Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.3, No.1, 2013

Effect of Fermented Liquid Feed on Boar Taint and Carcass Quality of Pigs

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Abstract
Twenty – four weaner pigs with an average initial weight of 11.51 ± 0.04kg were used to determine the effect of fermented liquid feed on boar taint and carcass quality of pigs. The Weaners were randomly divided into three treatment groups of four replicates having eight pigs per treatment, using a completely randomized design (CRD). The groups were fed one of three diets: Dry feed (DF), Non-fermented Liquid feed (NFLF) and Fermented Liquid Feed (FLF) for 9 months. The back fat of the pigs after slaughter were taken to the laboratory for analysis to determine the skatole/ indole level, while a portion was used for sensory evaluation/organoleptic test. There was a significant ($P < 0.05$) improvement in carcass quality (Boar taint) even without castration as a result of reduction in skatole production in the hind gut of those on fermented liquid feed and the non fermented liquid feed. The organoleptic test showed increased consumer likeness for the meat of those fed FLF probably because of absence of boar taint. The finding in this study shows that fermented liquid feed has the potential to make a significant contribution to the environment and food safety since it improves the carcass quality of pigs. This again may reduce the need for castration in pig production without loss of productivity.
Key words: Fermentation, Liquid feed, Pigs and boar taint,

1. Introduction

Boar odour is a complex phenomenon formed by several chemical reactions. The two compounds 5-androst-16en-3-on (androstenone) and 3-methylindole (skatole) are regarded as the main elements in boar odour (Bonneau, 1982). The reduction of boar taint due to skatole could decrease the risk and the number tainted carcasses. Skatole is formed in the large intestine as the result of the breakdown of tryptophan by microorganisms. Skatole presence in the intestine is not confined to boars; but due to greater metabolism of amino acids, boars have higher concentrations of skatole than females. As in the case of androstenon, skatole is found in the adipose tissue.

The NH_2 and NH_3 molecules are characteristics of the accumulation of tryptophan and skatole. Hofmann (1987) demonstrated that *Yucca schidigera* extract in the commercial feed additive product "De-Odorase" has ammonia binding capabilities. As such, the effects on aspects of boar taint were examined. The hypothesis for this approach was that skatole or NH derived from intermediary metabolism could be bound by the glycocompounds of the *Yucca* extract at the sit of origin (i.e., the large intestine) instead of eventual deposition in fat. Two trials examined whether boar odour due to skatole could be reduced through feeding De-Odorase. Because De-Odorase can be used as a feed additive, it was a further matter of interest to examine the effects of fermented liquid feed on carcass quality.

Castration of male pigs has been practiced for centuries in order to avoid the occurrence of boar taint, an unpleasant faecal or urine like odour that can be perceived when heating fat or meat from boar (Bonneah *et* a/, 1992). However, raising entire male pigs for meat production has considerable economic and welfare advantage. Adrostenone (5 androst-16-ene-3-one) and skatole (3-methylindole), two malodorous compounds stored in fat, are believed to be the main contributors to boar taint (Bonneah *et al.,* 1992). Skatole is a volatile compound produced by microbial degradation of tryotophan or, tryptophan-containing proteins in the gastrointestinal tract of several animal species (Jensen and Jensen. 1998). A fraction of the synthesized skatole is absorbed from the gut. In pigs-especially entire male pigs, skatole accumulates in adipose tissue, leading to severe reduction in carcass quality.

Case-control analyses of Danish pig herds have strongly indicated that herds using liquid feeding have a lower

skatole level in back fat of entire male pigs than herds using dry feeding (Kjeldsen, 1993). In order to substantiate these observations, experiments with liquid and dry fed pigs were carried out in two herds by the federation of Danish pig producer and slaughter houses (Kjeldsen, 1993). In herd 1 the dry fed pigs had a much higher skatole level in the back fat and correspondingly a rejection rate (skatole concentration in back fat above 0.20ppm) twice as high as the liquid fed pigs. In herd 2 however no difference in back fat skatole concentration or rejection rate were found between the liquid and dry fed pigs. These contradictory results were the background for a series of experiments carried out at the Danish Institute of agricultural sciences research centre foulum, with the aim of assessing how dry feed, liquid feed and fermented liquid feed could affect the production and deposition of skatole in back fat of entire male pigs (Jensen *et al.,* 1998). Although results from these experiments did not show conclusively how liquid feed affects skatole production, absorption and deposition in entire male pigs, the data strongly indicate that feeding pig fermented liquid feed rather than dry feed changes the microbial conversion of trytophan in the hind gut towards indole at the expense of skatole resulting in a lower skatole and *a* higher indole deposition in back fat. A possible explanation for these changes in skatole and indole production is the difference in the composition of the microflora found in the gastrointestina tract between pigs fed dry feed and fermented liquid feed.

2. Materials and Methods

2.1. Experimental Site

The experiment was carried out at the piggery unit of the department of Animal Science, Faculty of Agriculture and Natural Resources Management of Ebonyi State University, Abakaliki, Nigeria. Abakaliki is within 06004' and 080 65' E southeast of the derived savanna rainfall Nigeria in West Africa. The annual rainfall is about 170mm to 2060mm spread between April and November. The experimental site receives an abundant insulation from the sun with a maximum mean daily temperature of between *27* and 31° C (FDLR, 1985).

2.2. Experimental Animals/ Design

The experiment was conducted using a complete randomized design (Steel and Torrie, 1980). There were three treatments of eighteen animate replicated three times. Each of the treatment was fed with one of the three dietary treatments. The eighteen piglets between the ages of 8 - 9 weeks weighing 11.51 ± 0.04kg were used for the experiment. The Pigs were dewormed and quarantined for one week and were randomly assigned to experimental treatment.

They were then reared to slaughter age (28 weeks) and were not given any medication before or during the experimental period.

2.4 Dietary Treatments

They were three dietary treatments in the experiment. They dietary treatments are;

(a) Dry feed
(b) Non fermented liquid feed (NFLF) Fresh liquid feed).
(c) Fermented liquid feed

The feed was formulated with locally sourced materials/ ingredients that are cheap and affordable (Table 1). They were formulated to contain digestible energy of 14MJ/Kg and a comparable level of crude protein to meet the daily requirement of the pigs based on 10% body weight feeding (90% *ad libitum* intake) (Table 2). All other nutrients either met or exceeded NRC recommendations (NRC, 1998). However the protein level was reduced as the animal advanced in age.

2.5 Feed

The pigs were given *ad libitum* access to experimental diet from cemented dry meal feeding trough (1m long). Water was made available for consumption on concrete water troughs.

Non- fermented liquid feed (NFLF) was prepared daily by mixing the dry feed with water in a feed to water ratio of 1:2, while fermented liquid feed (FLF) was prepared by adding a strain of *Pediococus acidilactici* (PC – 81-11-02 Alltech) which was obtained by serial culturing on MRS medium (Oxford, Basingstoke, England) containing increasing concentration of *Pediococus acidilactici* to a non-fermented liquid feed. This gave a final concentration of between 6 and 7 log 10 CFU/ml liquid feed. This strain had previously been found to be an effective lactic acid bacteria (LAB) for fermenting liquid pig feed (Moran, 2001) as it produces more than 150mM lactic acid and less than 30mM acetic acid in 24 hours at 30^0C. the feed was then fermented in such a way

that a portion of it was left in the container to serve as the inoculums for the next day's feed.

2.6 Carcass Quality

At the end of the experimental period (28 weeks), two animals were slaughtered from each treatment and the carcass assessed while a portion was used for sensory evaluation/ organoleptic test. Samples were cut in cubes and heated in a pot on a hot plate. Carcass quality was assessed using a seven point scale by ten panelists who served as the assessors (Table 3). The attributes or factors tested include,

(a) Texture
(b) Boar taint
(c) Back fat thickness
(d) General Acceptability

2.7 Skatole/ Indole Level.

The back fat after slaughter was taken to the laboratory for analysis to determine the skatole/ indole level. Skatole or 3-methy indole is a volatile substance with an odour resulting from microbial degradation of tryptophane in the large intestine of several species including pigs. Skatole after absumption and distribution via the vascular system is stored at the adipose tissue, so that elevated concentrations are reached occasionally which may lead to adverse consumer reactions. This analysis was carried out using the HPLC methods as developed by Hillenbrand (2002). The adipose tissue sample was melted in microwave oven and 100ml of the liquid fat was dissolved in 1ml of n-hexana and extracted with aceonitiril water (75:25 v/v). A fluorescence detector was used for the quantification.

2.8 Statistical Analysis

All other data collected subjected to ANOVA and treatment means compared using F- SLD.

The statistical model is Xij = n + Ti + Eij

Where Xij = any observation.

u = population mean.
Ti = Treatment effect
Eij = Experimental error

3. Results.

Carcass quality

There was a marked reduction in skatole content ($P < 0.05$) of adipose tissue of boars given fermented liquid feed (Table 4) and the non-fermented liquid feed than those fed dry feed. Those on fermented liquid feed had 12.46g/kg in their skatole content which differed significantly ($P < 0.05$) from those on non -fermented liquid feed 23.07g/Kg, which again differed significantly ($P < 0.05$) from those on dry feed 26.37. The sensory evaluation showed a significant difference ($P < 0.05$) among the treatments in boar taint. The pigs on fermented liquid feed had the least value (1.20) in boar taint which did not differ statistically ($P < 0.05$) from those on non fermented liquid feed (3.90) but differed significantly from those on dry feed (5.00). The acceptability of the pork fed fermented liquid feed was therefore higher as reported by the panelists having the least value (2.11) that did not differ from those fed non fermented liquid feed (2.20) but differed significantly with those fed dry fed (3.40). The colour and texture of the meat showed no significant difference ($P > 0.05$) in all the treatment.

4. Discussion

4.1. Skatole and sensory evaluation

The marked reduction in the skatole content of the adipose tissue of boars given fermented liquid feed compared to those fed NFLF and DF is in agreement with the findings of Kjeldesen (1993) who indicated that in a case control analysis of Danish pig herds, herds using liquid feed have a lower skatole level in the back fat of entire males than herds using dry feed. A possible explanation for this change in composition of the microflora found in the gastrointestinal track between the pigs fed dry feed and fermented liquid feed is that feeding pigs fermented liquid feed rather than dry feed changes the microbial conversion of tryptophan in the hind gut towards indole at the expense of skatole resulting in a lower skatole and higher indole deposition in back fat (Jensen and Mikkelsen, 2001). The result of the sensory evaluation confirmed the above finding as there was a significant difference ($P<0.05$) in the boar taint and general acceptability in all the treatment. This again is in agreement with the findings of Ender *et al.,* (1993) who noticed that the reduction of skatole in the back

fat of entire male pigs slaughtered at 95kg body weight, considerably improved sensory score; and that of Close (1993) who also observed that high values of skatole in the back fat of entire male pigs led to complains of 'off' flavours and taste.

5. Conclusion

The control of meat quality is becoming increasingly important from both consumer and producer perspective. Feeding fermented liquid feed to pigs reduces the skatole content in the adipose tissue of boars, thus improving the sensory values without affecting the meat quality.

However there are a number of problems to be solved before this can be regarded as a commercial feeding system which can be generally adopted on commercial units. There include:

- Selecting appropriate lactic acid bacteria for use as inoculants to produce fermented liquid feed.
- Identifying nutrients and raw material constraints to be used in the formulation of diets which will be fermented.

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Table 1: Composition of The Experimental Diet.

Ingredients	Percentage inclusion (kg)
Maize by product (From pap)	40
Wheat offal	21.9
Bambra nut waste (dust from the mill)	15
Palm kernel cake	20
Bone meal	2.5
Premix	0.25
Salt	0.25
Synthetic lysine	0.1
TOTAL	100

Table 2: Proximate Composition of The Experimental Diet

Nutrient	Percentage composition
Crude Protein	20.8
Crude fibre	6.05
Ether Extract	4.05
Digestible Energy	14 MJ/ Kg

Table 3: Carcass Quality Evaluation Scale

Scale	Response
1	Like very much
2	Like moderately
3	Like slightly
4	Neither Like nor dislike
5	dislike slightly
6	dislike moderately
7	dislike very much

Table 4. Skatole Content (g/Kg), Back Fat Thickness (cm) and Sensory Evaluation of Pigs Fed DF, NFLF and FLF

Parameter	DF	NFLF	FLF	FLSD
Skatole g/kg	26.37[a]	23.07[b]	12.46[c]	1.12
Backfat thickness(cm) (cm)	2.60 [a]	2.70 [b]	2. 50 [b]	0.2
Sensory evaluation				
Colour	2.50	2.50	2.50	0.4
Boar taint	5.00 [a]	3.90 [b]	1.20[b]	0.71
Texture	4.60	3.60	3.40	0.7
General acceptability	3.40 [a]	2.20 [b]	2.11[b]	0.6

Means with different superscripts on the same row are significantly different (P< 0.05)

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