

Influence of Maize Cob Inclusion Level in Pig Diets on Growth Performance and Carcass Traits of Mukota × Large White F₁ Crossbred Male Pigs**

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ABSTRACT : A trial was conducted to evaluate the growth performance and carcass characteristics of LW × Mukota F₁ crosses when fed diets containing graded levels of maize cob meal. Sixteen LW × Mukota F₁ crossbred pigs of approximately 4.5 months of age, were randomly allocated to four diets that contained 0, 100, 200 and 300 g maize cobs/kg, which corresponded to 276.4, 360.3, 402.9 and 523.5 g NDF/kg, respectively. The pigs were fed *ad libitum* for 14 weeks. The diets were formulated to contain similar levels of energy (*ca.* 9MJ ME/kg) and protein (*ca.* 160 g CP/kg). Average daily feed intake (ADFI), daily gain (ADG) and feed conversion ratio (FCR) were monitored for 14 weeks. At slaughter, the cold dressed weight (CDM) and backfat thickness (BFT) were determined. There was no significant linear relationship ($p > 0.05$) between level of cob inclusion and ADFI. The ADG decreased as level of maize cobs increased ($p < 0.001$). The pigs that were on 300 g cobs/kg had the highest FCR ($p < 0.05$) as compared to pigs on the other three diets. No differences ($p > 0.05$) were observed in the CDM between pigs that were fed diets that had 0 and 100 g maize cobs/kg. In addition, pigs on 100 and 200 g cobs/kg diets had the same CDM ($p > 0.05$). The diet that contained 300 g cobs/kg gave the lowest ($p < 0.001$) CDM. Both BFT parameters showed a decrease ($p < 0.05$) as level of maize cobs increased. An increase in CDM was associated with an increase in BFT ($p < 0.001$), with the correlation coefficient between K7.5 and CDM being 0.84 ($p < 0.001$). It can, therefore, be concluded that crossbred pigs perform well on diets containing up to 200 g/kg maize cobs. (*Asian-Aust. J. Anim. Sci.* 2001. Vol 14, No. 12 : 1724-1727)

Key Words : Maize Cobs, LW × Mukota Crosses, Growth Performance, Carcass Traits

INTRODUCTION

The major exotic breed commonly found in Zimbabwe is the Large White (LW). It is highly regarded for its superior growth rates and fertility and has voracious feeding habits and superior slaughter weights. Under smallholder extensive farming conditions, however, the LW cannot withstand the high ambient temperatures and the generally low management levels. The white colour of the LW breeds can also make them susceptible to sunburn.

The Mukota is an indigenous breed, predominantly black in colour and adapted to survive under low planes of nutrition and can manage to reproduce at low dietary protein levels (Holness, 1973). Mukota pigs have also been shown to have good mothering abilities (Scherf, 1990). In addition, there is evidence that the Mukota can better utilise diets that contain high levels of fibre than exotic breeds (Ndindana et al., 2001). The Mukota breed, however, exhibits very low body weight gains and has a stocky body. Moreover, the indigenous breeds readily deposit body fat (Holness, 1991) and have lower dressing percentages than the improved breeds.

Besides selection, the other way to improve the indigenous breeds and develop a suitable animal for

smallholder farmers is crossbreeding. Scherf (1990) reported that crossbreeding is widely practised in many smallholder areas of Southern Africa. Crossbreds are believed to exhibit hybrid vigour in most traits of economic importance and to also complement the positive attributes of the indigenous and exotic breeds.

Close (1993) has suggested that pigs can obtain significant amounts of nutrients from dietary fibre. Although there are a number of reports on the utilisation of high fibre diets in pigs, most of them (e.g. King and Taverner, 1975; Van Wieren, 2000) focus on nutrient digestibility and put less emphasis on the effect of the fibre on voluntary feed intake, growth rate, feed conversion efficiency and carcass traits. This makes it difficult to gain an insight into the contribution of the fibre to pig production systems. The use of agricultural by-products, such as maize cobs in livestock feeding systems (Frank et al., 1983) would boost smallholder livestock productivity. This is largely because agricultural by-products, which are normally burnt, will not be wasted. The objective of the study was, therefore, to determine the growth performance and carcass traits of Mukota × LW F₁ crosses when given graded levels of maize cobs.

MATERIALS AND METHODS

Study site

The trial was carried out at the University of Zimbabwe farm, which is located 15 km to the west of Harare, the

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capital city of Zimbabwe. It lies at 30°E and 18.8°S. On average, the area receives 760 mm rainfall annually and ambient temperatures range from 18°C in the cold dry months to 30°C during the hot dry season.

Animals, diets and management

Sixteen male LW × Mukota crossbred pigs, selected at about 4.5 months of age were used in this trial. They were obtained from mating purebred LW boars and Mukota sows. The piglets were weaned at five weeks and fed on a pig growers' diet before they were put on experimental diets that were based on Ndindana et al. (2001). Diets contained 0, 100, 200 and 300 g maize cobs/kg and were formulated using a Format International formulation package to be of similar levels of energy (9.6 MJ ME/kg) and protein (160 g crude protein/kg). This ignored any nutrient contribution made by the cob meal to the diet. Vegetable oil blend, a by-product in cottonseed processing, was used to increase energy density in the diets that contained maize cobs. Sand was added to the diets as an inert substance, to ensure equal nutrient content in the four diets. Any differences in pig performance were therefore attributed to the level of maize cobs in the diets. The ingredient and chemical compositions of the diets are shown in table 1.

The pigs were randomly penned in pairs and each of the four diets was randomly allocated to each pen. The pens had walls that covered the full perimeter of the pen and had concrete floors. At the start of the trial, the pigs on the 0, 100, 200 and 300 g cobs/kg weighed 25.9±3.01, 23.4±3.19, 24.6±4.21 and 23.4±1.76 kg, respectively. Feeding was *ad libitum* and water was always available through low-pressure nipple drinkers. The trial lasted 14 weeks.

Measurements

Growth performance : To estimate average daily feed intake (ADFI), feed was pre-weighed and added regularly into the troughs such that the feed was available at all times during the day. The feed that was present before feeding at 0600 hours each day was treated as refusals of the previous day. The difference between the feed offered and the refusals was taken to be the ADFI for each pen. The pigs were weighed at 2 week intervals throughout the trial at 0530 hours on each occasion. The weights were used to compute the average daily body weight gain (ADG) for each 2-week period. Feed conversion ratio (FCR) for each pen was calculated as the proportion of the amount of feed consumed to gain a kilogram body weight.

Carcass traits : All the pigs were slaughtered after 14 weeks. The carcasses were put in a cold room at 0°C for 24 h after which the cold dressed mass (CDM) and length of carcass (CL) for each pig were determined. The CDM included the head, tail and the trotters. The CL was taken as the distance from the anterior edge of the first rib to the pubic bone. Each carcass was then cut at the last rib up to

the midline. Thickness of the backfat (BFT) was measured using a pair of vernier callipers at 50, 75 and 100 mm from the midline. These three positions were denoted as the K5, K7.5 and K10, respectively.

Statistical analyses

The relationships between the maize cob inclusion level (in g/kg) against ADFI, ADG and FCR were analysed using the PROC REG and the PROC CORR procedures of SAS (1998). Carcass characteristics for the four diets were compared using the generalised linear models procedure of SAS (1998).

RESULTS

Growth performance

Relationships between inclusion level of maize cobs and ADFI, ADG and FCR for the growing pigs are shown in table 2. There was no significant linear relationship ($p>0.05$) between level of maize cob inclusion and ADFI. The ADG decreased as the level of maize cobs increased ($p<0.001$). There was an increase in FCR as the level of maize cobs increased ($p<0.05$).

Carcass traits

The influence of maize cob inclusion level on CDM, CL and BFT measurements is shown in table 3. Increase in cob inclusion level decreased ($p<0.01$) CDM values. No differences ($p>0.05$) were observed in the CDM between pigs that were fed diets that had 0 and 100 g maize cobs/kg. In addition, pigs on 100 and 200 g maize cobs/kg diets produced the same CDM ($p>0.05$). Increasing the cob level from 0 to 200 g/kg did not influence CL values ($p>0.05$). The diet that contained 300 g maize cobs/kg had the lowest ($p<0.001$) CDM and CL values. All the BFT characters decreased ($p<0.05$) as the level of maize cobs increased. There were positive correlation coefficients between the K5 and K7.5 ($r=0.96$; $p<0.001$). Similarly, the correlation between K7.5 and K10 was significant ($r=0.97$; $p<0.001$). An increase in CDM was also associated with an increase in BFT ($p<0.001$). For example, the correlation coefficient between K7.5 and CDM was 0.84 ($p<0.001$). Although ADFI and BFT were not related ($r=0.37$; $p>0.05$), ADG and K7.5 values were positively correlated ($r=0.86$; $p<0.001$). In addition, there was a negative correlation ($r=-0.87$; $p<0.001$) between K7.5 and FCR.

DISCUSSION

The lack of relationship between maize cob inclusion level and ADFI was surprising. It does not conform to the commonly held notion that feeding a high fibre diet results in an increase in feed intake because of a reduced transit

Table 1. Ingredient and chemical composition (g/kg, as is) of the experimental diets

Ingredient (%)	Diets (g maize cob meal/kg)			
	0	100	200	300
Maize cob meal ¹	0	10	20	30
Sand	25.0	16.0	6.8	0
Milled white maize	43.4	36.4	35.8	29.7
Soyabean meal (44% CP)	19.5	18.3	17.8	18.2
Wheat bran	7.1	12.6	12.9	13.9
Meat and bone meal	5.3	5.2	5.1	5.0
Vegetable oil blend	0.2	1.0	1.0	2.6
Salt	0.2	0.2	0.2	0.2
Lysine-HCl	0.03	0.05	0.08	0.08
Methionine	0.05	0.05	0.08	0.08
Vit/min premix ²	0.35	0.35	0.35	0.35
Chemical composition (g/kg)				
Crude protein	163.7	158.8	166.7	170.1
Dry matter	915.7	902.8	918.0	892.9
Organic matter	632.0	687.2	818.2	833.8
Neutral detergent fibre	276.4	360.3	402.9	523.5
Acid detergent fibre	45.4	103.1	136.3	173.0
Hemicellulose ³	231.0	257.2	402.9	350.5
Ash	283.2	215.7	99.8	59.2

¹ Chemical analysis (% as is) of maize cob meal: dry matter=88.5, ash=7.3, crude protein=3.3, neutral detergent fibre=93.0, acid detergent fibre=57.3.

² The vitamin/mineral premix supplied by SAFCO Limited, Harare, Zimbabwe.

³ Hemicellulose was calculated as the difference between NDF and ADF.

Table 2. Relationship between maize cob level and average daily feed intake (ADFI), average daily body weight gain (ADG) and feed conversion ratio (FCR)

Parameter	Intercept	Regression coefficient	R ² value	Significance
ADFI	2.19	0.0009	0.23	NS ¹
ADG	0.65	-0.0005	0.67	*** ²
FCR	3.38	0.0045	0.42	* ³

¹ NS: not significant ($p > 0.05$), ² $p < 0.001$, ³ $p < 0.05$.

Table 3. Least square means on the effects of maize cob inclusion level (g maize cobs/kg) on cold dressed mass (CDM), carcass length (CL) and backfat thickness (BFT) in growing male pigs

Maize cob level	CDM (kg)	CL (mm)	BFT (mm)		
			K5	K7.5	K10
0	57.6 ^c	747.5 ^b	17.0 ^c	17.8 ^c	20.5 ^b
100	54.4 ^{bc}	726.3 ^b	14.0 ^{bc}	15.8 ^{bc}	19.3 ^b
200	51.9 ^b	712.5 ^b	10.3 ^{ab}	13.3 ^b	13.8 ^a
300	42.0 ^a	653.8 ^a	7.8 ^a	8.5 ^a	11.0 ^a

^{a,b,c} Values with similar superscripts in the same column are not different ($p > 0.05$).

time through the gut (Kennelly and Aherne, 1980; Agricultural Research Council, 1981; Whittemore, 1993) and that pigs compensate and maintain a certain level of

digestible energy intake (Frank et al., 1983). It is therefore, probable that the compensatory effect is only effective in diets with NDF levels that are lower than those used in this study since higher fibre levels depress palatability and, consequently, feed intake. Alternatively, it could be that although increasing intake of high fibre diets is limited by gut capacity (Van Wieren, 2000), the crossbreds may have relatively large small and large intestines as was found to be the case in the Mukota (Ndindana et al., 2001).

Although there was a concomitant decrease in ADG as level of maize cobs increased to 300 g/kg, there was no difference in CDM from 0 to 100 g cobs/kg. The similarity may indicate that M × LW crossbred pigs can utilise dietary fibre to deposit body tissues. More importantly, the 100 and 200 g cobs/kg diets gave similar carcass weights, suggesting that these pigs can withstand about 400 g NDF/kg in their diets, without compromising carcass yield. Such findings imply that there is scope in feeding crossbred pigs with low quality feeds, which would promote pig production, particularly in smallholder areas. It is possible that the pigs inherited the ability to adapt to low plane diets from the indigenous Mukota pigs, which have been shown to adapt to diets containing high levels of fibre (Ndindana et al., 2001).

The negative relationship between maize cob level and ADG was not surprising and agrees with Close (1993). Lower ADG at high levels of fibre would translate to an

extended time for the pigs to reach market weight. The observed increase in FCR as the level of cobs increased can be attributed to the lower efficiency of utilising fermentation energy obtained from the fibre and the loss of most of the energy as heat energy (Argenzio and Southworth, 1974; Van Wieren, 2000).

Besides body conformation, determining the extent of deposition of body fat is another way of assessing carcass quality for pigs (Holness, 1991). Fat deposition can be estimated by determining thickness of subcutaneous fat. The K7.5 position is the one that is used in Zimbabwe. All positions, K5, K7.5 and K10, showed that increasing levels of maize cobs in the diet produced leaner carcasses. This agrees with Whittemore (1993), who showed BFT to be inversely proportional to increase in fibre level. The positive correlation between CDM and BFT implies that keeping the crossbred pigs for extended periods of time will reduce the carcass quality, which would lead to downgrading of carcasses. More work should focus on designing breeding programmes that will ensure that the indigenous stock is conserved, for it to be successfully utilised in crossbreeding.

IMPLICATIONS

The inclusion of maize cobs in diets of Mukota × LW F₁ crossbreed male pigs did not affect ADFI, but reduced ADG and feed conversion efficiency. There were no differences in CDM and BFT in pigs that were fed 0 and 100 g cobs/kg. The 200 g maize cobs/kg diet did not reduce carcass quality.

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