Nepal Journal of Science and Technology 10 (2009) 29-35

Economic Use of Brewer's Dried Grain (BDG) in the Diet of Swine

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Abstract

An experiment was conducted from 18th October, 2006 to 18th January, 2007 at IAAS Livestock Farm, Rampur, Chitwan to determine the substitution effects of soybean meal with brewer's dried grain (BDG) on the performance, economics and meat traits of swine production. Starter, grower and finisher diets were formulated containing 18, 16, and 14% CP respectively with 3000 Kcal/kg ME and adequately supplemented with required vitamins, minerals and amino acids. The treatments were: diet without brewer's dried grain -T1 (control diet), diet substituted with 10% brewer's dried grain-T2, diet substituted with 20% brewer's dried grain-T3, diet substituted with 30% brewer's dried grain-T4 and diet substituted with 35% brewer's dried grain-T5. Twenty weaned piglets having 7.37 to 7.94 kg live weight were housed in individual pens. Five piglets were randomly assigned to the five treatments following a randomized complete block design (RCBD) considering each individual as a replication. Fortnightly live weight, daily feed consumption, income over feed and pig cost, and different meat traits of pigs were recorded. The effect of replacing formulated diets with various level of brewer's dried grains on body weight gain was significant ($p<0.01$) with higher level of substitution resulting lower live-weight at the end of each of starter, grower and finisher diet period. The average body weight of piglets substituted with 35%BDG (27.00kg) and 30%BDG (39.75kg) were significantly lower ($p<0.01$) compared to the weight of piglets receiving 0% (65.75kg), 10% (64.25kg) and 20% (60.25kg) BDG replaced diets at the end of 3 months experimental period. A significant reduction ($P<0.01$) in average daily feed consumption were also recorded with increasing level of BDG in the diet. Better feed conversion ratio (FCR) was observed in T2 at early period which at finisher stage T3 diet resulted significantly better FCR which was at par with T1 and T2 diet fed group. However, T5 diet resulted the poorest feed conversion ratio of 5.26, 4.92 and 5.87 for starter, grower and finisher respectively. There was reduction in feed cost with different levels of BDG substitution in diet of pig. Highest income (in per cent) over expenditure (109.01%) was found in T2 followed by T1, T3, and T4. Lowest income over expenditure (-8.2%) was found in T5. Highest dressing percent (71.87%) was recorded in T1 and lowest (70%) in T5 diet fed group. Inclusion of 10-20% BDG seems most acceptable level of substitution of SBM. However, this result needs to be verified under farmer's management condition before recommendation.

Key words: brewer's dried grains, swine performance

Introduction

Brewers' dried grain (BDG) is a solid waste from the brewery industries. It is available and cheap but difficult to dry to low moisture content for easy storage and use, especially during the wet seasons. There is wide variability in the proximate composition of BDG depending on the brewery that produced it. Feed accounts for about 65-70% of the cost of producing market-weight swine. Through the years, efforts have been made to optimize feed efficiency so that feed costs might be reduced. Such efforts depend on knowledge of nutrients availability in feed ingredients and the requirements of the pig for those nutrients for various physiological states. With increasing price of feed ingredients and their scarcity, intensive and continuous efforts are being made to seek agro-industrial by-products so that the cost is reduced without considerable effects on their performance. The aim of this study was to find out economic use of BDG in the diet of swine.

Materials and Methods

An experiment was conducted from October 18th 2006 to 18th January 2007, at IAAS Livestock Farm, Rampur, Chitwan. Twenty weaned crossbred (Landrace x Yorkshire) piglets of same age, weighing about 5 kg were purchased from local farmers two weeks prior to

the start of the actual experiment. Starter (45 to 75- days-old pig), grower (76 to 105- days- old pig), and finisher (106 to 135-days- old pig) diets were formulated containing 18, 16, and 14%, CP respectively. These diets were isocaloric containing 3000 Kcal/kg, ME and adequately supplemented with required vitamins, minerals and amino acids. The treatments were: diet without brewer's dried grain (WBDG) (Control Diet=T1), diet substituted with 10% brewer's dried grain (10% BDG= T2), diet substituted with 20% brewer's dried grain (20% BDG=T3), diet substituted with 30% brewer's dried grain (30% BDG=T4) and diet substituted with 35% brewer's dried grain (35% BDG=T5). Twenty weaned piglets of approximately 7.5 kg body weight were housed in individual pens. Five piglets were randomly assigned to five treatments following a randomized complete block design (RCBD) with four replications. Average daily gain (ADG), average daily feed consumption (ADFC), Feed conversion ratio (FCR), Carcass traits, and income over feed and pig cost were calculated. All the data collected were subjected to statistical analysis using the Microsoft Excel, and MSTAT-C version 1.3 Michigan University (1975). Tests of significance among treatments means were performed using the least significant difference (LSD) at 5%. The ingredients composition and calculated nutrients contents of swine starter, grower and finisher diets substituted with different levels of BDG is presented in Table 1, 2 and 3 respectively.

Table 1. Feed ingredients and nutrient contents of swine starter diets substituted with different levels of BDG

Ingredients	WBDG	10% BDG	20% BDG	30% BDG	35% BDG
Maize	47.82	50.62	58.06	49.75	45.72
Rice polish	12.00	10.00	0.10	0.05	0.05
Soybean meal	20.00	15.00	10.00	5.00	0.00
Til cake	4.30	5.50	6.50	7.00	9.60
Bone meal	0.50	0.50	1.60	1.60	1.60
BDG	0.00	10.00	20.00	30.00	35.00
DOC	12.00	5.00	0.10	0.05	0.00
L/stone	1.20	1.20	1.00	1.00	1.00
Molasses	1.00	1.00	0.10	0.05	0.00
Soy oil	0.00	0.00	1.20	4.00	5.50
Lysine	0.00	0.00	0.16	0.31	0.34
Methionine	0.18	0.18	0.18	0.19	0.19
Salt	0.50	0.50	0.50	0.50	0.50
Feed supplements	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Nutrient Contents					
ME kcal/kg	3064.15	3009.11	3003.14	3001.45	3003.05
CP %	18.02	18.09	18.01	18.05	18.01
Lysine %	1.08	0.95	0.95	0.95	0.95
Methionine %	0.48	0.48	0.48	0.48	0.48
Ca %	0.77	0.79	1.01	1.04	1.09
P %	0.75	0.64	0.60	0.60	0.61

Table 2. Feed ingredient and nutrient contents of swine grower's diet substituted with different levels of BDG

Ingredients	WBDG	10% BDG	20% BDG	30% BDG	35% BDG
Maize	54.96	58.15	66.25	56.96	53.43
Rice polish	6.50	5.00	0.30	0.00	0.10
Soybean meal	20.00	15.00	10.00	5.00	0.00
Tile cake	1.20	0.40	0.60	1.00	3.60
Bone meal	0.50	0.50	1.20	1.50	1.40
BDG	0.00	10.00	20.00	30.00	35.00
DOC	6.50	5.50	0.00	0.50	0.10
L/stone	1.20	1.20	0.50	0.50	0.40
Molasses	8.00	3.10	0.00	0.05	0.00
Soy oil	0.00	0.00	0.00	3.20	4.50
Lysine	0.00	0.00	0.00	0.14	0.31
Methionine	0.14	0.15	0.15	0.15	0.16
Salt	0.50	0.50	0.50	0.50	0.50
Feed supplements	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Nutrient content					
ME kcal/kg	3049.94	3008.26	3000.22	3000.30	3001.42
CP %	16.00	16.00	16.02	16.04	16.00
Lysine %	1.05	0.90	0.76	0.75	0.75
Methionine %	0.41	0.41	0.41	0.41	0.41
Ca %	0.70	0.69	0.61	0.71	0.70
P %	0.50	0.53	0.50	0.54	0.54

Table 3. Feed ingredients and nutrient contents of swine finisher diets substituted with different levels of BDG

Ingredients	WBDG	10%BDG	20%BDG	30%BDG	35%BDG
Maize	54.37	59.38	70.64	63.21	57.51
Rice polish	9.00	10.00	0.50	0.10	0.10
Soybean meal	15.00	10.00	5.50	0.80	0.00
Tile cake	0.00	0.00	0.00	0.00	0.00
Bone meal	0.30	0.50	0.50	0.50	0.50
BDG	0.00	10.00	20.00	30.00	35.00
DOC	10.00	3.00	0.00	0.10	0.10
L/stone	1.20	1.00	1.20	1.10	1.20
Molasses	9.00	5.00	0.50	0.20	0.10
Soy oil	0.00	0.00	0.00	2.70	4.20
Lysine	0.00	0.00	0.04	0.17	0.18
Methionine	0.13	0.12	0.12	0.12	0.11
Salt	0.50	0.50	0.50	0.50	0.50
Feed supplements	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Nutrient contents					
ME kcal/kg	3003.25	3005.30	3002.53	3003.10	3001.60
CP %	14.00	14.02	14.06	14.06	14.58
Lysine %	0.82	0.70	0.56	0.60	0.60
Methionine %	0.21	0.34	0.34	0.34	0.34
Ca %	0.62	0.59	0.67	0.64	0.69
P %	0.58	0.52	0.40	0.40	0.40

Results and Discussion

Live weight

The average cumulative live weight (kg) of crossbred (Landrace x Yorkshire) swine fed diets containing different levels of BDG is presented in Table 4. During the starter diet period (1 month feeding), the piglets fed diet without any BDG (T1) attained the highest body weight (19.97kg) followed by diet substituted with 20%BDG-T3(19.68kg) and 10%BDG substituted (T2) diet (18.75kg). Substituting more than 20%BDG significantly ($p<0.01$) reduced the body weight at the end of finisher diet period with body weight of only 15.43kg (T4) and 11.62kg(T5). Similar trend was also observed during growers' (3rd and 4th fortnight) and finisher diet period (5th and 6th fortnight). At the end of 3 months experimental period, the piglets in diet T2 (10% BDG substituted diet) attained 64.25kg body weight which was at par with the body weight of piglets (65.75kg) receiving control (WBDG-T1) diet.

Table 4. Average fortnightly cumulative live weight (kg) of crossbred (Landrace x Yorkshire) swine fed diets containing different levels of BDG

Treatments	Fortnightly live weight change						
	Initial	1st	2nd	3rd	4th	5th	6th
T1 (WBDG)	7.94	13.38^{ab}	19.97^{a}	28.25^{a}	41.25^{a}	51.25^{a}	65.75^{a}
T2 (10% BDG)	7.54	13.69^{a}	18.75^{a}	27.25^{a}	40.00^{a}	50.00^{a}	64.25^{ab}
T3 (20% BDG)	7.54	14.73^{a}	19.68^{a}	28.25^{a}	37.50^{a}	49.25^{a}	60.25^{b}
T4 (30% BDG)	7.37	11.28^{bc}	15.43^{b}	21.25^{b}	26.25^{b}	32.50^{b}	39.75^{c}
T5 (35 % BDG)	7.48	9.23^{c}	11.62^{c}	14.50^{c}	18.00^{c}	22.50^{c}	27.00^{d}
Probability	0.99	0.06	0.00**	0.00**	0.00**	0.00**	0.00**
CV%	18.99	15.19	14.22	15.52	12.77	10.89	7.19
LSD	ns	2.159	4.827	7.275	8.055	8.776	7.188

Means within columns having different superscripts are significant at $P<0.01$

Decreasing trend of live weight from 4th fortnight to 6th fortnight study period was observed with increasing levels of BDG. However, control diet, 10% BDG and 20% BDG substituted diet from 1st to 6th fortnight did not vary significantly ($p>0.05$). However, which was differed significantly ($p<0.05$) with the values observed in T5 diet. The results of this study are in line with those of Yaakugh and Tegbe (1990) who also recorded depressed growth performance of grower pigs at highest inclusion level of 30% BDG. Babatunde *et al*. (1975) and Yaakugh and Tegbe, (1990) indicated that grower pigs fed at 15% BDG and 35% BDG had the same growth rate and feed conversion ratio as compare to control diet respectively. Some of the reports indicated that high BDG levels in pigs' diets depressed feed intake and growth rate (Kornegay 1973), which was attributed to high dietary crude fibre intake (Yaakugh and Tegbe 1990). Yaakugh and Tegbe (1990) also reported that the bulky nature of BDG diets might have adversely affected the digestibility, as well as the availability of amino acids and other nutrients of pigs.

Daily feed consumption

Average daily feed consumption (kg) of cross bred (Landrace x Yorkshire) swine fed diets containing different levels of brewer's dried grain is presented in Table 5. Accordingly, average daily feed consumption (kg) did not differ significantly among the different treatments during first fortnight of feeding trial. However, the daily feed consumption differed significantly ($P<0.01$) during 2nd fortnight among treatment groups with highest daily feed consumption of 1.24 kg and lowest of 0.77 kg in control diet and diet substituted with 35% BDG respectively. In rest of the experimental period, daily feed consumption among the piglets receiving T1, T2 and T3 were similar but were significantly ($p<0.01$) higher than those in the piglets

groups receiving T4 and T5 diets. The average daily feed consumption during the whole experimental period was highest in piglets receiving T1 diet (1.86kg) and lowest in piglets receiving T5 diet (1.11kg). Yaakugh and Tegbe (1990) also reported that the bulky nature of BDG diets may have adversely affected the digestibility, as well as the availability of amino acids and other nutrients of pigs. This might be the reason in the present study also where increasing level of bulky BDG had reduced the total feed consumption.

Table 5. Average daily feed consumption (kg) of crossbred (Landrace x Yorkshire) swine fed diets containing different levels of Brewer's dried grain at IAAS, Livestock Farm, Rampur Chitwan 2006/07

Treatments	Average daily feed consumption in different fortnight						
	1st	2nd	3rd	4th	5th	6th	Overall mean
T1 (WBDG)	0.80	1.24^{a}	1.52^{a}	2.30^{a}	2.44^{a}	2.90^{a}	1.86
T2 (10% BDG)	0.67	0.91^{bc}	1.24^{ab}	1.78^{b}	2.41^{a}	2.80^{a}	1.63
T3 (20% BDG)	0.71	1.03^{ab}	1.29^{ab}	1.78^{b}	2.10^{b}	2.21^{b}	1.52
T4 (30% BDG)	0.67	1.06^{ab}	1.21^{b}	1.59^{c}	1.92^{c}	1.98^{c}	1.40
T5 (35% BDG)	0.61	0.77^{c}	0.78^{c}	1.15^{d}	1.50^{d}	1.87^{c}	1.11
Probability	0.13	0.01**	0.00**	0.00**	0.00**	0.00**	
CV%	13.28	15.82	15.36	5.13	3.47	3.98	
LSD	ns	0.24	0.28	0.13	0.10	0.14	

Means within columns having different superscripts are significant at P<0.05

Income over feed and pig cost

Income over feed and piglet cost of crossbred swine fed diets containing different levels of BDG is presented in Table 6. In general there was reduction in all types of feed cost with up to 20% BDG substitution. However, above 20% substitution, an increment per kg feed cost was observed. It was because of the fact that an increment in the level of substitution of BDG above 20% there was less energy content than the required. To fulfill the energy level, higher amount of soybean oil was used costing approximately Rs. 75/litre which increased the price of per kg diet resulting into higher production cost, consequently affecting in the gross as well as net income. Highest gross income (Rs. 5198.0) as well as net income (Rs. 2687.34) resulted from control diet (T1) followed by T2, T3 and T4. Lowest gross income (Rs. 2079) and net income (Rs. -191.09) was recorded in diet fed with 35% BDG substitution for SBM. However, maximum income (109%) over expenditure was observed in 10% BDG (T2) followed by control diet (T1), 20% BDG (T3) and 30% BDG (T4) and minimum (-8.42%) was obtained from 35% BDG (T5). It was observed that the lower total feed cost of 30% BDG and 35% BDG diet did not result increased gross income from sale of meat and in net income as well as percent income over expenditure. This result is in agreement with the result of Amaefule *et al.* (2006). They have observed that the lower total feed cost of 40% BDG diet did not result in lower feed cost per kg weight gain and increased gross margin, suggesting that there might not be increased financial benefit as a result of increasing the inclusion level of BDG in the diet above 30%. Therefore, from the economic point of view the optimum inclusion level of BDG in pig diet is 10-20%, since cost minimization and gross income optimization is observed at these levels.

Table 6. Income over feed and piglet cost (IOFPC) of cross bred (Landrace x Yorkshire) swine fed diets containing different levels of Brewer's dried grain

Treatments	Cost of ration (Rs/kg)			TFC (kg)	TFPMLC (Rs)	LW (kg)	CPM Rs/ kg	GISM @ Rs110/ kg	NI (Rs)	% IOE
T1 (WBDG)	13.68	13.61	12.97	168.32	2510.66	65.75	53.13	5198.00	2687.34	107.04
T2 (10% BDG)	12.70	12.54	12.07	147.50	2404.48	64.25	52.63	5025.70	2621.22	109.01
T3 (20% BDG)	12.92	11.78	11.39	137.00	2354.76	60.25	54.93	4715.47	2360.70	100.25
T4 (30% BDG)	13.55	12.57	11.36	126.50	2336.87	39.75	83.12	3092.67	755.80	32.34
T5 (35% BDG)	13.73	12.92	12.21	100.50	2270.09	27.00	120.11	2079.00	-191.09	-8.42

Means within columns having different superscripts are significant at $P<0.05$

Meat traits

Percentage sharing of different carcass traits of crossbred swine fed diets containing different levels of brewer's dried grain is presented in Table 7. Accordingly highest dressing percent (71.87%) was recorded with control diet (T1) and lowest (70%) with diet substituted 35% brewer's dried grain (T5). Higher inedible meat (18.83%) was observed in T4 and lower (17.17%) in T3. However, highest (11.67%) edible meat was recorded in T3 and lowest (10.44%) in T4.

Percentage sharing of different whole sale/retail cuts of carcass against live weight basis of crossbred swine fed diets containing different levels of BDG is presented in Table 8. Accordingly, percentage sharing of different carcass traits including heart, liver, spleen, kidney, lungs, head, hairs + blood were similar in all treatment groups. Percentage sharing of different whole sale/retail cuts of carcass including Ham, Loin, Boston Shoulder, Picnic Shoulder, Belly clear plate etc were also similar in all treatments groups.

Table 7. Meat traits dressing percent of crossbred swine fed diets containing different levels of Brewer's dried grain at IAAS, Livestock Farm, Rampur, Chitwan, 2006

Description ofdifferent cut parts	T1		T2		T3		T4		T5	
	Weight (kg)	%	Weight (kg)	%	Weight (kg)	%	Weight (kg)	%	Weight (kg)	%
Live weight	62	-	45	-	52	-	41	-	25	-
Dressed weight	44.56	71.87	32.00	71.11	37.00	71.15	29.00	70.73	17.50	70.00
Inedible	10.81	17.44	7.90	17.55	8.93	17.17	7.72	18.83	4.61	18.44
Visceral weight*	9.65	15.50	6.90	15.23	7.83	15.00	6.72	16.40	4.00	16.00
Hair + Blood	1.16	1.90	1.00	2.25	1.10	2.10	1.00	2.40	0.61	2.44
Edible	6.63	10.69	5.10	11.33	6.07	11.67	4.28	10.44	2.89	11.56
Heart	0.34	0.54	0.20	0.45	0.20	0.50	0.20	0.54	0.10	0.40
Liver	1.65	2.60	1.00	2.25	1.45	2.80	0.80	1.95	0.51	2.04
Spleen	0.15	0.29	0.75	1.66	0.12	0.25	0.10	0.25	0.06	0.24
Kidney	0.44	0.70	0.20	0.45	0.25	0.50	0.15	0.35	0.10	0.40
Lungs	0.55	0.90	0.65	1.45	0.55	1.00	0.33	0.80	0.12	0.48
Head	3.50	5.70	2.30	5.15	3.50	6.70	2.70	6.58	2.00	8.00
Left half	22.26	35.90	16.00	35.56	18.00	34.62	14.00	34.15	8.50	34.00
Right Half	22.30	35.97	16.00	35.55	19.00	36.54	15.00	36.58	9.00	36.00
Total	62.00	100.00	45.00	100.00	52.00	100.00	41.00	100.00	25.00	100.00

* (Intestine full +Stomach full)

Table 8. Meat traits and dressed weight of swine fed diets containing different levels of brewer's dried grain at IAAS, Livestock Farm, Rampur, Chitwan, 2006

Meat traits	T1		T2		T3		T4			
	Weight (kg)	%	Weight (kg)	%	Weight (kg)	%	Weight (kg)	%	Weight (kg)	%
Ham	9.36	15.13	6.50	14.45	7.50	14.35	6.20	15.00	3.60	14.40
Loin	8.50	13.74	6.00	13.35	6.50	12.50	5.40	13.20	3.20	12.80
Boston Shoulder	2.80	4.50	2.00	4.45	2.50	4.80	2.00	4.80	1.30	5.20
Picnic Shoulder	4.00	6.60	3.00	6.71	3.20	6.20	2.40	5.60	1.50	6.00
Belly	7.50	12.00	5.40	12.00	6.50	12.50	4.80	12.50	3.00	12.00
Spare ribs	1.50	2.60	1.10	2.45	1.50	2.90	1.00	2.30	0.60	2.40
Jowl	1.30	2.00	1.00	2.25	1.20	2.30	0.90	2.20	0.50	2.00
Feet, Tail, Neck bone	2.70	4.30	2.00	4.45	2.30	4.40	1.80	4.30	1.00	4.00
Fat back, Clear plate, Fat trim	5.00	8.00	3.50	7.65	4.30	8.30	3.20	7.73	2.00	8.00
Lean trim	1.90	3.00	1.50	3.35	1.50	2.90	1.30	3.10	0.80	3.20
Total	44.56	71.87	32.00	71.11	37.00	71.15	29.00	70.73	17.50	70.00

The results obtained from the study indicated that up to 20 % BDG inclusion could be the optimum substitutional level from all respect. Hence, farmers/ pig growers can utilize BDG in place of SBM up to 20% without jeopardizing the overall performance of the swine production. However, this result needs to be verified under farmer's management condition before recommendation.

Acknowledgment

The authors wish deep sense of gratitude to the Director of Research, Dean of Institute of Agriculture and Animal Sciences, and all those who directly or indirectly helped in this study.

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