CAFOBIOS
Cameroon Forum for Biological Sciences

Cameroon Journal of Experimental Biology 2005 Vol. 01, N°01, 15-20.

Original article *Animal science*

Effect of castration and protein level of diet on the growth performance of piglets

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ABSTRACT

A study designed to investigate the effect of dietary protein level and castration on growth performance of weaner pigs was conducted using crossbred piglets (Large white x landrace) of forty days of age and 7,50 kg average live weight. A total of 24 piglets (12 castrated and 12 non castrated) were divided into 3 experimental treatments with four piglets per treatment. The treatments corresponded to three dietary crude protein (CP) levels of 14,26, 16,49 and 20,4 % CP. The main findings of the study showed that there was a linear increase in feed consumption with increasing levels of protein in the diet. Irrespective of treatment, uncastrated piglets consumed more feed than castrated piglets. Increase in the dietary crude protein level and castration were observed to significantly ($P<0,05$) improve the mean daily weight gain. The feed efficiency increased with increasing protein level in the diet. The cost of feed needed to produce one kg of live weight decreased with increasing protein level in the diet. This cost was 9,60 and 16,76% lower for the 16,49% dietary treatment and 20,4% dietary treatment respectively as compared to the control treatment. Taking into consideration management conditions of MALO farms, the ration with 20,4% CP having a calorie-protein ratio of 216,34 seems to be the optimum feed. From the results of this study, it can be concluded that castration and high protein in the diet seems to improve the growth performance of piglets.

Key words: Protein, castration, growth performance, piglet.

RESUME

Une étude portant sur l'investigation de l'effet du niveau de protéine de la ration alimentaire et de la castration sur les performances de croissance des porcelets sevrés a été conduite. Ces porcelets étaient des hybrides issus du croisement Large White x Landrace âgés de 40 jours et avaient un poids moyen de 7,50 kg. Un total de 24 porcelets (12 castrés et 12 non castrés) ont été divisés en 3 groupes avec 4 porcelets par traitement. Les traitements correspondaient à 3 niveaux de protéines brutes (PB) dans la ration alimentaire (14,26 ; 16,49 et 20,4 % de PB). Les principaux résultats de cette étude ont montré une augmentation linéaire de la consommation alimentaire avec l'augmentation du niveau de protéines de la ration. Indépendamment du traitement, les porcelets non castrés ont consommé plus d'aliment que les porcelets castrés. L'augmentation du niveau de protéine brute de la ration et la castration ont eu une amélioration significative ($P<0,05$) du gain moyen quotidien. L'efficacité d'utilisation alimentaire a augmenté avec l'augmentation du niveau de protéine de la ration. Le coût de production de l'aliment nécessaire pour produire 1 kg de poids vif décroît avec l'augmentation du niveau de protéine de la ration. Ce coût était respectivement de 9,60 et 16,76 % plus faible pour les rations qui avaient 16,49 % et 20,4 % comparé à la ration contrôle. Considérant les conditions de gestion dans la ferme MALO, la ration avec 20,4 % de PB avec un rapport Energie/protéine de 216,34 semble être l'aliment de référence. Des résultats de cette étude, on peut conclue que la castration et le niveau élevé de la protéine alimentaire semblent améliorer les performances de croissance des porcelets.

Mot clés : Protéine, castration, performance de croissance, porcelet.

INTRODUCTION

The gap between the demand for and the supply of high quality protein-rich livestock products to improve the nutritional status of Cameroonians is ever widening [1]. In Cameron, like in most other developing countries, this gap is bringing about the massive importation of animal products, which has been increasing by about 10% annually for these countries [2]. For instance in Cameroon, the importation of frozen chicken, rose from 900 tons in 1996 to 24000 tons in 2003 [3].

The pig industry as well as other highly prolific livestock such as poultry, rabbits and minilivestock with a short generation interval could considerably contribute in reducing this protein gap. However, this has not been the case as the threat of protein nutritional stress dangles on. Although a number of management/production variables are known to influence the ability of these animals to achieve a high level of productivity, nutrition is evidently [4], the most limiting variable. This is the case in developing countries like Cameroon where feeding standards for formulation of rations have often depended on nutritional studies carried out in the socio-economic and technical environment of the developed world. The protein level of the diet is particularly implicated as the importance of protein to the growth of animals, especially young animals like piglets is widely recognised [5, 6, 7]. Although a study by Balogun *et al.*, [8] has indicated a range of 14.18-17.40 % of dietary crude protein in the diet of pigs the semi-arid zone of Northern Nigeria and another by Manjeli *et al.*, [1] has reported a range of 20.17 - 20.55% for piglets in the Forest zone of Cameroon, much information on nutritional studies is still needed in order to improve pig nutrition in the country

On the other hand, castration can considerably improve feed efficiency due to possible reduction of additional reproductive requirements normally incurred by

uncastrated animals. Indeed, Laborde, [9] and Tchoumboue *et al.*, [10] observed that nutrition of the male targets at the same time growth and reproduction. An elimination of the reproductive development needs of a male animal could improve the chances of growth for that animal given the same level of feeding. The present study was designed to investigate the effect of dietary protein level and castration on the growth performance of weaner pigs.

MATERIALS AND METHODS

Experimental Animals And Location

The study was conducted at the Malo farms, Edea situated in the forest zone of Cameroon. During the period of the study, (24 th June to 26 th July 2004) the mean daily temperature was 26 °C while the relative humidity was 70 %. The experimental house was an open-sided building (2 metres high) with concrete floor divided into four large pens of 6 m^2 each. Each pen was further subdivided into 12 compartments corresponding to a space allocation of 0.5 m^2 per piglet. A total of 24 weaned male piglets (12 castrated and 12 uncastrated) of the Large white x Landrace, crosses with an average weight of 7.05 kg and 30-35 days of age were used in the study. Animals were identified using ear-tags.

Feeding trial

Three experimental diets, R0, R1 & R2 corresponding to the respective crude protein levels in the diet of 14.26, 16.49 and 20.40 % were used in the study. The percentage and proximate chemical composition of the diets determined according to the methods described by A.O.A.C [11] is shown in Table 1.

Animals were randomly allotted to two groups of 12 piglets each (castrated and uncastrated group). Castration was done two weeks before the beginning of the study. Piglets of each group were subdivided into three groups of 4 piglets each corresponding to the respective crude protein levels in the diet. There was a progressive replacement of the traditional weaning diets of the farm with the experimental diet during the stabilisation period of 7 days for piglets of treatment R1 and R2 while for Ro the traditional weaner diet was maintained as control diet for the period of the study. Animals were fed and watered *ad libitum* and subjected to the prophylactic treatment programme shown in Table 2.

The study lasted for 30 days. Meanwhile all the piglets for treatment Ro were eliminated after 21 days of the study due to an outbreak of African swine fever. Piglets of treatments R1 & R2 did not seem to be affected during the length of the study of 30 days.

Data collection and statistical analysis

Live weight and feed measurements for animals were done using a simple spring balance with a 0.50g precision. Measurements of live weights were done weekly while the feed consumed were measured indirectly and daily by weighing the feed given and leftovers.

Due to the outbreak of African swine fever in the region within the period of the study carcass evaluation was done indirectly by taking measurements of body dimensions. Measurements for backfat thickness were done by piercing between 30-35mm either way of the vertebral column with a metallic wire until resistance was met corresponding to contact with nerve sensitive tissue and manifestation of discomfort by the piglets. Meanwhile measurements were made for height at withers, height of sternum from the ground, heartgirth and the length of the rump using a graduated ruler and tape.

Table1: Percentage and proximate composition (% DM basis) of the experimental diets

Ingredients	Experimental diets		
	R0	R1	R2
Maize	53,50	39,00	39,00
Wheat bran	18,70	39,00	23,00
Soya bean cake	13,40	8,50	20,00
Palm kernel cake	13,40	-	-
Fish meal	-	7,00	7,00
Palm oil	-	5,50	10,00
Premix*	0,50	0,50	0,5
Salt	0,50	0,50	0,5
Nutritive value			
DM (%)	90,20	92,00	96,5
Crude protein (%)	14,26	16,49	20,40
Ether extract (%)	3,90	11,64	15,82
Nitrogen free extracts (%)	67,44	57,26	49,33
Crude fibre (%)	8,04	5,20	5,90
Energy (kcal/kg)	3596,90	4088,90	4413,32
Ash (%)	6,35	9,41	8,53
Ca (%)	0,44	0,41	1,19
P (%)	0,39	0,55	0,36
Calorie-protein ratio	252,23	247,96	216,34

* one kg of premix contains: Vitamins A-2.400.000 I. U., D3-480.000 I. U., E-3.000mg, K3- 400mg, B1-200mg, B2 1.000 mg, B3- 2.000 mg, B6- 200mg, PP- 8.000 mg, B12- 4 mg, Chlorure de choline- 60.000mg, Manganese-16.000 mg, Cobalt- 30 mg, Zinc-12.000 mg, selenium-50mg, Iodine-200 mg, Copper-2.000 mg, Iron- 10.000 mg, DL Methionine- 150.000 mg, L Lysine-100.000mg, Flavophospholipol- 400 mg, Antioxidant-5.000 mg, Calcium-19%. DM= Dry matter

Table 2: Prophylactic program used for the piglets

Days	Intervention	Products used
Day 1	Anti-stress + vaccine against Erysipelas	Stress vitam + Rouvax
Day 2 & 3	Anti-stress	Stress vitam
Day 10	Antibiotics against Collibacillus	Oxytetratcycline
Day 14	Second vaccine against Erysipelas	Rouvax
Day 30	Antibiotics against Collibacillus	Oxytetratcycline

The following parameters were computed, feed intake, daily weight gain and the feed conversion ratio. The feed cost necessary for the production of one kilogram of live weight was computed by multiplying the cost of feed for one kg of each diet with the feed conversion ratio. The prices of ingredients at the local market, at the time of the study were used to calculate the feed cost.

The data collected were subjected to analysis of variance while significant means were separated using the Student-Newman-Keuls procedure [12].

RESULTS

Feed intake

The feed intake as reflected by the level of protein in the diet (Table 3), showed an increase in feed intake with increasing level of proteins in the diet irrespective of castration. Within the first 21 days of the study, this increase was to the order of 13.33% between the control diet and diet R1 and 16.09% between the control diet and diet R2. These differences were not significant (P>0.05). The increase in feed intake between R1 to R2 at 28 days of study was 4.22%.

Table 3 : Effect of castration and protein level of diet on the feed consumption of piglets.

Diets & state of piglet	Feed consumption (g/day)	
	21 days	28 days
R0		
Castrated	438,00 ± 4,00^{a}	-
Intact	432,00 ± 6,00^{a}	-
Mean 0	435,00 ± 0,00^{a}	-
R1		
Castrated	493,00 ± 4,00^{a}	725,25 ± 194,84^{b}
Intact	492,00 ± 3,00^{a}	777,50 ± 212,19^{b}
Mean 1	493,00 ± 7,00^{a}	762,36 ± 189,28^{b}
R2		
Castrated	501,00 ± 8,00^{a}	793,25 ± 212,06^{b}
Intact	509,00 ± 6,00^{a}	795,90 ± 209,00^{b}
Mean 2	505,00 ± 7,00^{a}	794,57 ± 194,92^{b}
Mean (0+1+2)		
Castrated	477,00 ± 9,00^{a}	770,25 ± 190,00^{b}
Intact	478,00 ± 2,00^{a}	786,68 ± 195,30^{b}
Mean (Castrated & Intact)	478,00 ± 5,00^{a}	778,46 ± 192,70^{b}

^{a}; ^{b}: means(± s.e.) bearing different superscripts within the same column or row differ significantly (P<0,05)
R0=14, 26 % Dietary Crude protein (CP),R1=16,49 %CP, R2=20,40 %CP

When castration is considered and independent of the level of protein in the diet, uncastrated piglets consumed about 0.22 % more feed than castrated piglets although this difference was not significant. The same trend was observed with the extension of the study to 28 days for R1 and R2.

Growth performance

The influence of castration and dietary protein level is shown in Table 4. Independent of the state of the animal, the Mean Daily Weight Gain (MDWG) increased significantly (P<0.05) with an increase of the level of protein in the diet. As a result piglets of the diet with 20.4% CP (R2) had a MDWG of 52.25% higher than the value for the control diet while treatment R1 (16.49% CP) was 22.86 % as compared to the control diet (14.26% CP).

Irrespective of the diet and period of study, castrated piglets recorded an increase of 20.87 % in MDWG as opposed to uncastrated piglets. The highest within treatment differences between castrated and uncastrated piglets was observed with the control diet. This difference was significant (P<0.05).

Table 4: Mean daily weight gain (g/d/piglet) of piglets as a function of castration and protein level in the diet.

Diets & state of piglet	Mean daily weight gain (g/d/piglet)	
	21 days	28 days
R0		
Castrated	226,00 ± 122,37^{b}	-
Intact	120,97 ± 69,98^{c}	-
Mean 0	173,48 ± 106,10^{c}	-
R1		
Castrated	229,72 ± 123,83^{b}	261,54 ± 19,30^{b}
Intact	220,90 ± 59,40^{b}	307,81 182,03^{b}
Mean 1	224,90 ± 86,88^{b}	284,67 ±144,60^{b}
R2		
Castrated	377,95 ± 78,47^{a}	435,21 ±131,23^{a}
Intact	348,67 ± 121,95^{a}	444,50 ±216,00^{a}
Mean 2	363,30 ± 93,10^{a}	439,86 ±165,52^{a}
Mean (0+1+2)		
Castrated	277,89 ± 121,39^{a}	348,37 ±48,65^{ab}
Intact	229,90 ± 24,90^{ab}	376,1 ±198,80^{ab}
Mean (Castrated & Intact)	253,89 ± 23,15^{ab}	362,26 ± 35,05^{ab}

^{a}; ^{b}: means(± s.e.) bearing different superscripts within the same column or row differ significantly (P<0,05)
R0=14,26 % Dietary Crude protein (CP), R1=16,49 %CPR2=20,40 %CP

Feed conversion ratio (FCR)

The FCR as reflected by the dietary protein level and castration (Table 5) shows that the feed efficiency was significantly affected by the protein level of the diet whether piglets were castrated or not. Significant values (P<0.05) for these parameters were recorded for the control diet as opposed to R1 and R2, which were comparable (P>0.05). When consideration was given to castration, the FCR was lower for castrated than uncastrated piglets for the first 21 days of the study while for a longer period of 28 days the trend was reversed. A significant (P<0.05) within treatment difference between castrated and uncastrated piglets was only observed between diets R1 for the 28 days period of study.

Table 5: Effect of castration and protein level of diet on the feed conversion ratio of piglets.

Diets & state of piglet	Feed conversion ratio	
	21 days	28 days
R0		
Castrated	3,24 ± 0,74[b]	-
Intact	4,79 ± 3,10[a]	-
Mean 0	4,01 ± 2,19[a]	-
R1		
Castrated	3,43 ± 1,04[b]	3,03 ± 0,15[b]
Intact	3,19 ± 0,29[b]	2,24 ± 0,78[c]
Mean 1	3,30 ± 0,70[b]	2,94 ± 0,90[b]
R2		
Castrated	1,89 ± 0,42[c]	1,97 ± 0,25[c]
Intact	2,50 ± 1,19[b]	1,64 ± 1,13[c]
Mean 2	2,19 ± 0,72[c]	1,80 ± 0,77[c]
Mean (0+1+2)		
Castrated	2,85 ± 0,99[b]	2,49 ± 0,96[bc]
Intact	3,49 ± 1,96[b]	1,94 ± 0,96[c]
Mean (Castrated & Intact)	3,17 ± 1,47[b]	2,21 ± 0,96[bc]

[a, b c]: means(± s.e.) bearing different superscripts within the same column or row differ significantly (P<0,05)
R0=14,26 % Dietary Crude protein (CP), R1=16,49 %CPR2=20,40 %CP

Carcass measurements

Values for back fat thickness and other body measurements (Table 6) were higher for diet R2 and R1. The above percentage difference between these two treatments, for this values were 25.50 %, 5.68%, 4.11% 18.52% and 9.59%, for back fat thickness, height at withers and sternum, heart girth and rump length. Castration was observed to affect the height at withers and the heart girth as higher values for these parameters were obtained with uncastrated piglets, whereas values for the height of sternum from ground and rump length were comparable. The highest difference between these parameters between treatment R1 and R2 was observed when castrates were compared.

Feed cost

The cost of feed required to produce a kilogram of live weight as reflected by the dietary protein level and castration is shown in Table 7. The results show a drop in cost of feed for the production of 1 kilogram live weight by 9.6% and 16.76 % for R1 and R2 respectively as opposed to the control diet. The cost of feed needed to produce one kilogram live weight seemed to be affected by castration.

Table 6 : Effect of castration and protein level of diet on carcass measurements of piglets

Diets & state of piglet	Carcass measurements				
	BFT	HW	HSG	HG	RL
R1					
Castrated	19,00 ± (1,00)	38,00 ± (2,00)	18,50 ± (0,50)	59,00 ± (3,00)	18,00 ± (1,00)
Intact	21,00 ± (1,50)	42,50 ± (0,50)	18,00 ± (1,50)	62,50 ± (0,50)	18,50 ± (0,50)
Mean 1	20,00 ± (1,25)	44,00 ± (1,25)	18,25 ± (1,00)	60,75 ± (1,70)	18,25 ± (0,75)
R2					
Castrated	26,25 ± (0,25)	47,00 ± (1,00)	18,50 ± (0,50)	71,50 ± (0,50)	20,50 ± (0,50)
Intact	24,00 ± (1,00)	47,00 ± (2,00)	19,50 ± (0,50)	72,50 ± (0,50)	19,50 ± (0,50)
Mean 2	25,12 ± (0,75)	47,00 ± (1,50)	19,00 ± (0,50)	72,00 ± (0,50)	20,00 ± (0,50)
Mean **(1+2)**					
Castrated	22,62 ± (1,08)	42,50 ± (1,33)	18,50 ± (0,50)	65,25 ± (1,75)	19,25 ± (1,75)
Intact	22,50 ± (1,25)	44,75 ± (1,25)	18,75 ± (1,25)	67,50 ± (0,50)	19,00 ± (0,50)

BFT : Backfat thickness ; HW: height at withers ; HSG: height of sternum from ground ; HG : heart girth ;
RL: rump length; (&) = standard deviation
R1=16,49 % Dietary Crude protein, R2=20,40 %CP

Table 7: Feed cost (in CFA) necessary for the production of one kilogram of live weight of piglets

Duration (days)	Diets & state of piglet											
	R0			R1			R2			Overall mean		
	Castrated	Intact	Mean 0	Castrated	Intact	Mean 1	Castrated	Intact	Mean 2	Castrated	Intact	Mean
21 d	517,10	765,4	647,2	608,1	565,6	585,1	484,6	543	538,7	536,6	624,7	580,6
28 d	-	-	-	537,2	403,5	521,2	492,8	455,9	414,1	529,2	429,7	479,5
Mean	517,1	765,4	647,2	572,6	484,4	553,1	488,7	499,4	476,4	532,9	527,2	

R0=14,26 % Dietary Crude protein (CP), R1=16,49 %CPR2=20,40 %CP

DISCUSSION

Feed intake (FI)

Values for FI observed in this study irrespective of the study period or castration are higher than the observations of Manjeli *et al.*,[1] who reported overall mean feed intake ranging from 245-324 g/d/piglet to 13 weeks of age, in Malo farms for weaner pigs with graded energy levels.

However, the values for this study are within the range of 367-371 g/d/ piglet earlier reported by SEREP-INRA [13] for early weaned piglets fed diets with energy levels ranging form 3300 kcal DE/ kg to 3500 kcal DE/kg.

.The increase in feed intake with the dietary protein level, which was more pronounced in uncastrated piglets could possibly be due to the additional reproductive requirements of the growing piglets. Such conclusions have been made by Laborde, [9] and Tchoumboue et al.,[10] who reported that the nutrition of the male animal targets at the same time the growth, production and sperm production.

Growth performance

The MDWG (g/day) observed in this study are higher than values earlier reported by ITP, [14] for piglets weighing between 10-25 kg live weight (103-106 g/d/piglet). These values are also higher than overall mean values reported by Manjeli *et al.*, [1] who observed MDWG values ranging from 157.14 - 337.16 g/day for diets with 20.36% CP and 3334 kcal DE/kg and 140.0- 280.28 g/day for dietary crude protein and energy level of 20.55% and 3534 kcal DE/kg.

The figures recorded for this study were quite smaller to the values reported by ITP (1977), SEREP-INRA, [13] who worked with older piglets and Indy-Feed [15], using younger piglets aged between 21 and 42 days. The increase in MDWG associated with an increase in dietary protein level irrespective of castration, translates the importance of protein nutrition to the growth of piglets. This importance has also been highlighted by Labroue [16], who concluded that a deficiency of dietary protein for piglets had repercussions on the growth cycle of the animal and the development of muscles. Meanwhile, Quiniou and Noblet [17], observed that the importance of protein nutrition was more pronounced with an adequate dietary energy level.

The higher MDWG recorded for castrated piglets of this study, independent of protein level, is indicative of the fact that the non-castrated piglets may have dissipated part of the dietary nutrients for the satisfaction of reproductive development needs. This observation corroborates with the findings of Laborde [9], who indicated that castration improved the growth rate.

Feed conversion ratio

The FCR reported for this study are in conformity with the observations of ITP [14], (3.1-2.33), Serres [18], Holmes [19] and Laborde [9], who recorded values ranging between 3.0- 2.49. Our results, are not in agreement with the results of Indy-Feed [15], who obtained values ranging from 1.07-1.05 for piglets weighing between 8 and 15 kg live weight. This differences can be attributed to the fact that Indy-Feed conducted his study under controlled environmental conditions. The values for this study are however, higher than those of Manjeli *et al.*, [1].

The drop in FCR associated to increasing dietary protein levels irrespective of castration is indicative of the importance of protein nutrition to feed efficiency. This relation has been highlighted by Laborde [9]. Serres [18] and Holmes [19] also indicated the fact that the FCR drops with an increase in dietary protein level.

The low feed conversion ratio obtained for castrated piglets of this study for the first three weeks of the study could possibly be explained by the fact that castration rendered the piglets docile and reduced the expenditure of nutrients for exercise resulting in an increase in growth of the animal.

Carcass measurements

The differences in the backfat thickness between R2 and R1 observed in this study could be attributed to the differences in the level of proteins, lipids and digestible energy for the respective diets. R2 being richer in these nutrients than R1 especially with regards to the palm oil level of inclusion in this diet may have brought about a significant increase in this parameter.

The higher value for the height at withers and sternum, the heart girth and the rump length recorded for uncastrated piglets could indicate the implication of sexual hormones in the growth and development of muscle and bone metabolism. Whereas the higher backfat thickness observed for castrated animals could also be explained by the fact that the absence of sexual hormones would have favoured the deposition of fat. Taking into consideration management conditions of MALO farms, the ration R2 with a calorie-protein ratio of 216,34 seems to be the optimum feed. In conclusion, for fattening of piglets, castration and high protein in the diet seems to improve the growth performance of piglets. This diet could also be important in terms of the cost of feed needed to produce a kilogram of meat. Further studies on the evaluation of dietary feed intake for a longer period of time within the dry and wet seasons of the year are recommended.

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