



Vitamin E and Selenium Ameliorate Growth Performance in Growing Pig Fed Crude Oil-Contaminated Diets

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***Monogastric Production/Nutrition**

Abstract

This study was carried out to investigate the amelioration effects of vitamin E alone or in combination with selenium on growing pigs that ingested crude oil-contaminated diets. 36 growing landrace pigs weighing on average 15.8 ± 1.4 kg were used and four dietary crude oil-contaminated treatment diets as: diet 1 (control diet) contained 0-gram of crude oil/kg of diet, diet 2 (5 g/kg), diet 3 (10g/kg) and diet 4 (15g/kg), respectively. Diets were fed to the different dietary treatment groups for 3 weeks tagged the toxicological phase with 9 pigs/dietary treatment group. At the end of the toxicological phase, the amelioration phase of incorporation of vitamin E alone or in combination with selenium commenced with 3 replications for each treatment group involving the transition of the animals from the toxicological phase to the amelioration phase for a duration of another 3 weeks. Results revealed that at the low and medium levels of crude oil-contaminated diets, vitamin E alone ameliorated the toxic effects on performance parameters as there were no significant ($P > 0.05$) effects on performance data compared with the control; whereas similar amelioration was only achieved in the high level of contamination by the combination of vitamin E and selenium as performance parameters were similar ($P > 0.05$) to the control. It was concluded that vitamin E alone reversed the toxic effects of crude oil ingestion at the low and medium levels of contamination whereas for similar reversal of the toxic effects of crude oil vitamin E needs to be combined with selenium.

Key words: Amelioration, Crude oil, Performance, Pig and Selenium.

Introduction

Different independent studies have investigated the toxicological effects of different concentrations of crude oil-contaminated diets on animal performance parameters data, namely:



feed intake, weight gain and feed efficiency in various animals, including livestock. In rodents and poultry, Amagu *et al.* (2005) and Onunkwo *et al.* (2013) reported adverse effects of crude oil on performance characteristics, respectively. These workers demonstrated that feed intake was significantly affected in their studies. Worse still, feed intake was significantly reduced to minimal levels as the animals rejected feeding entirely as the level of crude oil contamination increased in the diets. These scenarios led to depressions in the average daily weight gains and significant reductions in feed efficiencies of the crude oil-contaminated diets compared with their control counterparts' diets'.

Again, Monsi *et al.* (1991) that investigated the effects of crude oil-contaminated diets in poultry reported decline in feed intake and severe depression of growth rate in the birds that were fed crude oil-contaminated diets. These negative observations become severer as the levels of crude oil increased in their diets. Recently, in rabbits, Yahaya and Aruwayo (2014) showed significant reductions in feed intake, weight gain and feed efficiency. Furthermore, Nodu and Olajinre (2011) had earlier reported similar data in rabbits.

Ngodigha (2009) demonstrated that feed intake, body weight gain and feed conversion ratio were adversely affected by the ingestion of crude oil-contaminated feeds in goats. He further stated that as the crude oil contamination increases the more these performance parameters were depressed. In the same vein, Okejim *et al.* (2020) observed similar results in the pig. However, in our current study, we were interested in investigating the ameliorations attributes of vitamin E when administered alone or in combination with selenium in the face of the adverse effects of ingested dietary crude oil. Therefore, the objectives of this study are to investigate the ameliorative effects of vitamin E and selenium on feed intake, body weight gain and feed efficiency in pigs fed crude oil-contaminated diets and ameliorated with vitamin E alone or in combination with selenium.

Materials and Methods

Animals and Management: 36 growing landrace pigs weighing on average 15.8 ± 1.4 kg were obtained from Cape Farms, Irete, Imo State and humanely transported to the Rivers State University Teaching and Research Farm. The animals on arrival at the animal wing of the



Teaching and Research Farm of the University were weighed and randomly assigned to their pens based on the principles of completely randomized design (CRD) and similarly fed the same diet (Pfizer grower mashTM) for 2 weeks and water was provided *ad libitum* to fully stabilize them to their new environment. During the 2 weeks of pre-conditioning, animals were dewormed by subcutaneous injection of ivermectin and were also given amoxicillin a broad-spectrum antibiotic intramuscularly. At the end of the two weeks, experimental diets were presented to the animals for 3 weeks. There were 9 replications/diet. This was the first phase of study tagged 'toxicological phase'. At the end of the toxicological phase, ameliorative phase of the study immediately followed by another 3 weeks of 3 pigs per treatment. 3 pigs from dietary treatment 1 (0-gram of crude oil/kg of diet) whereas, the 9 pigs for the other 3 treatment groups were randomly divided into 3 sub-groups as: (5₀, 5_{vit E}, 5_{vit E + Se}), (10₀, 10_{vit E}, 10_{vit E + Se}) and 15₀, 15_{vit E}, 15_{vit E + Se}), respectively. Therefore, in this phase, there were four controls of 0-gram of crude oil/kg of diet, 5₀, 10₀ and 15₀, respectively. This means 5₀, 10₀ and 15₀, animal groups received no crude oil, vitamin E or selenium in their diets during the amelioration phase.

Experimental Diets and Crude Oil Contaminations: There were 4 dietary treatments as: diet 1 (control diet) contained 0-gram of crude oil/kg of diet, diet 2 (contained 5-gram of crude oil/kg of diet, diet 3 (contained 10-gram crude oil/kg of diet and diet 4 (contained 15-gram crude oil/kg of diet), respectively. Incorporation of the crude oil into the diets were done according to the method of Berepubo *et al.* (1994). At the beginning of each day of the 3 weeks' experimental period, orts from the previous day were collected, weighed and weights recorded. This was done to determine actual amount of diet consumed by each animal within the 3 weeks' period of study. Animals were also re-weighed to obtain their final weights at the end of the 3 weeks' study period. The difference between final and initial BW represents weight gained during the study period. Average daily feed intake (ADFI), average daily gain (ADG) and gain to feed, that is, feed efficiency (FE) for the study period were thus computed. After collating these data in the toxicological phase, the ameliorative phase involving vitamin E and selenium immediately commenced. Thus, in this phase, there were 10 treatments as: T₀, (5₀, 5_{vit E}, 5_{vit E + Se}), 10₀, 10_{vit E}, 10_{vit E + Se}) and (15₀, 15_{vit E}, 15_{vit E + Se}). T₀ = overall control, 5₀, 5_{vit E}, 5_{vit E + Se} treatment 2 of 5g of crude oil-contaminated diet but in this ameliorative phase 5₀, diet contained no crude oil again, 5_{vit E}, diet contained no crude oil but 200mg of vitamin E and 5_{vit E + Se} diet contained no



crude oil but 200mg of vitamin E + 5mg of Se. These descriptions were the same for the 10 and 15 g of crude oil-contaminated diets for vitamin E and Se, respectively. As stated previously, this phase also lasted for 3 weeks. Therefore, as was done in the toxicological phase, at the end of the 3 weeks, animals were re-weighed to obtain their final body weights. With the obtained ADFI for this phase and weight gained for each group in this phase, performance parameters were computed as was done in the toxicological phase.

Performance data obtained were subjected to analysis of variance (ANOVA) using general linear model (GLM) procedure of SAS. Treatment means were compared using Tukey's test. Therefore, the model was: $Y_{ij} = \mu + X_i + E_{ij}$, where Y_{ij} = individual observation of the treatment, μ = population mean, X_i = effect of the i^{th} treatment and E_{ij} = the error term. An α -level of 0.05 was used for all statistical comparisons to represent significance.

Results

The results of the toxicological phase of crude oil ingestion on pig performance parameters are shown in Table 1.

Table 1: Effects of different levels of crude oil-contaminated diets on growth parameters of the growing pig

Parameters	TREATMENTS				SEM	P-value
	0g	5g	10g	15g		
ADFI (kg/d)	1.05 ^a	1.05 ^a	1.09 ^a	1.15 ^b	0.02	0.010
ADG (kg/d)	0.42 ^a	0.43 ^a	0.42 ^a	0.31 ^b	0.01	0.002
FE (%)	0.40 ^a	0.41 ^a	0.38 ^b	0.27 ^c	0.001	0.001

^{a,b,c} means within the same row with different superscripts are significantly ($P < 0.05$) different

The ADFI of animals on treatments 1 – 3 were not significantly different ($P > 0.05$) but significantly ($P < 0.05$) lower than that of treatment 4. This could be due to an attempt by the animal to ingest more feeds to meet its physiological needs. Conversely, animals on treatments 1 – 3 had similar ($P > 0.05$) ADG that were significantly ($P < 0.05$) higher compared with that of treatment 4. The FE almost mirrored ADG. The FE of treatments 1 and 2 were the best as they



were similar ($P > 0.05$) and significantly ($P < 0.05$) higher compared with treatments 3 and 4; although treatment 3 had intermediate FE whereas treatment 4 had significantly ($P < 0.05$) the most inferior FE compared to the rest of the treatments.

The results of the amelioration phase of vitamin E alone or in combination with selenium are shown in Table 2.

Table 2. Amelioration of the toxic effects of crude oil ingestion with vitamin E alone or in combination with selenium on growth performance parameters in the growing pig.

TREATMENTS												
Item	T ₀	5 ₀	5 _{vitE}	5 _{vitE+Se}	10 ₀	10 _{vitE}	10 _{vitE+Se}	15 ₀	15 _{vitE}	15 _{vitE+Se}	SEM	<i>P-value</i>
ADFI (kg)	1.26 ^a	1.48 ^b	1.49 ^b	1.48 ^b	1.48 ^b	1.14 ^c	1.15 ^c	1.25 ^a	1.19 ^a	1.25 ^a	3.00	0.001
ADG (g)	398 ^a	357 ^a	462 ^b	459 ^b	394 ^a	394 ^a	396 ^a	269 ^c	255 ^c	425 ^a	14.10	0.001
FE (%)	32 ^a	24 ^b	31 ^a	31 ^a	25 ^b	34 ^a	34 ^a	22 ^c	21 ^c	34 ^a	0.05	0.000

^{a,b,c} means within the same row with different superscripts differed significantly ($P < 0.05$); 5₀ = no more crude oil in feed, 10₀ = no more crude oil in feed and 15₀ = no more crude oil in feed.

The results of the amelioration phase of the study are shown in Table 2. Vitamin E alone was able to restore the appetites of the animals meaning that vitamin E removed or diminished the anorectic effects of the ingested crude oil from the pigs that consumed it at the dietary level of 5gram crude oil/kg of diet as the ADFI were significantly ($P < 0.05$) higher compared with the overall control group but similar ($P > 0.05$) with 5₀, 5_{vitE+Se}, and 10₀, respectively. Also, the ADG of the animals given vitamin E in this group was significantly ($P < 0.5$) higher compared to the control and all other groups. Similarly, vitamin E alone was able to reverse the negative effects of crude oil contamination of the 10g crude oil/kg diet group as the animals gained weight and had similar FE rate ($P > 0.05$) with the overall control. However, at the 15g of crude oil contamination, vitamin E was not able to reverse the negative effects of crude oil except when combined with selenium in all growth performance parameters measured, namely: ADFI, ADG and FE (Table 2).



Discussion

Different independent studies have demonstrated that crude oil causes poor performance of animals that consumed it, such as those of Berepubo *et al.* (1994), Monsi *et al.* (1991) and Onunkwo *et al.* (2013). These observations by these workers were also established in this current study as shown in Table 1. However, this study was specifically designed to evaluate the ameliorative influences of vitamin E alone or in combination with selenium in reversing the negative effects of the ingested dietary crude oil on growth performance parameters of the growing pig. To this point, vitamin E and selenium were incorporated into the diets of the growing pig to aid in investigating their abilities to ameliorate/reverse the toxic and consequently the poor growth performances of the animals emanating from the ingested dietary crude oil.

It was observed that there were significant improvements in the performance parameters of the groups of pigs administered with vitamin E alone or in combination with selenium in a dose-dependent manner. In other words, in the low (5g dietary crude oil-contamination) group as well as the medium (10g crude oil-contamination) group was able to erase the toxic and negative effects of the ingested crude oil as observed, especially in the ADG and FE of the groups. However, these reversal effects of the ingested crude were only achieved in the high (15g dietary crude oil-contamination) group when vitamin E was given in combination with selenium. These findings further corroborated the earlier assertions of Akhter *et al.* (2012) and Manju and Sushovan, (2017) that demonstrated significant weight gains and feed efficiencies after supplementation of vitamin E in combination with selenium in goats their studies.

Our findings in this current study are also in tandem with the data of Aslam *et al.* (2010) in their studies with broiler chickens. It is therefore not a gainsaying that vitamin E alone was very efficacious in ameliorating the negative effects of the ingested dietary crude oil-contamination only in the low and medium levels but not at the highest level (15g dietary level); where they were more severe negative impacts of the ingested dietary crude oil on performance parameters of the pigs. However, as shown above it was by the combination of vitamin E and selenium that those negative effects on performance parameters: ADFI, ADG and FE were best eradicated as judged by the degree of the improvements in the performances of the animals in this group. This



finding here again is not surprising as it has been demonstrated that vitamin E and selenium always demonstrate synergistic relationships in improving the health status of the animal, probably via their effects on the glutathione defense system of the animal, thereby maintaining the normal health of the animal. To this point therefore, it is a known fact that selenium converts oxidized glutathione (GSSG) to the reduced form (GSH) which is the active form of glutathione in reducing oxidative stress, such as the one induced by dietary crude oil in the animal via the activity of glutathione peroxidase (GSH-Px).

Conclusions

Ingestion of crude oil-contaminated diets depressed pig performance parameters. However, supplementation of such diets with vitamin E eradicated the negative effects of crude oil in performance parameters of the animal. Nevertheless, the eradications of the negative effects of the ingested crude oil on pig performance parameters by vitamin E is best when vitamin E is combined with selenium, especially at high levels of dietary crude oil-contamination, such as 15g of crude oil/kg of diet.

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