EFFECTS OF REPLACING CONVENTIONAL DIETS WITH BREWER'S RICE BYPRODUCTS ON PERFORMANCE OF CROSSBRED (HAMPSHIRE X GHUNGROO) GROWER PIGS

K. BARMAN^{1*}, S. BANIK¹, R. THOMAS¹, GOKULDAS PP¹, P. KAUSHIK², S. KUMAR¹,
B. C. DAS¹, A. K. DAS¹, D. KONWAR³ AND S. RAJKHOWA¹

¹ICAR-National Research Centre on Pig, ICAR, Rani-781 131, Guwahati, Assam, India

²CVSc, Assam Agricultural University, Khanapara- 781 022, Guwahati, Assam, India

³FVSc & AH, SKUAST-Jammu, Jammu-181 102, Jammu & Kashmir, India

Twenty four crossbred (HS x GH) grower pigs (about 2 months old, body wt. ranged from 12.34 ±0.51 to 13.53±1.53 kg) of either sex were divided into four groups using randomized block design. Four different diets were used for feeding of the animals namely - T₁: standard grower ration without brewer's rice byproducts (BRB); T₂: standard grower ration substituted with 25% BRB; T₃: standard grower ration substituted with 50% BRB; T₄: 100% BRB. The crude protein content (% DM) of the ration was 17.71±0.07 while that of BRB was 19.59±0.59. The average dry matter intake were (kg/d) 1.33±0.05, 1.19±0.16, 1.14±0.12 and 0.90±0.03, respectively which was reduced significantly (P<0.01) in T₃ and T₄ groups in comparison to T₁ and T₂ groups. Digestibility coefficients (%) of dry matter, organic matter, crude protein and nitrogen free extracts were increased (P<0.05), while digestibility coefficients of crude fiber were reduced (P<0.05) significantly with increased level of brewer's byproduct in the ration while no differences in ether extract digestibility. The growth (g/d) was similar in T₁, T₂ and T₃ groups while reduced (P<0.01) in T₄. The feed conversion ratio (FCR) was found similar in T₁, T₂ and T₃ groups while reduced (P<0.01) in T₄ group. The cost (Rs/kg gain) was found similar in T₁, T₂ and T₃ groups while reduced (P<0.01) in T₄ group. From this study, it is concluded that 50% replacement of whole concentrate with BRB can meet the nutritional requirement of grower crossbred pigs without affecting growth and FCR.

Key words: Brewer's rice byproduct, Concentrate, Crossbred, Grower, Pigs

In pig production, feed alone represent 70-75% of total cost of production. In intensive pig production, pig directly compete with human being for feeding, since conventional fattening is based on the feeding of cereals like maize, wheat, oats, barley etc along with other protein, mineral and vitamin supplement. Farmers are unable to support costly feeding program because of high cost of cereals and oil cakes. As a result, animal nutritionist used to search for new feed resources especially unconventional feeds in order to produce economic feeding programme for pig and

other livestock (Abd El-Hack *et al.*, 2017a; 2017b). Brewer's rice byproduct is one of such unconventional feed resource used by farmers to reduce the feed cost for swine as well as for other livestock such as Rabbit (Adeniji and Adewole, 2015), lamb (Radzik *et al.*, 2018), broiler chicken (Abd El-Hack *et al.*, 2019) and beef cattle (Stefanello *et al.*, 2019).

Brewer's grains are quite rich in protein (27-33% DM), which makes them a valuable source of protein. Brewer's grains are usually fed dried

*Corresponding Author

to pigs, as they are easier to store and more stable (Blair, 2007). In temperate countries, dried brewer's grains are often not recommended for starter pigs and should only be given in limited amounts to growing or finishing pigs as well to lactating sows (Holden and Zimmerman, 1991). It is reported that brewer's grain can be included as high as 20 to 45% (diet DM) in growing pigs (Amaefule *et al.*, 2009; Albuquerque *et al.*, 2012) or even higher up to 60% as reported by Ugye *et al.* (1988). It can be included up to 40% in sows ration without any detrimental effect on reproduction as reported by Wahlstrom and Libal (1976). However, higher rates tend to be detrimental to intake and performance (Young and Ingram, 1968). Brewer's grain can be part of basal diets in combination with palm kernel meal and cassava meal (Amaefule *et al.*, 2009). Several workers (Yaakugh *et al.*, 1994) had reported that dried brewer's grains can totally replace rice bran; partially replace maize grain (up to 45%), copra meal (50%) and concentrates (8-9%), and it is cost effective (Yaakugh *et al.*, 1994; Amaefule *et al.*, 2006). Brewer's rice product is locally known as 'Mewa' or 'Juguli' and it is abundantly available in the tribal areas of North Eastern State of India. In the present studies, brewer's rice byproduct was used at different levels by replacing whole concentrate to see its effect on growth and nutrient utilization in crossbred grower pigs.

MATERIALS AND METHODS

The experiment was conducted after approval from the institute animal ethics committee. Twenty four crossbred (HS x GH) grower pigs (about 2 months old, body wt. ranged from 12.34 ± 0.51 to 13.53 ± 1.53 kg) of either sex were divided into four groups of six each in a randomized block design. Four different diets were used for feeding of the animals namely - T_1 : standard grower ration without brewer's rice byproducts (BRB), control diet, T_2 : standard grower ration substituted with 25% BRB, T_3 : standard grower ration substituted with 50% BRB, T_4 : 100% BRB mixed with required salt and mineral mixtures similar to standard diet. The nutrient requirement of pigs

was made as per BIS (1986). The pigs were fed on the experimental grower rations twice daily in the morning and evening. The experiment was conducted for a period of one month. Digestibility trial was conducted at the end of the experiment. The lysine and methionine are balanced in all the rations as per requirement. The calculated energy (ME, Kcal/kg) of experimental diet was 3000, 3152, 3304 and 3600, respectively in T_1 , T_2 , T_3 and T_4 . The protein content of the experimental diet was 17.71 ± 0.21 , 18.18 ± 0.39 , 18.94 ± 0.06 and 19.59 ± 0.59 , respectively in T_1 , T_2 , T_3 and T_4 . Proximate composition was done as per AOAC (1990).

Statistical analysis: Feed intake, nutrient digestibility, nitrogen balance, feed conversion ratio (feed gain ratio), feed cost per kg gain, average daily weight gain was subjected to a one-way ANOVA with experimental diet (T_1 , T_2 , T_3 and T_4) as fixed effect as per Snedecor and Cochran (1989). Differences were considered significant when $P < 0.05$ and $P < 0.01$.

RESULTS

The protein content (% DM) of the ration was 17.71 ± 0.21 and that of brewer's rice byproducts (BRB) was 19.59 ± 0.59 . Nitrogen free extract content (% DM) of the ration was 68.10 ± 0.82 and that of BRB was 73.86 ± 0.93 (Table 1).

The digestibility coefficient of DM ranged from 84.88 ± 1.66 to 93.46 ± 0.25 in T_1 to T_4 respectively. Similarly, CP digestibility was ranged from 74.59 ± 0.51 to 78.74 ± 0.07 in T_1 to T_4 respectively. The digestibility of OM and NFE also followed the same patterns, while digestibility of crude fiber decreased and digestibility of EE did not follow any pattern (Table 2).

The dry matter intake (kg/d) ranged from 1.33 ± 0.05 in T_1 to 0.90 ± 0.03 in T_4 group. The average gain in weight (g/d) was ranged from 498.81 ± 31.73 in T_1 to 157.14 ± 5.07 in T_4 group. The FCR was ranged from 3.07 ± 0.22 in T_1 to 5.76 ± 0.20 in T_4 group (Table 3).

Table 1. Proximate composition (on % DM) of experimental ration and brewer's rice product

Diet	OM	CP	CF	EE	Ash	NFE
Brewer's rice products	97.12±0.75	19.59±0.59	1.71±0.23	1.97±0.18	2.88±0.75	73.86±0.93
Grower ration	94.44±0.07	17.71±0.21	5.03±0.40	3.60±0.57	5.57±0.07	68.10±0.82

Table 2. Effect of brewer's rice product on digestibility coefficient of various nutrients in crossbred (HSxGH) grower pigs

Groups	DM	OM	CP	EE	CF	NFE
T ₁	84.88 ^a ±1.66	87.45 ^a ±1.26	74.59 ^a ±0.51	88.20±0.34	68.05 ^a ±2.30	88.43 ^a ±1.42
T ₂	85.70 ^a ±2.45	88.63 ^a ±1.92	75.85 ^b ±1.09	87.59±1.19	66.02 ^a ±0.19	93.43 ^b ±1.35
T ₃	89.10 ^b ±0.13	91.18 ^b ±0.01	76.89 ^b ±0.34	85.56±2.90	64.51 ^b ±0.86	95.86 ^c ±0.16
T ₄	93.46 ^c ±0.25	94.83 ^c ±0.18	78.74 ^c ±0.07	89.69±1.67	58.20 ^c ±1.61	94.75 ^d ±0.14
P Value	0.131	0.106	0.110	0.705	0.100	0.06
Level of significance	*	*	*	NS	*	*

^{a, b, c, d} different superscript in a column differ significantly (*, P<0.05), T₁: 0% replacement of concentrate with brewer's rice byproducts; T₂: 25% replacement of concentrate with brewer's rice byproducts; T₃: 50% replacement of concentrate with brewer's rice byproducts; T₄: 100% replacement of concentrate with brewer's rice byproducts

Table 3. Effect of brewer's rice products on nutrient utilization in crossbred grower pigs

Parameters	T ₁	T ₂	T ₃	T ₄	P value	Level of significance
DMI, g/day	1.33 ^a ±0.05	1.19 ^{ab} ±0.16	1.12 ^b ±0.11	0.90 ^c ±0.03	0.01	**
Initial b wt	13.53±1.53	12.34±0.51	12.44±1.37	12.93±1.54	0.879	NS
Final b wt	24.00 ^a ±2.11	19.48 ^a ±1.10	19.73 ^a ±1.54	14.83 ^b ±1.80	0.032	*
Average gain, g	498.81 ^a ±31.73	405.71 ^a ±33.99	415.48 ^a ±9.73	157.14 ^b ±5.07	0.01	**
Feed conversion ratio	3.07 ^a ±0.22	3.23 ^a ±0.23	4.24 ^a ±0.29	5.76 ^b ±0.20	0.01	**
Feed cost/kg gain	68.57 ^a ±4.92	67.97 ^a ±6.41	67.98 ^a ±6.82	40.38 ^b ±1.69	0.003	**

^{a, b, c} different superscript in a row differ significantly (**, P<0.01*, P<0.05), T₁: 0% replacement of concentrate with brewer's rice byproducts; T₂: 25% replacement of concentrate with brewer's rice byproducts; T₃: 50% replacement of concentrate with brewer's rice byproducts; T₄: 100% replacement of concentrate with brewer's rice byproducts

DISCUSSION

The digestibility coefficient of dry matter, organic matter and crude protein was increased (P<0.05) with increased level of BRB in the ration while digestibility coefficient of crude fiber and nitrogen free extract was increased with increased level of BRB up to a level of 50 percent and thereafter their digestibility was reduced (P<0.05) significantly (Table 2). In contrast to the present findings, Amaefule *et al.* (2006) found higher digestibility of ether extract and crude fiber at

35% inclusion of brewer's dried grains (BDG) than 30% level of BDG higher level of feeding of brewer's dried grains, which might be due to diet composition (Myer *et al.*, 1975), animal variation (Zivkovic and Bowland, 1970) etc.

Average DM intake (g/d) was decreased with increased level of brewer's rice products. Decreased in feed intake upon supplementation of wet brewer's grains was also reported by

other workers (Lazarevich and Lesnov, 2010). Average growth rate (g/day) was found similar in T_1 , T_2 and T_3 groups while reduced significantly at 50% replacement of concentrate with BRB in grower crossbred pig and decreased ($P<0.01$) at 100% replacement of concentrate with BRB (Table 3). Growth was found similar in group T_1 , T_2 and T_3 while decreased significantly ($P<0.01$) at 100% replacement of concentrate with BRB. In contrast to present finding, it was reported that inclusion of dried brewer's grain up to 25 % in poultry diet without addition of enzyme decreased the weight gain (Alabi *et al.*, 2014).

In similar manners, feed conversion ratio was not differed in T_1 , T_2 and T_3 groups while reduced ($P<0.01$) at T_4 group. The feed cost per kg gain was found similar in T_1 , T_2 and T_3 groups while reduced ($P<0.01$) significantly in T_4 group (Table 3). The increase digestibility of DM, OM, CP and NFE with increased level of BRB in the ration might be due to low crude fiber level in BRB. Ashour *et al.* (2019) also found better feed conversion efficiency in broilers fed on diet containing 9% dried brewer's grain. Similarly, Ironkwe and Bamgbose (2011) also reported better growth and feed conversion efficiency by utilizing dried brewer's grain at 0%, 25%, 50%, 75% and 100% by replacing maize in broiler finishers bird.

It is reported that dried brewer's grains can totally replace rice bran, partially replace maize grain (up to 45%), copra meal (50%), and concentrates (8-9%) as reported by several workers (Yaakugh *et al.*, 1994). Inclusion rates tend to be higher in

temperate countries, ranging from 20 to 45% (diet DM) in growing pigs (Amaefule *et al.*, 2009; Albuquerque *et al.*, 2012). Inclusion rates as high as 60% have been used (Ugye *et al.*, 1988). It is reported that in tropical and subtropical climates, rates of 30% in weaner pigs and 40-50% in finishing pigs have been proposed and have been found cost-effective in spite of the performance losses (Meffeja *et al.*, 2007).

It is reported that wet or ensiled brewer's grains can be used in pig diets, but they tend to have a depressive effect on feed intake, DM and energy digestibility, animal performance and carcass dressing (Lazarevich and Lesnov, 2010). In temperate countries, they are only recommended for finishing pigs (over 60 kg) and lactating sows, at about 20% inclusion rate or 1-2 kg/d (up to 3 kg) (Blair, 2007). In tropical and subtropical climates, rates of 30% in weaner pigs and 40-50% in finishing pigs have been proposed and have been found cost-effective in spite of the performance losses (Meffeja *et al.*, 2007). Amoah *et al.* (2017) reported a significant reduction of feed cost at 17 and 20% level of inclusion of sun dried brewer's spent grain in pigs. Similarly, in the present study cost per kg gain was reduced non significantly in T_2 and T_3 groups and significantly at T_4 group in comparison to T_1 group.

From the present study, it is concluded that, 50% replacement of whole concentrate with brewer's rice product can meet the nutritional requirement of grower crossbred pigs without affecting the growth and feed conversion efficiency.

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