



## RESEARCH ARTICLE

### Effects of Replacement of Fish Meal with Spent Grain on the Performance of Growing Pigs

CM Ayo Enwerem<sup>1</sup>, CF Ezeafulukwe<sup>2</sup>, EO Ahaotu<sup>1</sup> and A Akinfemi<sup>3</sup>

<sup>1</sup>Department of Animal Production Technology, Imo State Polytechnic, Umuagwo, Nigeria

<sup>2</sup>Department of Fisheries and Marine Technology, Imo State Polytechnic, Umuagwo, Nigeria

<sup>3</sup>Department of Animal Science, Nasarawa State University, Laffia, Nigeria

#### ARTICLE INFO

Received: July 22, 2013

Revised: July 27, 2013

Accepted: July 31, 2013

#### Key words:

Feed conversion

Fish meal

Growth

Spent grain

#### ABSTRACT

Two groups each of twelve pigs were used in simultaneous growing and finishing experiments to evaluate 4 levels of fresh spent grain diets based on rice bran, broken rice and fish meal. The spent grain replaced 0 (control), 30, 60 or 100% of the fish meal protein. Feed DM intakes and growth rates were reduced as the dietary levels of spent grain were increased, with the effect being more marked in the finishing phase. Contrasting results were obtained for feed DM conversion, with apparently better conversion on the diets with spent grain in the growing phase, but poorer conversion on these diets in the finishing phase. A 30% replacement level appeared to give the best economic return.

An on-farm trial was conducted with 4 households with 4 pigs in each with initial weights of 40 to 46 kg. The control diet used in the on-station trial was evaluated in one household, while in the other three households the 30% replacement rate with spent grain was applied.

Performance of the pigs was very good in all the households, with no apparent difference between the control diet and the diet with 30% replacement of fish meal protein by the spent grain. It is concluded that in diets for fattening pigs, based on broken rice, rice bran and fish meal, spent grain can replace 30% of the fish meal on a protein basis, without affecting performance.

#### \*Corresponding Author

EO Ahaotu

emmaocy@gmail.com

**Cite This Article as:** Enwerem CMA, CF Ezeafulukwe, EO Ahaotu and A Akinfemi, 2013. Effects of replacement of fish meal with spent grain on the performance of growing pigs. *Inter J Vet Sci*, 2(3): 78-80. www.ijvets.com

## INTRODUCTION

Preliminary studies showed that the best solution to take full advantages of local feed resources in pig production is through the use of by-products from agricultural and industrial processing such as distillers' rice waste Ezeafulukwe *et al.*, 2013, Ahaotu *et al.*, 2012a), unripe plantain peel (Uwalaka *et al.*, 2013), feather meal (Ahaotu *et al.*, 2010, Madubuike *et al.*, 2012), spent grain (Madubuike *et al.*, 2007), raw *Moringa oleifera* seed (Ahaotu *et al.*, 2013 a). This can help to improve farmers' economic returns.

Madubuike (1984) stated that spent grain is not commonly used for pigs and it is generally recommended that it should not exceed 50% of the dietary protein otherwise growth rate and feed efficiency may be reduced. Spent grain has 18% crude protein in dry matter and also high in fibre. Spent grain has often been used for duck, guinea fowl and pig production by small-holder farmers in South East Nigeria (Ahaotu *et al.*, 2012b, Chukwu *et al.*, 2013 and Ahaotu *et al.*, 2013b).

The aim of this research was to study a range of levels of spent grain as a replacement for the protein in fish meal in diets for growing-finishing pigs. Trials were carried out in the Teaching and Research Farm of the Imo State Polytechnic, Umuagwo, Nigeria

## MATERIALS AND METHODS

Two trials were conducted to evaluate the replacement of fish meal by wet spent grain for growing pigs. The first and second studies were conducted for three months at the Teaching and Research Farm of the Imo State Polytechnic, Umuagwo, Nigeria.

### Animals and experimental design

#### Animals and Treatments

Trials were carried out simultaneously with two groups each of 12 pigs to evaluate the effect of spent grain in the growing (12 to 50 kg) and finishing phase (50 to 90 kg). The pigs for the growing trial weighed 12.1±1 kg and those in the finishing trial 45±1 kg. The animals were

allocated according to a completely randomized design into four different diets, in which spent grain replaced fish meal at levels of 0, 30, 60 and 100% on a crude protein basis. All animals were individually housed, and de-wormed and vaccinated before starting the trials. The daily feed allowance was set at 4% of the animal's live weight, and was given at 09:00 and 14:00 hours. Refusals were recorded daily to measure feed intake. Water was available throughout the experiment. The pigs were weighed at the start of experiment, at intervals of one month and at the end of the trial.

### Feeds

Spent grain, residue of beer making company, was purchased every two days at the consolidated brewery company in Awomama, Imo State, Nigeria. Fish meal, rice bran and broken rice were purchased at the same time from a feed ingredient vendor in Owerri, Imo State, Nigeria. The diets in the growing phase were formulated to contain 17% protein in DM which was reduced to 14% in the finishing phase (Tables 1, 2 and 3).

**Table 1:** Composition of the dietary ingredients (% in DM, except for DM which is on fresh basis)

	DM	Ash	CP	EE	CF	NFE
Rice bran	86.9	9.10	13.3	13.5	11.9	52.2
Broken rice	85.5	1.33	10.7	1.55	1.04	85.3
Fish meal	86.2	43.8	34.6	2.34	1.76	17.5
Spent grain	29.9	3.57	31.0	15.0	14.7	35.7

Key: DM = Dry Matter, CP = Crude Protein, EE = Ether Extract, CF = Crude; Fiber, NFE = Nitrogen Free Extract.

**Table 2:** The formulation of diets (% in DM) for growing pigs

	Control	SG30	SG60	SG100
<b>Ingredients, %</b>				
Rice bran	40	41.82	45	44.6
Broken rice	35.8	33.2	29.2	28.4
Fish meal	23.2	16.2	9.3	0
Spent grain	0	7.8	15.5	26
Bone meal	0.5	0.5	0.5	0.5
Premix vitamin	0.5	0.5	0.5	0.5
<b>Composition</b>				
DM % in air-dry	85.4	81.0	76.7	70.8
Ash % in DM	14.3	11.6	9.11	5.36
CP % in DM	17.2	17.2	17.2	17.0
EE % in DM	6.51	7.72	9.09	10.4
NFE % in DM	55.5	55.8	55.6	56.8
CF % in DM	5.53	6.75	8.1	9.43

**Table 3:** The formulation of diets for the finishing phase

Ingredients, % DM basis	Control	SG30	SG 60	SG 100
Rice bran	40	40	37.6	39
Broken rice	46.3	44.4	46.3	45.8
Fish meal	12.7	8.9	5.1	0
Spent grain	0	5.7	10.0	14.2
Bone meal	0.5	0.5	0.5	0.5
Premix	0.5	0.5	0.5	0.5
<b>Composition % dry matter basis (except for DM which is on fresh basis)</b>				
DM	85.3	82.1	79.7	77.3
Ash	9.81	8.33	6.63	4.66
CP	14.7	14.9	14.8	14.5
EE	6.43	7.17	7.43	8.12
CF	5.46	6.21	6.51	7.20
NFE	62.6	62.35	63.6	64.5

### Animals, Diets and Treatments

Four households participated in the trial, each having 4 large white pigs. In one household the diet was the basal control diets as used in the trial. In the other 3 households the Sg30 diet from the first trial was used, with 30% of the fish meal protein replaced by spent grain. Initial weights of the pigs were from 40 kg to 46 kg. All households using boiled broken rice, which was cooked over night. The spent grain was mixed with the boiled broken rice, rice bran and fish meal. The feed was prepared freshly for every meal with 3 litres of water being added to the mixture before feeding. The pigs were fed three times per days, the amounts of feed being adjusted so that there were no refusals. The pigs were de-wormed and vaccinated before starting the trial.

### Data Collection

The pigs were weighed at the beginning of trail, once each month and on finishing the trial, using a 100 kg capacity portable scale with accuracy of 0.5 kg. Feed intake was recorded for every week, using a 12 kg capacity portable scale.

### Chemical Analysis

Feed samples were analysed in duplicate for dry matter (DM), crude protein (CP), ash and ether extract (EE) according to the standard procedure of AOAC (2000).

### Statistical Analysis

All data were analysed by analysis of variance (Gordon and Gordon, 2004). Sources of variation were treatments and error.

## RESULTS AND DISCUSSION

### Experimental Trial

Feed DM intakes and growth rates were reduced as the dietary levels of spent grain were increased, with the effect being more marked in the finishing phase (Table 4). Contrasting results were obtained for feed DM conversion, with apparently better conversion on the diets with spent grain in the growing phase, but poorer conversion on these diets in the finishing phase.

Two factors are likely to have contributed to the poorer performance with spent grain; the high fibre content of this feed and the lower digestibility and inferior amino acid balance compared with fish meal. Madubuike, (1994) and Ngodigha *et al.*, (1994) also found that increasing the level of spent grain led to poorer live weight gain and feed conversion in pigs; while Ong and Hutagalung, (1987) and Ugye *et al.*, (1988) reported that the digestibility of DM, crude fibre and crude protein were significantly reduced with increasing levels of spent grain in the diet.

### Economic analysis

The feed cost of the finishing pigs was reduced with increasing levels of spent grain (Table 5), as the spent grain was much cheaper than the fish meal. However, this advantage was offset by the poorer performance on the diets with spent grain, thus there was little difference between the margin over feed cost between the control diet and that with 30% replacement of the fish meal

protein by spent grain. However, with higher levels of the spent grain, the margin over feed was found less than on the control diet.

#### On-farm trial

Performance of the pigs was very good in all the households, with no apparent difference between the control diet and the diet with 30% replacement of fish meal protein by the spent grain (Table 6).

**Table 4:** Effect of spent grain on performance and intake of growing pigs (60 days)

	Control	Sg30	Sg 60	Sg 100	SEM
Growing phase					
Live weight, kg					
Initial	20.3	20.0	20.3	20.3	
Final	52.3	52.5	49.7	48.1	
Daily gain	0.533 <sup>a</sup>	0.541 <sup>ab</sup>	0.490 <sup>bc</sup>	0.463 <sup>bc</sup>	0.01*
DM intake, kg/day	1.67 <sup>c</sup>	1.55 <sup>b</sup>	1.46 <sup>ab</sup>	1.33 <sup>a</sup>	0.01*
Feed DM conversion	3.13 <sup>a</sup>	2.86 <sup>b</sup>	2.98 <sup>b</sup>	2.87 <sup>b</sup>	0.01*
Finishing phase					
Live weight, kg					
Initial	45.3	46.7	44.3	44.33	
Final	88.7	89.6	81.0	74.3	
Daily gain	0.722 <sup>a</sup>	0.716 <sup>a</sup>	0.611 <sup>b</sup>	0.500 <sup>c</sup>	0.026*
DM intake, kg/day	2.26 <sup>a</sup>	2.26 <sup>a</sup>	2.13 <sup>ab</sup>	1.93 <sup>b</sup>	0.027*
Feed DM conversion	3.14 <sup>a</sup>	3.18 <sup>a</sup>	3.49 <sup>ab</sup>	3.87 <sup>b</sup>	0.118*

<sup>abc</sup> Means in the same row without common superscripts are different at P<0.05; Key: DM = Dry Matter, Kg = Kilogram, Sg = Spent Grain.

**Table 5:** Economic analysis of the trial with finishing pigs

	Sg 0	Sg 30	Sg 60	Sg 100
Gain in live weight, kg	43.3	43	36.7	30
Feed cost /kg	2174	1912	1648	1355
Total feed cost	94149	82214	60474	40657
Sale value of LW gain	476300	473000	403700	330000
Margin over feed	382151	390786	343226	289343

Keys: LW= Live Weight

**Table 6:** Mean values for growth rate and economic returns of pigs in 4 households in Umuagwo, South East, Nigeria.

	Control	Sg 30	Sg 30	Sg 30
Duration of trial, days	60	61	62	62
Live weight, kg				
Initial	43.3	43.3	42.0	44.8
Final	88.3	90.2	89.4	94.0
Daily gain	0.751	0.770	0.765	0.794
Cost of feed	244690	217635	223297	216577
Feed cost/live weight gain	5431	4635	4710	4401

Key: Sg= Spent Grain

#### Conclusion

In diets for fattening pigs, based on broken rice, rice bran and fish meal, spent grain can replace 30% of the fish meal on a protein basis, without affecting performance.

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