Trop. Anim. Prod. Invest. 14 (1): 18-23 (2011)
ISSN: 1115-2540
http://animalsci.agric.ui.edu.ng/TAPI/index.php/tapijournal/index

ORIGINAL RESEARCH ARTICLE

Evaluation of carcass quality of N'dama yearlings fed varying levels of oil palm slurry

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ABSTRACT

This experiment was conducted to evaluate the carcass quality of N'Dama yearlings fed varying levels of oil palm slurry (OPS). Sixteen N'Dama yearlings were randomly assigned into four treatment groups (4/animals per group) and fed Panicum maximum supplemented with 0%, 10%, 20% and 30% OPS replacing wheat offal as treatments I, II, III and IV respectively. Three animals per group were slaughtered after 180 days of feeding to evaluate the carcasses for dressing percentage (DP), meat colour (MC), shear force (SF) and meat to bone ratio (MBR). The DP (%) of yearlings on treatment I (40.86) and IV (43.45) were similar and significantly lower than those on treatments II (49.19) and III (50.99) respectively. The scores for MC and SF for yearlings on treatments II, III and IV were similar and ranged from 6.00-7.00 and 5.03-5.27 respectively. However, these scores were significantly (P<0.05) higher than corresponding scores for MC (4.00) and SF (4.23) in treatment I. The MBR (5.56-12.50) increased significantly from treatments I to III after which it decreased to 7.69. Oil palm slurry can replace up to 20% of wheat offal in yearling diets with improvement in carcass quality.

Keywords: Carcass quality, N'Dama yearlings, Oil palm slurry, Dressing percentage, Meat to bone ratio

INTRODUCTION

Meat is an excellent source of high quality protein, and it also contains large amount of minerals and essential B vitamins. Among the domesticated animals in Nigeria, cattle remains the supplier of the bulk of meat consumed. Beef is acceptable in most parts of Nigeria, where it is either consumed after cooking or processed into other forms like Kundi, Kilishi, Suya e.t.c. (Ogunsola and Omojola, 2007, Igene *et al.,* 1990). Beef cattle in Nigeria are mostly in the hand of Fulani pastoralists who are accustomed to extensive management system (Adamu and Alawa, 2005). This system is characterized by inadequate nutrition and hence low quality beef and beef products. In addition, these animals cannot express their genetic potential under inadequate nutrition. Variations in cattle carcasses are mainly due to sex, age and nutrition. Out of these, nutrition plays a significant role. For Nigeria beef industry to survive, adequate nutrition is essential for cattle through supplementation. The supplements must add value to carcass in terms of quantity and quality. In view of this, carcass quality of N'Dama yearlings fed various levels of oil palm slurry (OPS) was evaluated.

MATERIALS AND METHODS

Twelve (12) yearlings of N'Dama cattle fed the different levels OPS were used for the evaluation. Three animals per treatment were slaughtered after 180 days of feeding the diets. The average age of these animals was 12.67± 1.02 months with average live weight that varied between 128.50 and 158.33 kg. The animals were starved for sixteen hours and weighed before slaughtering. The slaughtering was done at the Department of Animal Science, University of Ibadan abattoir. Gross composition and chemical composition of supplementary diets fed are as shown in Tables 1 and 2

Slaughtering method

The animals were immobilized before slaughtering. Immobilization involved lying the animals down and tying up their limbs with rope. This was followed by killing that involved the cutting of the neck blood vessels that allowed the bleeding of as much as possible blood from the carcasses. After bleeding the animals, the heads were removed from the carcasses. This was followed by the removal of the legs (shank) and then initiation of hide removal. After skinning off the hides, the carcasses were opened and the abdominal viscera (intestine, stomach) were removed. After this, the carcasses were sawed or split into two sides (Strydom *et al.,* 2000a).

CARCASS MEASUREMENTS

Dressing percentage

After slaughtering and dressing of the carcass, the hot carcasses weights were taken and the dressing (%) calculated as described by Ukah *et al. (*2006).

Chilling loss

The semi-tendinosus muscles were used for the determination of the chilling loss. 30gms of the muscle was kept in a refrigerator at 4^0C for 24 hrs.

Table 1: Gross composition of supplementary diets fed to N'Dama calves

OPS Level (%) Ingredients (kg)	0	10	20	30
Palm kernel cake	15.00	15.00	15.00	15.00
Dried Brewer's Grain	30.00	30.00	30.00	30.00
Wheat Offal	53.00	43.00	33.00	23.00
Sun-dried OPS	0.00	10.00	20.00	30.00
Limestone	1.00	1.00	1.00	1.00
Premix	0.25	0.25	0.25	0.25
Salt	0.75	0.75	0.75	0.75
Total	100	100	100	100

OPS = Oil Palm Slurry

The initial weight of the muscle was taken before chilling and after 24 hrs of chilling, the samples were reweighed and chilling loss calculated as described by Ukah *et al.* (2006).

Shear force

Five cores (1.0 cm^2 in diameter) were removed from cooked semi membranosus muscle using coring machine from five standardized locations (central, dorsal, medial, ventral, and lateral). Each core was sheared by Warner-Bratzler shear force instrument perpendicular to the orientation of the muscle fibres (Ukah *et al.*, 2006).

Meat: Bone ratio

The carcasses were manually separated into muscles (meat) and bones. The bones and the muscles were weighed separately and the meat to bone ratio was calculated (Ukah *et al*., 2006)

Meat colour

Beef meat colour is the colour of the rib eye muscle (*Longissimus dorsi*). It was assessed on the 12^{th} -13^{th} rib interface and scored against the Canadian colour reference chart.

Rib eye area

Rib eye area is the area of the surface of *M. Longissimus dorsi* at the ribbing site between 12^{th} and 13^{th} ribs and was measured by tracing on an acetate paper and its area calculated in square centimeters using a graph sheet (Ukah *et al.*, 2006).

RESULTS

Carcass weight, dressing percentage, rib eye area and meat to bone ratio

The carcass weight, dressing percentage and rib eye area of N'Dama yearlings fed varying levels of OPS is shown in Table 3. The carcass weight increased from 52.60kg for 0% OPS to 78.07kg for 20% OPS after which it decreased to 59.17kg (30% OPS). The dressing percentage followed the same trend. The animals with the highest carcass weight (20% OPS) also had the highest dressing percentage. The rib eye area of 76.60cm^2 for 20% OPS inclusion level was the highest and was significantly ($P<0.05$) different from other inclusion levels. While the values for 10% and 30% OPS levels were similar they were significantly ($P<0.05$) different from the control that had the least rib eye area value of 44.00cm^2. The meat to bone ratio was highest at 20% OPS inclusion level and was significantly ($P<0.05$) different from 0%, 10%, and 30% OPS inclusion levels.

Physical characteristics

The physical characteristics of the dressed N'Dama yearling carcasses are shown in Table 4. The scores for meat colour ranged from 4.00 to 7.00. The values obtained for 10%, 20% and 30% OPS inclusion levels were similar ($P>0.05$), they however differ significantly ($P<0.05$) from the control that had the least valve of 4.00. The results of the shear force had the same trend as the meat colour. The values obtained for chilling loss were similar ($P>0.05$), but numerically lowest for 20% OPS inclusion level.

External offals

Table 5 shows the proportion of the external offal to the live weight of the yearling N'Dama fed varying levels of OPS. The result showed that the proportion of head was similar ($P>0.05$) for 10% (6.32%), 20% (6.01) and 30% (6.14) inclusion levels of OPS respectively but significantly differently ($P<0.05$) from the control (0% OPS). The animals that had the highest slaughtered weight also recorded the highest external offals.

Internal organ

The proportion of internal organ to the live weight is shown in Table 6. There was no significance difference ($P>0.05$) for the values obtained for the liver, kidney and spleen for various inclusion levels of OPS, however, the values for the large intestine were similar up to 20% OPS inclusion level, but significantly ($P<0.05$) higher than 30% OPS inclusion level. The proportion of the small intestine was similar for all the inclusion levels of OPS.

Table 2: Chemical composition of the supplementary diets and forage (g/100g DM)

OPS Level (%)	0	10	20	30	*P. maximum*
Dry matter	92.85	92.98	93.21	94.01	27.18
Crude protein	18.40	17.17	14.92	12.40	2.39
Crude fibre	13.03	13.99	15.66	17.78	10.06
Ether extracts	4.32	13.96	30.52	28.20	2.45
Nitrogen free extract	43.90	34.77	29.07	23.36	9.78
Total ash	13.12	13.09	12.29	12.27	2.50
Neutral detergent fibre	33.26	34.14	36.12	44.05	50.00
Acid detergent fibre	25.26	28.50	30.11	30.18	19.11
Acid detergent lignin	12.00	14.14	15.18	17.01	11.08
Gross energy (kcal/kg)	3.41	3.41	4.27	4.93	1.17

OPS = Oil Palm Slurry

DISCUSSION

Dressing percentage, carcass weight and rib-eye-area

The dressing percentage of N'Dama yearling fed OPS improved from 40.86% to 50.99%. This could be an economic advantage to beef industry. Despite being young animals, their dressing percentage fell within the range of 48-55% reported for zebu steer by Adebowale *et al* (1986). These values also compared favourably with 50-55% reported by Purchas *et al* (1992) for exotic breeds. It is however, slightly below 52% that was considered to be standard (Zhou *et al.*, 2001). As the animals increased in age coupled with supplementation of OPS, they could reach the standard values of 52% even before maturity (3yrs). Dressing percentage is most important in determining the final income per animal slaughtered in markets where trading involves whole carcass. Therefore, OPS is an ingredient that can be used to finish young calves so that they can reach market weight within a short period of time. The area of the rib eye is a good predictor of cut-out. The values for the rib-eye area obtained for yearling N'Dama cattle increased as OPS increased in their supplemental diets. All the values apart from the control were higher than 42.5cm^2 reported for Cindali cattle. It was also higher than 51cm^2 at the age of 2 years for Friesian and Jersey breeds reported by Barten *et al* (1994). The result indicated that OPS inclusion in N'Dama diet improved the cut-out value of their carcass. In this case 20% OPS inclusion gave the highest value of 76.60cm^2 and could represent economic advantage on a weight based marketing system (Strydom *et al.*, 2000a, b)

Meat to bone ratio

It is the prediction of meatiness of carcass and therefore the higher it is, the better for beef industry. The OPS-based supplements had higher meat to bone ration. This is an indication that OPS favoured muscular formation than bone formation.

Physical characteristics

Meat colour

Appearance of meat as displayed had a major influence on the consumers when meat is purchased at retail (Van Oseckel *et al.,* 1999). Most consumers have a concept of the proper appearance of meat from any given species, and any significant deviation from that colour will be discriminated against. The result of this study showed that the colour of meat obtained from yearlings fed the OPS-based supplements were the same with the control. While the animals fed OPS-based supplements fell within the reported readily acceptable colour of bright cherry red (6) and moderately dark red (7) the control (4) was pale red and fell below the standard. This was probably due to increasing oxidative metabolism and muscle formation which favoured the formation and the increased myoglobin that causes redness (Robert, 1975).

Table 3: Dressing percentage, carcass weight and rib eye area of N'Dama yearlings fed varying levels of oil palm slurry

OPS Level (%) Parameters	0	10	20	30
Age at slaughter (mths)	12.67	12.67	12.67	12.80
Live weight at slaughter	128.50^{c}	145.50^{b}	158.33^{a}	136.00^{bc}
Carcass weight (kg)	52.60^{b}	74.20^{a}	78.07^{a}	59.17^{b}
Dressing percentage (%)	40.86^{b}	49.19^{a}	50.99^{a}	43.40^{b}
Rib-eye area (cm^2)	44.00^{c}	58.00^{b}	76.00^{a}	55.00^{b}
Meat to Bone Ratio	5.56^{c}	10.84^{a}	12.50^{a}	7.69^{b}

OPS = Oil Palm Slurry

Means in the same row with different superscripts differ significantly ($p<0.05$), SEM = Standard Error of Mean

Table 4: Physical characteristics of dressed carcasses of N'Dama yearling

Treatments	I	II	III	IV	
OPS Level (%)	0	10	20	30	SEM
Parameters					
Colour	4.00[b]	7.00[a]	7.00[a]	7.00[a]	0.50
Shear force (kg/ cm^3)	4.23[b]	5.03[a]	5.09[a]	5.27[a]	0.13
Chilling loss	5.00	5.00	4.70	5.00	0.20

OPS = Oil Palm Slurry

Means in the same row with different superscripts differ significantly ($p<0.05$), SEM = Standard Error of Mean

Table 5: Proportion of external offal to live weight of yearling N'Dama cattle fed varying levels of ops-based diet

Treatments	I	II	III	IV	
OPS Level (%)	0	10	20	30	SEM
Head	5.05[b]	6.32[a]	6.01[a]	6.14[a]	0.21
Skin	4.82[d]	6.87[b]	7.59[a]	5.56[c]	0.15
Leg	2.96[a]	3.29[a]	3.16[a]	3.16[a]	0.11
Tail	0.86[b]	1.58[a]	1.67[a]	1.57[a]	0.10

OPS = Oil Palm Slurry

Means in the same row with different superscripts differ significantly ($p<0.05$), SEM = Standard Error of Mean

The inclusion of OPS in N'Dama yearlings supplement improved the carcass colour to the acceptable colour range (6-7) cherry red of meat in Nigeria (Okubanjo and Aziza, 1986). The inclusion of OPS in young ruminant diets could assist the beef industry in bringing this animal meat into the acceptable retail colour.

Shear force

Meat tenderness is one of the major palatability factors that is affected by the age of animals. Meat from the carcass of relatively young animals is tenderer than that from older animals because the connective tissues of young animals are more easily broken down during cooking than the connective tissues from older animals. The observed difference in the carcass shear force values of N'Dama yearling fed OPS supplemental diets and the control was an indicator of treatment effects on the beef. The OPS-based supplements produced beef which fell between range of 3 and 4.9 for intermediate beef (Miller et al., 2001) while the control produced a tender meat characteristic of young animals. The study showed that OPS based-diets influenced yearling beef favourably. This could assist in bringing young animals' meat to acceptable toughness within a short period of time as a result of the formation of more non-striated muscles resulting in decreasing inter-musclar collagen solubility (Savell *et al.*, 1989).

Chilling loss

Similarities in the chilling loss at different levels of OPS supplements could be as a result of the age and physiological state of the animals that ensured similar keeping qualities. This observation is consistent with earlier report of Omojola and Attah (2006) who observed similar chilling losses for animals of uniform age and physiological state. The low chilling losses could also be an economic advantage in the processing and marketing of fine flavoured, wholesome beef products.

External offal

In Nigeria, contrary to developed countries the external offal (head, skin, leg and tail) are suitable for human food and are consumed regularly. These offals increased with increasing levels of OPS in N'Dama yearling supplements. This is contrary to the report of Omojola and Attah (2006) who observed decreasing external offal with increasing slaughtered weight

Table 6: Proportion of internal organs of yearling N'Dama cattle (as percentage of slaughtered weight)

Treatments	I	II	III	IV	
OPS Level (%)	0	10	20	30	SEM
Heart	0.47[a]	0.43 [b]	0.38[b]	0.47[a]	
Liver	1.32	1.31	1.26	1.19	0.04
Kidney	0.47	0.41	0.44	0.46	0.02
Spleen	0.60	0.50	0.52	0.46	0.02
Lungs	0.85[a]	0.91[a]	0.96[a]	0.44[b]	0.03
Small intestine	3.00	2.70	2.07	2.07	0.09
Large intestine	2.00[b]	1.80[b]	2.93[a]	1.60[c]	0.04

OPS = Oil Palm Slurry

Means in the same row with different superscripts differ significantly ($p<0.05$), SEM = Standard Error of Mean

of male West African dwarf goats slaughtered at different weights. However, it is in agreement with the report of Richardson (2001) that observed an increase in the weight of external offals with increasing slaughter weight of growing cattle.

Internal offal

The internal offals are considered as excellent sources of many essential nutrients that are required for our daily need (Ikeme, 1990). The reduction in internal offals for the OPS-based supplements of yearling N'Dama cattle is contrary to the observations of Owen and Berger (1983) and Adegbuyi *et al.* (1979) that the internal offals of Red Sokoto and West African dwarf goats increased as external offals increased.

CONCLUSION

In the study, carcass qualities of yearling N'Dama were enhanced with the inclusion of oil palm slurry in their supplement. However, these qualities were enhanced most optimally by the 20% inclusion level. Therefore, oil palm slurry has the potential to be used as all year round dietary energy supplement to bring N'Dama cattle to marketable weight within a short period of time with good carcass qualities.

CONFLICT OF INTEREST

The authors agreed to the publication of this article without any conflict of interest whether personal, financial or otherwise.

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