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Evaluation of potato hash silage from two bacterial inoculants and their effects on the growth performance of grower pigs

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Abstract

Potato hash was mixed with wheat bran at 7:3 ratio, treated with homofermentative LAB inoculant (BMF, bonsilage forte), heterofermentative lactic acid bacteria (LAB) (LFLB, Lalsil Fresh LB) and without LAB inoculant and ensiled in 210 L drums for 90 days. After 90 days of ensiling, concentrates that contained 40% potato hash silage (PHS) were formulated and the treatment groups were control (no silage), untreated PHS, BMF treated PHS and LFLB treated PHS. The diets were fed to 64 growing pigs (60 days old and 30.4 ± 2.3 kg body mass). The pigs were allocated in a complete randomized block design with four treatments, and each treatment consisted of eight boars and eight sows. Pigs were fed *ad libitum*, feed intake was measured daily while body masses were recorded at the start and weekly throughout the experimental period. The dry matter intake (DMI) was higher in the control diet (1062 g/kg) than in the untreated PHS diets (933 g/kg), BMF treated PHS (873 g/kg) and LFLB treated PHS (919 g/kg) diets, respectively. Pigs in the control group had higher final body weight (60.77 kg), average daily gain (ADG) (551 g/d) and better feed conversion rate (FCR) (4.92 g/g) at the end of the trial compared to those in other treatment groups. It can be concluded that potato hash silage produced with or without LAB inoculants had the same effect on the growth performance of growing pigs. However, further work is needed to evaluate the effects of higher dietary inclusion levels (>40 %) of ensiled potato hash on pig growth and reproductive performance.

Keywords: Potato hash, grower pigs, LAB inoculation, growth performance
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Introduction

Feed costs usually account for 70 – 80% of the animal production costs and reducing feed expenses is very important (Henning, 1998; Okereke *et al*., 2008). This can be achieved through the use of agro-industry by-products (Okereke *et al*., 2008). Potato hash is one of the by-products that are available in relatively high volumes in the Gauteng province of South Africa. This by-product contains a DM of 150 g/kg, 700 g/kg DM of starch, 11.16 MJ kg DM of ME, 105 g/kg DM of CP, and a crude fibre of 58.5 g/kg DM (Nkosi, 2009). Feeding of this by-product to livestock in its fresh form is possible, however if it is not consumed in a short period of time by animals, it gets mouldy and quickly becomes useless for animal feeding. Production of a meal from potato waste products is technically feasible, but high drying and processing are economic deterrents (Charmley *et al*., 2002). Ensiling of potato hash is the most suitable method for its conservation for a long period. It has been reported that lactic acid bacteria (LAB) inoculants reduce silage pH, proteolysis and deamination (Seale, 1986) and inoculated silages are expected to improve feed intake, dry matter digestibility (DMD) and organic matter digestibility (OMD), resulting in improved animal performance (Chamberlain, 1982; Bolsen *et al*., 1996). The objective of this study was to evaluate the effects of feeding potato hash silage that was treated with or without bacterial inoculants on the growth performance of pigs.

Materials and Methods

Potato hash was collected from Simba (Pty) Ltd (Isando, Gauteng Province) and brought to the Animal Production Institute (ARC-Irene, Pretoria) for analysis and silage making. An amount of 700 g/kg potato hash was mixed with 300 g/kg of wheat bran to produce silage. The mixtures were treated with: a) *Bonsilage Forte* (BF), a homofermentative LAB inoculant, b) Lalsil Fresh LB (LFLB), a heterofermentative LAB, and c) without a LAB inoculant (control). The mixtures were compacted in 210 L drums lined with plastic bags. The bags were closed and a concrete paving stone (20 kg) was placed on top of the bags. The

drums were therefore closed with a rubber lid to prevent damages to the bags by rodents. After three months of ensiling, samples were collected and analysed for fermentation characteristics, and four concentrates (no silage or 40% potato hash silage) were formulated and fed to 64 crossbred pigs (Large White x Landrace) consisting of 32 males and 32 females (aged 64 days and 30 ± 2.3 kg live weight). The pigs were housed in groups of two per pen in a grower house. The pigs were evenly distributed in-between treatments and there were 16 pigs per treatment. The pigs were weighed at the start and at weekly intervals until the end of the trial. An adaptation of 21 days was given and diets were fed *ad libitum* until a target slaughter mass of 60 kg was achieved. Data on the effects of treatments (inoculants) on the fermentation characteristics of silage, and concentrates on the growth performance of pigs were analysed in a completely randomized design by ANOVA using Genstat (2000) and significance was declared at 5% probability level.

Results and Discussion

The chemical compositions of diets fed to pigs are as portrayed in Table 1. The inoculated silage had lower pH, butyric acid and ammonia-N while increasing the content of lactic acid compared to the control (data not shown). However, all the silages had pH of less than 4.6, lactic acid concentration of more than 64 g/kg DM, butyric acid of less than 0.1 g/kg DM and NH_3-N of less than 0.2 g/kg DM indications of well preserved silages (McDonald, 1981).

Table 1 Chemical composition of diets fed to pigs (DM basis, unless otherwise stated)

	Treatments			
	Control	UPHS	BFPHS	LFLBPHS
DM, g/kg	864	757	658	785
OM, g/kg	778	681	592	707
CP, g/kg	178	158	161	156
GE, MJ/kg DM	18.9	18.5	18.1	18.0
EE, g/kg	119.7	64.5	60.1	63.8
ADF, g/kg	75.6	94.5	112.0	101.1
NDF, g/kg	252	258	276	314
Calcium, g/kg	10.4	12.0	11.0	11.9
Phosphorus, g/kg	7.2	8.6	6.4	6.9

DM - dry matter; OM - organic matter; CP - crude protein; GE - gross energy; EE - ether extract; ADF - acid detergent fibre; NDF - neutral detergent fibre.
Treatments: cont - control (commercial diet); UPHS - untreated potato hash silage; BFPHS - bonsilage forte treated potato hash silage; LFLBPHS - lalsil fresh *lactoctobacillus buchneri* treated potato hash silage.

Higher dry matter intake (DMI) was obtained in pigs that were fed on the control diet (1062 g/kg) compared to those fed in diets that contained potato hash silage (Table 2). The reduced DM intake on the potato hash silage (untreated, BF and LFLB) diets could be attributed to the low DM and high fibre contents (Table 1) of these feeds compared to the control, which is consistent with Just (1984) who reported a high DMI in pigs fed high DM and low fibre content diet compared to those fed on low DM and high fibre diets. In contrast, Shimizawa *et al*. (2007) did not obtain a difference in feed intake between pigs that were fed either on a concentrate or total mixed potato silage. Higher growth rates and a better FCR were obtained in pigs fed the commercial diet than with those on silage. Peters *et al.* (2005) obtained a growth rate of 454 g/d in pigs fed diets containing 30% sweet potato root silage, which is comparable to the results obtained in this study from pigs fed on diets containing the potato hash silage.

Conclusions

It can be concluded that dietary inclusion of potato hash silage that was treated with or without LAB inoculants did not yield better pig performance when compared to the control. Furthermore, the effects of LAB inoculants on pig performance was not significant in this study and therefore further work that will evaluate the effects of higher dietary inclusion level (>40 %) of ensiled potato hash on pig growth and reproductive performance is warranted. It was later found that age of the pigs should be taken into consideration when ensiling potato hash for pig's diets.

Table 2 Effects of dietary treatments on the growth performance of pigs (n = 16)

	Treatments				P-value	SEM
	Control	UPHS	BFPHS	LFLBPHS		
IBW, kg	30.4	30.9	30.3	29.9	0.68	0.834
FBW, kg	60.8[a]	52.5[b]	52.0[b]	48.5[b]	0.05	2.131
DMI, g/kg	1062[b]	933[b]	919[b]	873[b]	0.05	57.73
ADG, g/d	551[a]	386[b]	388[b]	335[b]	0.05	34.21
FCR, kg/kg	4.92[b]	7.02[a]	7.14[a]	7.86[a]	0.05	0.582

[a,b] Means with different letters in a row differ significantly (P <0.05).
IBW - initial body weight; FBW - final body weight; DMI - dry matter intake; ADG - average daily gain; FCR - feed conversion rate.
Treatments: cont - control (commercial diet); UPHS - untreated potato hash silage; BFPHS - bonsilage forte treated potato hash silage; LFLBPHS - lalsil fresh *lactoctobacillus buchneri* treated potato hash silage.

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