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Effect of Dietary Kaolin as Feed Additive on Semen Parameters of Two Strains of Rabbits

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ABSTRACT

The study assessed the effects of dietary kaolin as feed additive on some semen traits in two rabbit strains (New Zealand White and Chinchilla rabbit bucks). Thirty-two (32) adult New Zealand White (16) and Chinchilla (16) rabbits acquired from Unberik Farm, Rivers State which were divided into two groups based on strain. Each strain was allocated to four (4) treatments T1 (0g of Kaolin per kg of feed), T2 (20g of Kaolin per kg of feed), T3 (30g of Kaolin per kg of feed) and T4 (40g of Kaolin per kg of feed) replicated four (4) times with each replicate having one (1) rabbit, in a Completely Randomized Design (CRD). The result of multivariate analysis showed no statistically significant impact of dietary Kaolin on most semen parameters such as pH, volume, viability, normal morphology, abnormal morphology, actively motile, sluggishly motile and %dead. There was however, significant improvement in sperm count of both New Zealand White and Chinchilla bucks at supplemental levels of 30g and 40g per kg of feed respectively. Further research, using different approaches such as feeding frequency, combination with other feed additives, etc. was recommended

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INTRODUCTION

Maintaining good semen parameters is crucial for optimizing reproductive efficiency, litter sizes, overcoming environmental challenges, genetic improvement programs, artificial insemination optimization and economic benefits in rabbit farming operations (Cesare *et al*., 2010). Enhancing rabbit reproduction is crucial due to their high reproductive potential because higher quality semen leads to better fertility rates and larger litter sizes, which is crucial for efficient rabbit production in both commercial and research settings (El-Tarabany *et al*., 2015). Good quality semen is essential for successful artificial insemination programs, allowing for more efficient breeding and genetic improvement. Better semen quality can also increase the number of inseminating doses prepared from each ejaculate, reducing costs and improving profitability for rabbit farmers and can help mitigate the negative effects of environmental stressors, such as heat stress, which can significantly impact rabbit fertility (El-Tarabany *et al*., 2015).

Kaolin, also known as kaolinite, is a clay mineral with the chemical formula $Al_2Si_2O_5(OH)_4$. Kaolin, is sometimes used in animal feed to improve gut health and nutrient absorption. While specific studies on kaolin's effects on rabbit semen parameters are lacking, its general benefits to gut health could theoretically support overall health and reproductive performance. Improved nutrient absorption might lead to better overall health, which could positively influence semen quality. While there is no direct evidence on the effects of dietary kaolin on rabbit semen parameters, related studies on dietary supplements (e.g., Garden Cress (*Lepidium sativum*) and flaxseed, a source of n-3 polyunsaturated fatty acids) suggest that improving overall health and reducing oxidative stress through diet can enhance semen quality.

This study, will therefore assess the effect of dietary kaolin as feed additive on semen parameters of two rabbit strains (New Zealand white and Chinchilla).

MATERIALS AND METHODS

Experimental site

This experiment was carried out at the Rabbit section of the Rivers State University Teaching and Research Farm, Nkpolu-Oroworukwo, Port Harcourt which is located on longitude 4°48'18.50"N and latitude 6°58'39.12"E and on and elevation of 18m above sea level (David *et al*., 2019). Mean annual rainfall is between 2000m to 3000mm and annual temperature ranges from 25°C to 31°C.

Experimental animals and treatment

Thirty-two (32) adult male rabbits (16 New Zealand and 16 Chinchilla) acquired from Unberik Farm, Rivers State were allocated to two set/group of same experiments (represented by the two breeds). Each breed is subjected to four (4) treatments (T1, T2, T3 and T4) replicated four (4) times with each replicate having one (1) buck, in a Completely Randomized Design (CRD).

The rabbits were subjected to an acclimatization period of two (2) weeks before the commencement of the treatment which lasted for 4weeks.

A commercial rabbit grower feed was administered daily and equally to the rabbits throughout the duration of the experiment but at different inclusion levels of dietary Kaolin. The inclusion levels of dietary Kaolin were based off the different treatments for both rabbit breeds as follows:

T1 = Control (0g of dietary Kaolin per kg of feed)
T2 = 20g of dietary Kaolin per kg of feed
T3 = 30g of dietary Kaolin per kg of feed
T4 = 40g of dietary Kaolin per kg of feed

Other routine management practices like washing of drinkers, cleaning of the feeders, renewal of the disinfectant solution in the foot dip, general sanitation of the environment, routine medication and vaccination were strictly observed.

Prior to the experiment, samples of the experimental feed additive (Kaolin) was sent to the laboratory for composite analysis. The result is presented below:

Table 1 Composition of dietary kaolin and feed

Nutrient	Kaolin	Feed
Available Phosphorus	1.21 mg/kg	71.52 mg/kg
Calcium	584.8 mg/kg	46.2 mg/kg

Data collection

At the end of the experiment, sixteen (16) bucks (8 from New Zealand group and 8 from Chinchilla group) were randomly selected for semen collection. Two bucks were randomly selected from each replicate for each experimental set. A doe was used to tease the bucks and sample was collected using a non-EDTA bottle. The semen samples were immediately taken to the laboratory for semen analysis for the following parameters: sperm count, volume, pH, motility and morphology.

Statistical Analysis

For the semen parameters, the data collected was subjected toa multivariate analysis outlined in the general linear model using IBM SPSS (version 20, 2013). Significant means at p<0.05 were separated using the Turkey test techniques.

RESULTS

The effect of dietary kaolin as feed additive on some semen parameters in Chinchilla rabbit is shown in Table 2. There were significant differences (p<0.05) in sperm count with Treatment 3 (T3) having the highest value and Treatment 2 (T2) having the lowest value. However, the other traits such as pH, Volume, Viability, Normal morphology, Abnormal morphology, actively motile, sluggishly motile, % Dead, recorded no significant difference (p>0.05), although numerical differences existed among the treated groups for the other traits.

Table 2: Effect of dietary Kaolin as feed additive on some semen traits in Chinchilla rabbit bucks

Parameter	T1 (0g/kg)	T2 (20g/kg)	T3 (30g/kg)	T4 (40g/kg)	SEM
pH	8.00	8.16	8.00	7.83	0.312
Volume (ml)	0.86	1.03	0.90	0.86	0.200
Viability (%)	60.00	73.33	61.67	38.33	18.597
Normal morphology (%)	75.00	78.33	85.67	86.67	4.262
Abnormal morphology (%)	25.00	21.67	14.33	13.33	4.262
Actively motile (%)	76.67	87.00	75.00	36.67	13.689
Sluggishly motile (%)	23.33	13.00	15.00	13.33	2.867
Dead sperm (%)	26.67	20.00	25.00	55.00	13.566
Sperm count (x10^6/ml)%	84.33^{c}	61.67^{d}	91.33^{a}	88.33^{b}	6.579

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

The effect of dietary kaolin as feed additive on some semen parameters in New Zealand white rabbits' strain is shown in Table 3. Result from the table indicates that there were significant disparities (p<0.05) found only in sperm count with the T4 having the highest value of 99.0 and T2 having lowest value of 67.33. The remaining traits showed no significant disparity (p>0.05) however, numerical differences existed.

Table 3: Effect of dietary Kaolin as feed additive on some semen traits in New Zealand white rabbit bucks

Parameter	T1 (0g/kg)	T2 (20g/kg)	T3 (30g/kg)	T4 (40g/kg)	SEM
pH	8.00	8.00	8.00	8.16	0.264
Volume (ml)	1.20	1.30	0.60	1.13	0.291
Viability (%)	87.33	89.67	84.33	86.67	3.432
Normal morphology (%)	85.00	84.33	81.00	88.33	1.772
Abnormal morphology (%)	13.33	15.67	19.00	11.67	1.958
Actively motile (%)	85.00	81.67	80.00	85.00	3.333
Sluggishly motile (%)	15.00	18.33	20.00	15.00	3.333
Dead sperm (%)	4.67	9.00	9.67	7.67	2.466
Sperm count (x10^6/ml)%	79.67^{b}	67.33^{c}	67.67^{c}	99.00^{a}	4.453

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

DISCUSSION

The result showed significant effect Kaolin only on the sperm count of both strains of rabbits (New Zealand White and Chinchilla). However, while the Chinchilla showed significant improvement of sperm count at a feeding rate of 30g of Kaolin per kg of feed, the New Zealand White (NZW) rabbit bucks achieved such significant improvement at 40g of Kaolin per kg of feed.

This could imply that the Chinchilla bucks have higher reproductive sensitivity compared to the New Zealand white. The findings of Jimoh & Ewuola (2017) and Ariyo & Odunsi (2024) indicated that Chinchilla rabbits show better reproductive performance, including higher litter sizes and kit survival rates, than NZW rabbits. Additionally, Chinchilla rabbits have been reported to have superior fertility traits, making them more effective in breeding scenarios. This suggests that Chinchilla bucks may be more responsive in reproductive contexts compared to their NZW counterparts (Mady *et al.*, 2018).

Another possibility could be due to their maturity age. Since the New Zealand reaches maturity earlier than the Chinchilla (Ariyo & Odunsi, 2024), they were more likely to respond to treatment involving sperm count earlier. This implies that, with time, they would require higher dose of Kaolin to achieve the same effect, thus explains why the New Zealand White bucks had significantly higher sperm count at a higher inclusion level (40g of Kaolin per kg of feed). The Chinchilla bucks on the other hand, just attaining sexual maturity would not require as much level of Kaolin to achieve such feat within the same period of treatment. This highlights the importance of duration of dietary Kaolin as feed additive on and age of sexual maturity on sperm parameters of rabbit buck. There is however, limited research works on this area.

Failing to cause significant improvement in most semen parameters such as pH, Volume, Viability, Normal morphology, Abnormal morphology, Actively motile, Sluggishly motile and %Dead but sperm count however, challenges its (Kaolin) suitability as an effective or potential feed additive for use in improving semen quality in rabbits. The tendency to increase the inclusion level is therefore, necessary for further studies to ascertain if such increase will significantly affect these parameters and create a change.

CONCLUSION

The research examined the effect of dietary Kaolin as feed additive on some semen traits in New Zealand White and Chinchilla rabbit bucks. While dietary Kaolin additive did not result in significant improvement of most semen parameters such as pH, Volume, Viability, Normal morphology, Abnormal morphology, Actively motile, Sluggishly motile and %Dead, significant improvement was observed in Chinchilla and New Zealand White bucks fed 30g and 40g of Kaolin (feed additive) per kg of feed respectively.

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