of the trail was performed by calculating the feed cost incurred and weight gain, mortality and meat production per unit area. Prices were calculated according the market price in prevailing 2019.

Table II. Gross Percent Composition of experimental diets

Items	T_0	T_1	T_2	T_3
Yellow Corn	38.50	37.00	34.50	34.00
Rice broken	7.00	8.00	11.00	10.00
Rice polishing	7.00	8.00	7.64	9.50
Gluten 30 %	12.00	8.00	4.00	0.00
Brewer's spent grain	0.00	3.60	7.30	10.90
Soybean meal(CP45 %)	4.00	5.00	6.00	6.56
Canola meal	10.0	9.00	7.50	8.00
Gaur meal	4.80	4.80	5.30	5.00
Fish meal 60%	3.00	3.00	3.65	3.00
Corn gluten 60%	6.50	6.00	5.00	5.00
Di-calcium	1.00	0.80	0.55	0.45
Calcium carbonate	1.30	1.30	1.55	1.50
Molasses	4.00	4.46	5.00	5.00
L-Lysine	0.40	0.45	0.45	0.47
DL-Methionine	0.02	0.03	0.04	0.04
Vitamin-Mineral Premix*	0.50	0.50	0.50	0.50
Calculated Analysis %				
Crude protein	21.10	21.10	21.10	21.10
ME Kcal/kg diet	2850	2856	2851	2853
Crude fiber	4.70	4.90	4.90	5.40
Di-calcium	1.04	1.01	1.11	1.05
Available Phosphorus	0.46	0.45	0.46	0.45
L-Lysine	1.06	1.12	1.17	1.19
DL-Methionine	0.45	0.45	0.45	0.45
M+C	0.75	0.74	0.73	0.72

[1]DietsT_0= Control, T_1, T_2 and T_3 were enriched with 4, 8 and 12 % BSG by replacing gluten meal 30%, respectively

RESULTS

The result of growth performance has been illustrated in (Table III). Among the treatment feed intake remained statistically non-significant but numerically the feed intake increased with the increased level of DDSG. The dietary group T_3 consumed more feed as compared to other counterparts. But interestingly, body weight gain was increased ($p>0.05$) in T_2 group (8%BSG) and minimum was recorded in T_3 group (12% BSG). Moreover, the BWG remained statistically similar between T_0 and T_1 treatment groups, as shown in Table II. Best feed conversion ratio was found in the T_2 group ($p>0.05$) followed by T_0 group (control). While T_3 group exhibited poorest FCR. In an overall the FCR remained statistically different among the treatment group. The survival percentage during the experiment failed to exhibit any significant change among the groups however it tended to be lower in T_3 dietary group. The results show that a gradual increased DDSG increased survival percentage.

Further, Table IV illustrates the carcass characteristics indicating that dietary group T_1 and T_2 exhibited optimum dressing percentage and remained statistically similar, however dressing percentage was found to be lowest in the in T_0 and T_3 dietary group. Breast, drum stick and wing yield remained non-significant among the treatment group. The value of the gizzard with respect to relative organ weight was

increased ($p>0.05$) in T_3 group whilst T_1 and T_2 group exhibited similar result for gizzard weight. The relative weight of heart and liver showed no significant change.

Table III. Impact of substituting corn gluten meal with varying levels of brewers spent grain on the growth performance of broiler chicks from 1-5 week period

Parameters	T_0	T_1	T_2	T_3	SEM
Feed intake, g	1926.00	1928.00	1935.60	1930.30	9.50
Weight gain, g	1013.00^{ab}	999.60^{ab}	1032.30^{a}	979.60^{b}	6.60
FCR	1.90^{b}	1.93^{ab}	1.87^{b}	1.97^{a}	0.01
Mortality	5	5	4	3	0.76

[1]DietsT_0=control, T_1, T_2 and T_3 were enriched with 4, 8 and 12 % BSG by replacing gluten meal 30%, respectively.

[a,b,c] Values in the same row with different superscripts letters differ significantly ($p<0.05$)

Table IV. Impact of substituting corn gluten meal with varying levels of brewers spent grain on Carcass characteristics of broiler at the age of 35 day

Parameters	Diets[1]				SEM
	T_0	T_1	T_2	T_3	
Average dressing percentage	65.03^{ab}	65.20^{a}	65.13^{a}	64.76^{b}	0.63
Breast meat yield %	18.90	18.96	18.80	19.03	0.13
Drumstick %	5.53	5.45	5.26	5.30	0.10
Wing %	2.50	2.93	3.06	3.20	0.12
Relative Heart weight	0.56	0.63	0.60	0.63	0.02
Relative Gizzard weight	1.53^{b}	1.80^{ab}	1.73^{ab}	2.13^{a}	0.09
Relative Liver weight	2.53	2.70	2.86	2.63	0.09

[1]DietsT_0=control, T_1, T_2 and T_3 were enriched with 4, 8 and 12 % BSG by replacing gluten meal 30%, respectively.

[a,b,c] Values in the same row with different superscripts letters differ significantly ($p<0.05$)

The results of economic efficiency are illustrated in Table V. The dietary group T_0, T_2 and T_3 group exhibited similarity for the total feed consumed by each bird but T_1 (4%) group eat minimum feed. The total cost of feed bird was significantly low in ($p<0.05$) in T_3 group and T_0 group exhibited significantly increased ($p>0.05$) total cost of feed bird. The treatment group T_1 and T_2 which contained 4 and 8 percent BSG showed statistically similar response. The cost of production for each Kg in this trail was significantly lower in T_2 group ($p<0.05$) as compared to T_0, T_1 and T_3 dietary group which were having 0.4 and 12% BSG. The best economic efficiency in term of cost differential per kg gain were significantly improved ($p>0.05$) in T_2 group. The table 5 illustrates the economic analysis. Results indicates that the T_2 dietary group exhibited lowest ($p<0.05$) feed cost per kg weight followed by T_3, T_1 and T_0 respectively.

Table V. Effect of replacing corn gluten meal with brewers spent grain on economics of broiler chicks (0-35 day)

Parameters	T_0	T_1	T_2	T_3	SEM
Feed consumed (kg)	1.93	1.90	1.93	1.93	0.01
Total feed cost(Rs.) per bird	74.3^{a}	73.2^{ab}	72.70^{ab}	71.20^{b}	0.48
Total cost(Rs.) per kg weight	73.30^{a}	73.20^{a}	70.70^{b}	72.70^{a}	0.41
Cost differential(Rs.) per kg weight gain	-	0.10^{b}	2.70^{a}	0.70^{b}	0.38
Relative cost benefit per kg weight gain	100^{b}	100^{b}	104^{a}	101^{b}	0.58

[1]DietsT_0=control, T_1, T_2 and T_3 were enriched with 4, 8 and 12 % BSG by replacing gluten meal 30%, respectively. Rupees (Rs.) is Pakistani currency.

[a,b,c]Values in the same row with different superscripts letters differ significantly ($p<0.05$)

DISCUSSION

Feed intake remained statistically unchanged ($P>0.05$) among the groups throughout the trial. Similar to our finding (8) noted no significant impact of feeding gradually increased wet BSG on feed intake trait of broilers. Further, inclusion of sorghum dried brewer grains (SDBG) did not influence the feed intake of broiler (9).This study illustrates that birds gain more weight up to a certain level of BSG inclusion, Similar

result negatively impact palatability. Our findings noted significantly (p<0.05) reduced weight gain in broilers fed gradually increased BSG. Similar, to this (10) also recorded in a linear drop (p<0.001) in body weight gain with the increased DDGS levels during grower phase of production. Same as above, (8) found insignificant effect of feeding BSG on broilers weight gain. Present findings also align also with (11).

Birds of T_2 dietary group i.e. 8% BSG diets had superior FCR (p<0.05) than other dietary groups which exhibited poor FCR. The current study correlates with the published data of (12) who also observed poor FCR with respect to high dietary brewery dried grain. The T_1 and T_2 dietary group exhibited increased (P<0.05) dressing percentage, (13) also noted that dressing percentage remained statistically unchanged with the gradually higher levels of (DDGS) in broilers. Furthermore, study pointed out that treatment failed to exert any influence (p>0.05) on the yield of relative organs i.e wing, breast and drumstick yield. Similar to our conclusion (14), also found no appreciable change on the breast, leg and wing yield by feeding DDGS during the starter phase of production. Moreover, (15) also reported that DDGS inclusion could not significantly influence relative organs yield such as carcass, leg and breast weights. The present finding highlights that that dietary group T_2 and T_3 exhibited increased cost benefits relative to other groups. The diet T_2 with a replacing level of 66.6 BSG exhibited minimum (p<0.05) price per kilogram (kg) of gain subjected to all other groups.

On the contrary, a significantly higher relative gizzard weight was recorded with gradually higher levels of BSG (12). The findings of this study align with (16) who found that addition of 20% DDGS lowered the feed cost and promoted efficiency of feed cost after a replacement with soybean meal in broilers. Hi-sex Brown pullets were fed a basal diet containing 25, 50, 75 and 100 % DDGS by replacing soybean meal.

CONCLUSION

The present study revealed that by substituting corn gluten 30% with BSG up to 7.3% in the broiler diet may ends up with comparable growth, better turnover and profit margin.

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