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Effect of Dietary Alpha-Tocpherol and Ascorbic Acid on the Reproductive Performance of Gilts

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Abstract
An experiment was conducted to evaluate the effect of dietary combination of alpha-tocopherol and ascorbic acid on the reproductive performance of gilts in the humid tropical zone of Nigeria.Sixteen20 weeks old gilts were selected for this trial and randomly assigned to 4 dietary treatments. Each treatment was replicated twice with two gilts per replicate.One basal ration containing 15% CP and 2,500 kcal/kg, ME was used with different levels of vitamins E and C which were added to the feed at the time of feeding. The gilts were placed on the gestation/lactation diet immediately after selection and were allowed to attain their second estrus before mating took place. Initial body weights of the gilts were recorded before mating following the manifestation of second estrus and date of mating recorded. Gilts were fed 2.0kg of the 15% CP diet each day when pregnancy was confirmed. Weekly body weights of the gilts were subsequently taken throughout the gestation period. At farrowing, their ration was increased to 2.6 kg per pig per day until piglets were weaned at the age of 8 weeks. The birth weights of the piglets were recorded within 24 hours of parturition and subsequently, piglets' weekly body weights were recorded until weaning. Similarly, the body weights of the lactating sows were taken weekly to monitor their body weight changes during lactation. All the data were processed and analyzed in accordance with 2x2 factorial arrangements in a Completely Randomized Design (CRD). The result of the experiment showed that average litter size values and the corresponding birth weight mean values were not significantly different ($p>0.05$) among the treatments. Significantly lower ($p<0.05$) pre-weaning body weight gain was observed for piglets on T_1 with mean value of 126.25±5.62 compared to piglets on T_2, T_3 and T_4 with respective values of 150.77±5.00, 150.51±1.59 and 164.12±7.23. A range of 22.07±3.45% to 25.10±0.10% pre-weaning mortality was observed across treatments. Piglets on T_1 had the least weaning weight of 7.25±0.28 kg which differed significantly ($p<0.05$) from piglets on T_2, T_3 and T_4 with weaning weight values of 8.42±0.24 kg, 8.62±0.08 kg and 8.71±0.60 kg, respectively. The highest ($p<0.05$) gestation weight gain of 44.33±4.48 kg was observed in gilts on T_1.This study suggests that dietary supplementation with vitamins E and C at 250 mg vitamin C alone, 120 IU vitamin E alone and 120 IU vitamin E / 250 mg vitamin C combination during gestation of gilts and their lactation will effectively enhance litter size and lactation performance.

Keywords: alpha-tocopherol, ascorbic acid, reproduction, gilts

Introduction

Site-specific information on the exact levels of vitamin E supplementation to gilts to optimize their reproductive ability and subsequently the body development of the piglets are lacking in most parts of the world particularly in the developing nations like ours. Most estimates on vitamin E supplementation are based on the minimum level required to overcome deficiency symptoms and not necessarily to promote productivity.

The fundamental role of vitamin E in optimizing fecundity rates and litter size in gilts/sows is demonstrated by the fact that maximal early growth and general wellbeing of the piglets depend among other factors on correct vitamin E supplementation to dam's pre and post coitus.

Vitamin E is a critically important nutrient for all confinement-reared swine especially for the fact that it is not synthesized in the body of pigs. Thus, all swine require dietary sources to meet metabolic needs.

If gilt's tissue tocopherol must be mobilized, the source of vitamin E for reproducing gilts/sows, nursing pigs and weaned piglets should be the diet (Nwangwu, 2012).

Pigs however, can synthesize vitamin C in their body and do not require it in the diet. But according to Mc Dowell (1989), it is possible that the endogenous synthesis of vitamin C in the pigs is inadequate to maximize vitamin C's contribution to oxidative stability in some situations. The synthesis of vitamin C by pigs is insufficient under stressful conditions such as high environmental temperature, high humidity and diseases.

After fortifying some diets with vitamins E and C, an increased litter size at birth was generally demonstrated, litter birth weight increased, pre-weaning mortality reduced, pre-weaning growth rate increased and weaning weight increased accordingly (Nwangwu, 2012).

Vitamins C and E have been demonstrated by Gey (1998) to work together in preventing oxidative insult caused by biological free radicals such that vitamin E is the major chain-breaking antioxidant in lipid phase such as cellular membranes while the oxidizing free radical chain reactions are terminated in aqueous compartment of the animal body with vitamin C as the terminal reductant. Vitamin C has also been found to rejuvenate vitamin E in the animal body.

The objective of the study is therefore, to evaluate the effect of dietary combination of alpha-tocopherol and ascorbic acid on the reproductive performance of gilts.

Materials and Methods

The study was carried out at the piggery unit of the Department of Animal Science farm, University of Nigeria, Nsukka. The study lasted for 168 days. A total of sixteen20 week old Large White x Landrace cross-bred gilts with an average weight of 65kg were used. The gilts were housed in an open sided fly-proof pens measuring 3.2 x 2.7m with concrete feeding troughs and drinkers. They were randomly assigned to four treatments namely, T1, T2, T3 and T4 and each treatment was replicated twice. One experimental ration containing 15% CP and 2500 kcal/kg, ME was used for the 16 gilts but different levels of vitamins E and C for each treatment were added to the feed at the time of feeding. The gilts were ear-notched for easy identification and having been placed on the gestation/lactation diet after arrival were allowed to attain their second estrus before mating took place. The body weights of the gilts were recorded before mating following the attainment of second estrus and the date of mating recorded. When pregnancy was confirmed by gilts not showing signs of estrus 21 days after mating, gilts were fed 2.0kg of 15%CP each day (Table 1 and 2) throughout gestation. Weekly body weights of the gilts were subsequently taken throughout the gestation period. Following farrowing, their ration was increased to 2.6kg per sow per day during lactation till weaning. The birth weights of the piglets were recorded within 24 hours of parturition. Thereafter, piglets' body weights were recorded every week till weaning at 8 weeks of age. Similarly, the body weights of the lactating sows were taken weekly to monitor their body weight changes during lactation. Routine management procedures were observed such as injection of iron dextran at two days of parturition to prevent piglet anaemia and a follow-up with antibiotics treatment when deemed necessary. The percentage and proximate composition of the experimental diet are presented in Tables 1 and 2 respectively.

Table 1: Percentage composition of gestation-lactation diet

Ingredients	Percentage
Cassava meal	39.8
Palm kernel cake	19.9
Maize	10.0
Wheat offal	10.0
Soya bean meal	17.7
Bone meal	2.00
Salt	0.30
Vitamin Premix[a]	0.25
Methionine	0.025
Lysine	0.025
Total	100
Calculated:	
Energy (kcal/kg, ME)	2500
Crude protein(%)	15

[a]Supplied per kg of diet: 5,000iu vit.A; 1000,000iu vit. D_3; 800mg vit.E; 400mg vit.k; 1200mg vit.B_2; 1000mg vit.B_3; 4mg vit.B_{12}; 3,000mg Niacin; 4,000mg vit.C; 112mg chlorine; 24000mgMn; 8000mg Fe; 1,600mg Cu; 18,000mg Zn; 500mg Iodine; 48mg Se; Antoxidant (BHT).

Table 2: Proximate composition of gestation-lactation Diet

Nutrients	Proximate composition (%DM)
Crude protein	15.17
Ether extract	2.8
Crude fibre	6.9
Ash	5.42

N-Free Extract	56.29
Moisture	8.0
Dry Matter	92

Results and Discussion

The result of the effect of dietary supplementation of vitamins E and C on the reproductive performance of gilts is summarized on Table 3. The results showed that gilts on vitamins E and C supplemented diets were better in performance in pre-weaning mortality of piglets, pre-weaning growth rate of piglets, weaning weight of piglets and litter size at weaning than gilts on the control diet that had no vitamins supplementation. The trend recorded in the present study conforms to then values earlier reported by Williamson and Payne (1978), Davidson and Coey (1966) and Machebe (2009).

Table 3: Effect of dietary supplementation of vitamins E and C on the reproductive performance of gilts

Parameters	T_1	T_2	T_3	T_4	Mean±SE	LOS
CR (%)	75	100	50	50		
GL(days)	116±0.58	117±0.91	115.10±0.10	114.10±0.10	85.52±0.47	NS
Litter size	7.00±0.58	8.00±0.41	8.00±0.00	7.00±1.00	7.55±0.28	NS
ABW (kg)	0.97±0.076	1.05±0.11	1.19±0.00	1.24±0.03	1.09±0.05	NS
PWM (%)	46.23±8.59^a	22.07±3.45^b	25.10±0.10^b	25.05±0.05^b	29.75±3.96	*
PWGR (g/day)	126.25±5.62^a	150.77±5.00^b	150.51±1.59^b	164.12±7.23^b	48.81±3.11	*
WWP(kg)	7.25±0.28^a	8.42±0.25^b	8.62±0.08^b	8.71±0.60^b	8.30±0.17	*
LSW	3.67±0.33^a	6.25±0.48^b	6.50±0.50^b	6.50±0.50^b	5.64±0.43	*
GWG (kg)	44.33±4.48	40.50±5.87	50.20±0.20	46.1±7.10	5.96±3.18	NS
LWL(kg)	25.83±2.35^a	28.53±2.92^a	40.10±0.10^b	24.50±3.80^a	9.16±2.09	*

CR= Conception rate, GL= Gestation length, ABW= Av. birth weight, PWM= Pre-weaning mortality, PWGR= Pre-weaning growth rate, WWP=Weaning weight of piglets, LSW=Litter size at weaning, GWG= Gestation weight gain, LWL=Lactation weight loss.

Conclusion

Based on the results of this study, the gilts and their progenies fed diets supplemented with varying levels of vitamins E and C and their combination at higher than the recommended levels were superior in terms of pre-weaning piglet mortality, pre-weaning piglet growth rate, weaning weight of piglets and litter size at weaning than when fed diets unsupplemented with the vitamins. It is therefore recommended that the gestation and lactation diets for pigs should be supplemented with at least 250 mg vitamin C, 120 IU vitamin E or a mixture of 120 IU and 250 mg of vitamins E and C to improve reproduction in gilts. In the overall, pig farmers will be able to improve both health and reproductive performance of their herd through the above mentioned recommendations.

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