Effect of split-mealing on growth performance, haemo-biochemical indices and economics of pig production in Nigeria

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Abstract

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Split mealings as a feeding management strategy to improve animal wellbeing and profit generation of pig farmers is the focus of this study. The effect of split-mealing on growth performance and haemo-biochemical indices of weaner pigs (n=45) of mean weight 6.6kg was assessed in a feeding trial that lasted for twelve weeks. Pigs were allotted to three treatments replicated 15 times of a pig per replicate in a completely randomized design. The treatments imposed were based on frequency of one or two or three meals a day. A measured quantity of feed at 5% body weight were made into either one or two or three portions and fed once at 8.00 am or twice at 8.00 am and 12.00 pm or thrice at 8.00 am and 12.00 pm and 4.00 pm, throughout the experimental period. Feed intake, weight gain and feed efficiency were not affected ($P>0.05$) by frequency of feeding. However, numerical improvement by 12.0% in the weight gain and 9.0 – 15.9% in feed intake of pigs fed three times daily were observed compared with those fed once or twice daily. While no significant ($P>0.05$) difference was found in the haematological profile of the pigs on single and split meals, split-meal significantly ($P<0.05$) influenced the TSP, serum urea, LDL AST and ALP of pigs. Economics of pig production showed that the cost of feed expended to gain a kilogram weight of pigs was lesser with higher net returns and better profitability ratio in pigs fed twice or thrice meal a day compared with those fed the whole feed in a single meal.

Keywords: Feeding frequency, growth, haemo-biochemical, pigs, split meal

L'Effet de la farine fractionnée sur les performances de croissance, les indices hémobiochimiques et l'économie de la production porcine au Nigéria

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Résumé

Le repas fractionné en tant que stratégie de gestion de l'alimentation pour améliorer le bien-être des animaux et la génération de profits des éleveurs de porcs est au centre de cette étude. L'effet du repas fractionné sur les performances de croissance et les indices hémobiochimiques des porcs sevrés (n = 45) de poids moyen 6,6 kg a été évalué dans un essai d'alimentation qui a duré douze semaines. Les porcs ont été attribués à trois traitements

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répliqués 15 fois d'un porc par réplique dans un plan complètement aléatoire. Les traitements imposés étaient basés sur la fréquence d'un ou deux ou trois repas par jour. Une quantité mesurée d'aliment à 5% du poids corporel a été transformée en une ou deux ou trois portions et nourrie une fois à 8h00 ou deux fois à 8h00 et 12h00 ou trois fois à 8h00 et 12h00 et 16h00, tout au long de la période expérimentale. L'apport alimentaire, le gain de poids et l'efficacité alimentaire n'ont pas été affectés ($P > 0,05$) par la fréquence d'alimentation. Cependant, une amélioration numérique de 12,0% de la prise de poids et de 9,0 à 15,9% de la prise alimentaire des porcs nourris trois fois par jour a été observée par rapport à ceux nourris une ou deux fois par jour. Bien qu'aucune différence significative ($P > 0,05$) n'ait été trouvée dans le profil hématologique des porcs lors des repas simples et fractionnés, les repas fractionnés ont influencé de manière significative ($P < 0,05$) le TSP, l'urée sérique, le LDL le 'AST' et l'ALP des porcs. L'économie de la production porcine a montré que le coût de la nourriture dépensée pour gagner un kilogramme de poids de porcs était moindre avec des rendements nets plus élevés et un meilleur rapport de rentabilité chez les porcs nourris deux ou trois fois par jour par rapport à ceux nourris avec la totalité de la nourriture en un seul repas.

Mots clés : fréquence d'alimentation, croissance, hémo-biochimie, porcs, repas fractionné

Introduction

Whole meal feeding is challenged to increase feed wastage, fecal output, decrease feed efficiency with consequent increase in feed cost per kilogram gain of livestock on intensive production.

Livestock farmers are evolving nutritional strategy that will optimize growth, ensure lean carcass quality and achieve low cost of production without adversely affecting the growth performance and wellbeing of the animals.

In Nigeria, most farmers feed their pigs once daily while others allow their animals' free access to agro-by-products throughout the day. In conventional pig feeding management, more variable feeding management systems are applied. The question of how often pigs should be fed for efficient feed utilization still remains unanswered.

The objective of livestock farmers was evolve a nutritional strategy that will produce animals with lean body mass, higher feed conversion efficiency, maximum growth and minimum cost of production with negatively affecting the health of the animal. Thus, there is need to adopt a feeding program that will achieve

this objective.

Materials and methods

Experimental site

The study was carried out at the Pig Unit, Department of Agricultural Science, Adeyemi College of Education, Ondo, Nigeria.

Feed formulation

The diet was formulated to meet the nutrient requirements for the pigs (NRC 2012) (Table 1).

Experimental design

A total of thirty (45) pigs of mixed sexes (Large white $\times$ Landrace) were arranged in a completely randomized design (CRD) of 3 treatments of 15 replications of a pig per replicate.

Animal management

A measured quantity of feed at 5% body weight were made into either one or two or three portions and fed once at 8.00 am or twice at 8.00 am and 12.00 pm or thrice at 8.00 am and 12.00 pm and 4.00 pm, with water served ad-libitum throughout the feeding trial

Prior to the start of the experiment, the pigs were treated against parasitic infection by 0.2ml Ivermectin injected intramuscularly.

Table 1: Gross composition of experimental diet

Ingredients, kg	
Maize	53.8
Groundnut cake	8.13
Soybean meal	10.8
Palm kernel cake	15.5
Wheat offal	9.97
Limestone	0.50
Premix	0.50
Lysine	0.15
Methionine	0.15
Salt	0.50
Total	100

Blood collection

Blood samples were collected from all the experimental animals after fasting overnight. The blood samples were collected from individual pigs with the aid of sterilized 10-gauge needles made through the anterior venacava. The bleeding was done in the morning before feeding. Ethylene Diamine Tetraacetic Acid (EDTA) (as anticoagulant) was added to the bijoux bottles meant for hematological indices such as the packed cell volume (PCV), Red blood cell (RBC) counts and hemoglobin concentration (HBC). The PCV was determined using the Win trobe's micro hemotocrite techniques while the RBC and hemoglobin concentration values were determined using the improved Neubauer hemocytometer and cyano methane-moglobin method, respectively (Coles, 1986). The mean corpuscular hemoglobin concentration (MCHC) mean corpuscular hemoglobin (MCH) and mean corpuscular volume (MCV) were calculated as follows:

$$MCV = \frac{PCV}{RBC} \times 10$$

$$MCHC = \frac{HB}{PCV} \times 100$$

b

$$MCH = \frac{HB}{RBC} \times 10$$

The rate (ESR) was determined as described by Jain (1986). The serum was separated and

frozen at 20⁰ prior to analysis. The serum total protein, albumin, globulin, cholesterol, urea, high density lipoprotein, (HDL) Low density lipoprotein (LDL) Alkaline, phosphatase (ALP) Aspartate transaminase (AST), Alanine, transaminase (ALT) were determined with a reflection (R) Plus 8c 79 (Roche Diagnostic, GonbH Mahnheim, Germany), using commercial kits.

Data collection and analysis

Data on feed intake, weight gain, feed conversion ratio, blood variables and serum lipids were analyzed by one-way analysis of variance (ANOVA) using SPSS (2006). Where significant differences existed, the means were separated using Duncan option of the software.

Results

Results show that feed intake, weight gain and feed conversion ratio of pigs were not affected ($P > 0.05$) by the frequency of feeding (Table 2). Although, pigs on meal split thrice a day recorded improvement in feed intake by 9.0-15.9% and in weight gain by 12.0% compared with those fed the whole feed in a single meal. Judging from the returns and profitability ratio, economics of pig production reveals better economic advantage of adopting split mealing rather than whole mealing in pig production.

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Table 2: Performance and economics of production for pigs on varying feeding frequency

	Frequency of feeding, in days				
	Once	Twice	Thrice	SEM	Sig
Performance indices					
Initial body weight, kg/pig	6.67	6.63	6.63	0.77	0.83
Final live weight, kg/pig	55.3	55.3	62.7	4.06	0.74
Average weight gain, kg/pig	0.44	0.44	0.50	0.32	0.62
Average feed consumed, kg/pig	1.32	1.22	1.45	0.11	0.65
Feed conversion ratio	3.01	2.78	2.88	0.08	0.26
Cost and returns					
Cost					
Purchase price, ₦	3335	3315	3315		
Labour, ₦	450	450	450		
Pen maintenance, ₦	125	125	125		
Depreciation on building, ₦	87.7	87.7	87.7		
Cost of feed, ₦/kg	118	118	118		
Cost of feed, ₦/kg weight gain	355	328	343		
Saving cost, ₦	-	26.9	11.8		
Relative cost benefit, %	-	7.58	3.33		
Cost of weight gain, ₦	17363	16065	19117		
Total cost, ₦	21361	20043	23095		
Returns					
Return on sale, ₦	27665	27665	31335		
Net profit, ₦	6304	7622	8240		
Profit/kg over control group, ₦	-	1318	1936		
% Profit over control group	-	20.9	30.7		
Profitability ratio					
Benefit cost ratio (BCR)	1.29	1.38	1.36		
Rate of return (ROR)	0.29	0.38	0.36		
Gross ratio (GR)	0.77	0.72	0.74		

Table 3 shows no significant ($P>0.05$) difference in the blood profile of pigs fed once and those fed up to 3 times a day. Among the serum lipids and serum enzymes of pigs, while the TSP was

significantly ($P<0.05$) higher in pigs fed thrice a day, serum urea, LDL, AST and ALP decreased significantly ($P<0.05$) in those pigs (Table 4).

Table 3: Haematological indices of pigs on varying feeding frequency

	Feeding frequency, in days				
	Once	Twice	Thrice	SEM	Sig
Parameters					
ESR, mm/hr	4.86	4.74	4.50	0.25	0.60
PCV, %	37.40	37.80	39.00	0.68	0.27
RBC, 10^9 /ml	5.56	5.50	5.84	0.18	0.40
Hb, g/ml	12.48	12.50	12.60	0.34	0.92
MCH, pg	21.92	20.75	21.18	0.57	0.39
MCV, mm	64.58	63.10	62.20	1.94	0.69
MCHC, %	33.18	32.72	32.48	0.38	0.44
WBC, 10^9 /l	11.98	12.32	13.72	0.80	0.30
Differential counts, %					
Neutrophil, Neu	44.34	43.68	46.28	2.33	0.72
Lymphocytes, Lym	47.76	48.30	46.36	2.20	0.82
Monocytes, Mon	3.54	3.56	3.18	0.36	0.71
Eosinophil, Eos	2.62	2.56	2.40	0.18	0.69
Basophil (Bas)	1.74	1.90	1.78	0.20	0.83

Table 4: Serum lipids of pigs on varying feeding frequency

	Feeding frequency, in days			SEM	Sig
	Once	Twice	Thrice		
Parameters					
TSP, g/dl	7.00 ^b	7.18 ^{ab}	7.36 ^a	0.10	0.04
Alb, g/dl	3.92	4.03	4.12	0.06	1.40
Glo, g/dl	3.09	3.15	3.26	0.08	0.35
Urea, mg/dl	4.88 ^a	4.76 ^a	4.32 ^b	0.23	0.03
Cholesterol, mg/dl	4.18	4.12	4.20	0.10	0.25
HDL, mmol/l	1.09	1.12	1.12	0.03	0.85
LDL, mmol/l	2.09 ^a	1.89 ^{ab}	1.43 ^b	0.16	0.04
LDH, u/l	11.50	11.21	10.13	0.61	0.30
ALT, u/l	7.82	7.74	7.46	0.36	0.77
AST, u/l	10.63 ^a	10.43 ^a	9.23 ^b	0.36	0.04
ALP, u/l	15.86 ^a	15.88 ^a	5.15 ^b	0.16	0.02

^{ab} Means with different superscripts are significantly different at ($P < 0.05$)

Discussion

The similar weight gain and feed consumption of pigs in the present study is in agreement with findings by Lee and Leeson (2001) but contradicts the findings in Tilapia (*Oreochromis niloticus*) and Nile Tilapia (Gaber *et al.*, 2008; Gaber *et al.*, 2014) and broilers (Urdaneta-Rincon and Leeson 2002; Khurshid *et al.*, 2019) and growing pigs (Daza *et al.*, 2003).

The similar blood profile recorded for pigs fed once and those on 3 meals a day was in line with hybrid cat fish - *Heteroclinus* reared under different feeding patterns (Afia and Ofor, 2016). The non-significant difference in the haematological profile, WBC and differential counts shows that irrespective of pigs daily feeding pattern, blood synthesis against the destruction of erythrocytes and the ability of the immune response of the pigs to fight against infectious agents were not compromised. The significant increase in the TSP of pigs on 3 times meal a day is a possible forecasting of the degree of protein utilization. The low serum urea suggests the physiological tendency of the digestive capacity of the animal to efficiently utilize nitrogen, recycle urea and possibly conserving nitrogen (Rajman *et al.*, 2006). Low urea levels might be responsible for

the high TSP. Offering feeds in bits had been reported to decrease the passage of digesta chymous in the gut with resultant improvement in feed utilization (Oliveira *et al.*, 2013) and reduction in colic disease and improve health status of animal (Clauss *et al.*, 2009).

Economics of production shows the economic viability and profitability of exploring split mealing in pig management compared with offering the whole feed in a single meal. The decreased in cost of production and improved revenue in pigs on split meals could have resulted from the better feed utilization which was reflected in increased weight gain of those pigs. Novele *et al.* (2008) reported that feeding protocol gave economic advantage because of the monetary savings obtained from enhanced feed utilization by the animal.

Conclusion and application

The study revealed that better daily gain, lesser feed cost, better economic advantage without compromising the health in pigs on split meals (twice or thrice a day) compared with those fed the whole meal at a time. Pig farmers are advised to adopt split meal feeding of either twice or thrice a day.

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Received: 11th August, 2020

Accepted: 21st November, 2020