EFFECTS OF *CURCUMA LONGA* RHIZOMES (TURMERIC) ON REPRODUCTIVE PERFORMANCE IN RABBITS IN THE HUMID TROPICS

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ABSTRACT

The purpose of this experiment was to determine the effects of graded levels of Curcuma longa (turmeric) powder on the kits sired by dosed male and female rabbits. Twenty rabbits (16 does and 4 bucks) 7 months of age were used for this experiment. The does and bucks were assigned to four groups (A – D) of 4 does to 1 buck per group. Groups A, B and C received 250, 500 and 1000 mg/kg body weight of turmeric powder reconstituted in distilled water. Group D (control) received 1 ml of distilled water. Dosing was done per os daily for 30 days before the buck in each group was allowed to cohabit with the dose of the corresponding group. Gestational length, litter body weights (at birth), litter size and crown-rump lengths were all measured. There were no significant variations (p>0.05) in the gestation length of does and litter body weight in all the groups. The mean litter size in Group B does was significantly higher (p<0.05) than that of Group D does. The crown-rump length of pups from does in all the turmeric-treated groups (A, B and C) were however significantly (p<0.05) higher than that of pups from Group D. The results of this study showed that at 500 mg/kg of turmeric powder, the dose had improved reproductive performance than when given at a higher dosage (1000 mg/kg) of turmeric powder per os.

Keywords: Rabbit, Turmeric, Reproductive performance, Gestation, Humid tropic, Nsukka

INTRODUCTION

The rabbit (*Oryctolagus cuniculus*), due to its favourable biological characteristics - short gestation interval, and high prolificacy, has been identified by the FAO (Lebas *et al.*, 1997) as one of the animals that can be reared successfully at the family level (Beaumont *et al.*, 2002). Rabbits can be classified as multipurpose animals for research and human uses because their uses are well-acknowledged in the fields of agriculture, biotechnology and medicine (Chantry-Darmon *et al.*, 2003). A rabbit needs inexpensive food sources and simple housing that can be easily constructed (Petrescu *et al.*, 2013). Rabbit has been recognized as an economic livestock that could bridge a wide gap in dietary protein in Nigeria. Rabbit is a micro-livestock producing about 47 kg of meat per doe per year, which is enough to solely meet the animal protein requirements of a medium-sized family under small-scale rural farming systems (Kalio *et al.*, 2008; Obasi *et al.*, 2019). Furthermore, the white meat of rabbits is very nutritious, easily digestible

and extremely low in cholesterol and sodium levels (Omole *et al*., 2005; Zamaratskaia *et al*., 2023). Due to its excellent protein content (22%), low-fat content (4%), and cholesterol content (5%), rabbit meat is considered to have health-promoting properties (Nistor *et al*., 2013; Gál *et al*., 2022). According to Nistor *et al*. (2013), rabbit meat has lower levels of fat (9.2 g/100 g) and cholesterol (56.4 mg/100 g) than other types of meat and higher levels of calcium (21.4 mg/100 g) and phosphorus (347 mg/100 g). Because of its high essential fatty acid content, low cholesterol rate, and high crude protein/energy ratio, its meat is valued for its organoleptic qualities (Gál *et al*., 2022). Research on the reproductive system revealed that the main obstacle to reaching peak performance in rabbit breeding is feeding (Iheukwumere and Okoli, 2002). For breeding rabbits, Effiong and Wogar (2007), recommended higher feeding and nutrient levels to sustain pregnancy longer, produce larger litters, and prevent does from letting down their milk. A modern production system must be used to increase animal production to meet the growing needs of the human population in terms of nutrition and economy. Research is still ongoing to learn more about these natural products that can improve rabbit performance. In the poultry industry, phytobiotics are a relatively new class of feed additives that have garnered a lot of attention recently. When added to livestock feeds, phytobiotics, which can be plant-derived materials from leaves, roots, flowers, whole plants, or extracts, help to improve animal performance (Grashorn, 2010). Ginger, garlic, turmeric, and other plants are examples of phytobiotics.

Curcuma longa L. (Zingiberales: Zingaberaceae) commonly called turmeric, is a perennial herb from the ginger family, that is an important ingredient in Indian ayurvedic medicine. Turmeric has been used as a spice and natural food colouring in Indian traditional medicine for centuries. Curcumin is the active ingredient in turmeric, and it contains three components: curcumin, desmethoxycurcumin, and methoxycurcumin, all of which are referred to as curcuminoids (Aggarwal *et al*., 2003). Curcumin gives turmeric its distinctive yellow colour and is known to be responsible for the majority of its therapeutic effects, including antibacterial, antifungal, anti-protozoal, antiviral, antioxidant, anti-inflammatory, and hypocholesterolemic properties (Chattopadhyay *et al*., 2004; Adamczak *et al*., 2020; Sharifi-Rad *et al*., 2020). Turmeric provides numerous health benefits at a low cost with no negative effects on livestock production (Sureshbabu *et al*., 2023). There is a need to boost the reproductive performance of rabbits in other to enhance their ability to supply the much-needed animal protein, especially in the tropical region as heat is one of the most significant climatic factors which may upset rabbit production. The rabbit is very largely dependent on respiratory evaporation for the regulation of its body temperature and this confers only a limited power of adaptation to hot climates. Drugs and synthetic hormones have been the mainstay for fertility boosting and reproductive-related disease treatment in farm animals before now. There is a global campaign towards organic livestock production to prevent the deleterious effects of drug residues and hormones from edible animal tissues to humans. Turmeric, which contains vitamins and minerals and is antibiotic-free, has been used as a dietary supplement for rabbits and poultry to improve voluntary feed intake, nutrient digestibility, and growth performance (Lagua and Ampode, 2021; Aderemi and Alabi, 2023). Research have also reported the use of turmeric in improving reproductive indices in rabbits. Studies by El-Rawi *et al*. (2020) and El-kholy *et al*. (2021) reported that dietary turmeric supplementation improved the testicular functions and reproductive performance of buck rabbits. In doe rabbits, dietary turmeric powder enhances the release of ovarian hormones and the response of ovaries to gonadotropin. This simultaneously causes an increase in the fertility, fecundity, production and growth of ovarian follicles and vitality of the pups (Sirotkin *et al*., 2017). These studies were carried out in the subtropical regions within the arid and semi-arid zones. Acknowledging the influence of weather on the reproductive performance of animals, there is, however, a paucity of information on the effect of dietary turmeric supplementation on the reproductive indices of rabbits kept in the tropical Guinea Savanna (humid) climate of sub-Saharan

West Africa. The objective of the study, therefore, is to evaluate the effect of feeding graded levels of *C. longa* on reproductive performance in rabbits reared in the humid tropics.

MATERIALS AND METHODS

Study Location: The study was carried out at the Animal House of the Department of Veterinary Obstetrics and Reproductive Diseases, Faculty of Veterinary Medicine, University of Nigeria, Nsukka situated in the Northern Guinea Savannah Zone of Nigeria and lying between latitudes 6°52′N and 6°58′N and between longitudes 7°20′E and 7°27′E at an elevation of 646 m above sea level (Ugwuanyi *et al*., 2015). The average annual rainfall in the area is 502 mm lasting from late March to mid-October. The daily temperature during the wet season is about 23.04°C and the daily relative humidity is about 72%. The dry season lasts from November to April, with the daily temperature ranging from 18 to 37°C and the daily relative humidity ranging from 20 – 30% (Ezeh and Ugwu, 2010; Okoro *et al*., 2021).

Ethic: The approval for this study was obtained from the Institutional Animal Care and Use Committee (IACUC), Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Nigeria (Approval Number: FVM-UNN-IACUC-2021-0264).

Turmeric: The turmeric powder (Tiger Brand) used for this study was procured from Tiger Foods Limited, Onitsha-Owerri Road, Obosi, Anambra, Nigeria. The turmeric powder was reconstituted in distilled water into different concentrations (250, 500 and 1000 mg/kg) as required.

Experimental Animals: A total of sixteen (16) does and four (4) bucks, seven (7) months of age, weighing between 950 – 1500 grams were used for this experiment. They were acclimatized for two (2) weeks before the commencement of the experiment. The does and bucks were kept in separate cages.

Experimental Design: After acclimatization, the does and bucks were assigned to four groups (A – D) of four does to one buck per group. Groups A, B and C received 250, 500 and 1000 mg/kg body weight of turmeric powder reconstituted in distilled water, respectively. Group D (control) received 1 ml of distilled water as a placebo and served as the control. The rabbits were treated with turmeric for 30 days before the bucks were introduced. All treatments were given *per os* daily till the does kindled. The animals were allowed to cohabit for five days before taking the does to their cages and observed till they were kindled. Immediately after parturition, the following parameters were determined:

Gestational length: This was determined mathematically by obtaining the difference from the dates of mating to the date of kindling (Loytved and Fleming, 2016).

Litter body weights: The pups were placed on a sensitive scale and the weight of the pups from each doe was recorded (in grams). After, the mean weight from all the litters in each group was obtained.

Litter size: This was determined by counting the number of pups from each group.

Crown-rump lengths: A neat thread was placed from the crown to the rump of each pup, after which the thread was placed on a meter rule to obtain the length in centimetres. The mean length of the pups in each group was obtained.

Statistical Analysis. One-way analysis of variance (ANOVA) followed by a least significant difference (LSD) test post hoc was performed using the IBM Statistical Package for Social Sciences (SPSS) statistics version 16.0 for Windows. P-values ($p<0.05$) were considered statistically significant. Summary data generated are expressed in mean ± standard error of mean (SEM) and presented in graphs.

RESULTS

Gestation Length: The administration of turmeric showed no significant variations ($p>0.05$) in the gestation length of does in all the groups. The gestation period of the does was between 30 – 31 days (Figure 1).

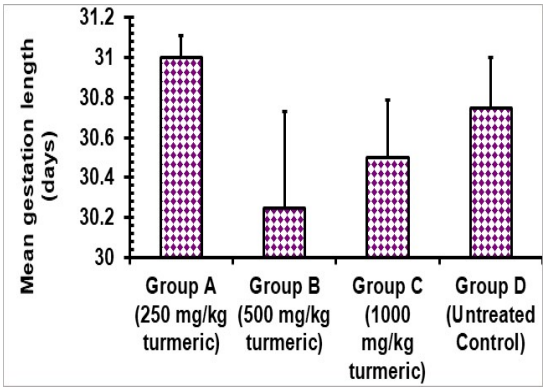

Figure 1: Mean gestation period of does that were treated with varied levels of turmeric for 30 days before breeding compared to the control

Litter Size: The does in Group B (500 mg/kg) had a significantly higher ($p<0.05$) number of pups than that of Group D (control) does (Figure 2).

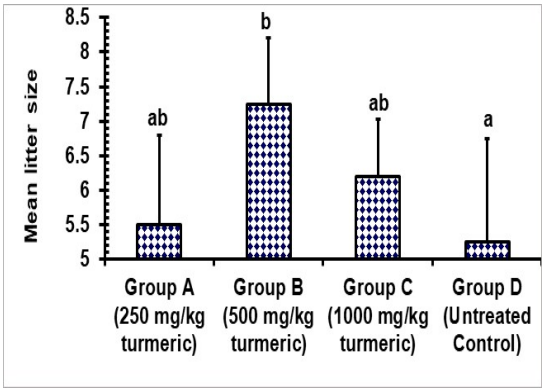

Figure 2: Litter size from female rabbit groups given varied levels of turmeric for 30 days before breeding. *[ab] = plotted mean values with different letter superscripts are significantly different (p<0.05)*

Body Weight of Pup: The pup's body weight in all the groups did not significantly vary ($p>0.05$) (Figure 3).

Length of Pups: The crown-rump length of pups from does in all the turmeric-treated groups (A, B and C) was however significantly higher ($p<0.05$) than that of pups from group D (control) (Figure 4).

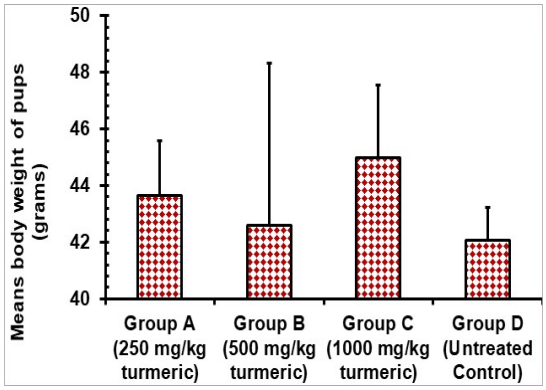

Figure 3: Pup body weight of the litter from female rabbit groups given varied levels of turmeric for 30 days before breeding

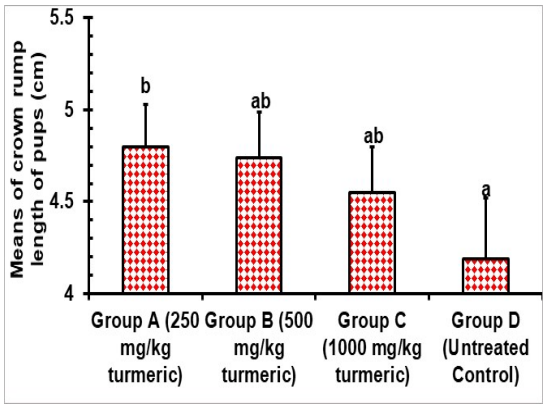

Figure 4: Crown-rump length of pups from female rabbit groups given varied levels of turmeric for 30 days before breeding. *[ab] = plotted mean values with different letter superscripts are significantly different (p<0.05)*

DISCUSSIONS

The productivity of a rabbit breeding program is directly dependent on the reproductive performance of rabbits. Evaluating reproductive performance is essential for selecting ideal rabbit breeds and food supplements that enhance effective breeding. It was observed that the administration of graded levels of turmeric powder had no significant effect on the gestational length of the does. This finding suggests that subacute exposure of rabbits to *C. longa* at a dose below 1000 mg/kg does not alter the hormonal and other body biochemical interplay that are necessary for maintaining pregnancy in does. It also suggests that the administration of *C. longa* at the studied levels was safe concerning the gestation length of rabbits. The results of this study were similar to that of Majeed *et al.* (2019)

who reported that the oral treatment of tetrahydrocurcumin had no significant effect on gestation length of the treated female rats. Similar findings by Symeon *et al.* (2015) and Saidj *et al*. (2018) reported that nutrition did not affect the gestation length of rabbits.

The significantly higher litter size recorded for does in Group B (500 mg/kg) when compared to the control suggests that there may be an optimal turmeric dose below and/or above which the turmeric components will give a maximal effect on the litter size of treated does. The results from groups A and C agree with the findings of Majeed *et al.* (2019) who reported no treatment-related effect on mean litter size after oral treatment of female rats with tetrahydro curcumin, in comparison to the control group. However, the groups A and C results are not consistent with Habeeb *et al.* (2019) who observed significant improvement in litter size of does fed ginger and curcumin-supplemented diets during the hot summer season.

Studies have shown that low birth weight infants are at higher risk of perinatal and infant death (Kang *et al.*, 2013; Luo *et al.,* 2021; Belabbas *et al*., 2022). The results of this study showed no significant difference ($p>0.05$) in the pup body weights across the groups. This suggests that *C. longa* had no adverse effect on the survival rate of embryos and foetuses during gestation and that the dietary levels of *C. longa* used in this study were safe.

A positive correlation has been reported between crown-rump length and birth weight (Kang *et al*., 2013). Results from our study showed higher crown-rump length of pups from does across all groups given graded levels of *C. longa* powder in comparison to pups kindled by the control does. Studies on the impact of food supplements on crown-rump length of rabbits and other animals are very rare, however, fetal crown-rump is affected by the parity order of the dam and when the horn contains more foetuses; the foetal crown-rump is reduced in nulliparous compared to primiparous does (Argente *et al*., 2008). The does used in this study were nulliparous, but the treated does recorded higher crown-rump lengths compared to the control does. Available uterine space per foetus is higher in nulliparous than primiparous and increased when the number of implanted embryos per horn decreased (Argente *et al.,* 2008). Argente *et al*. (2008) reported that the crowding of the uterine horn was associated with lesser uterine space per foetus. However, the significantly increased crown-rump length of pups observed in the treated groups may suggest improved reproductive health of the does due to the administration of *C. longa* powder.

Conclusion: The results of this study showed that the levels of *C. longa* used in the study had no adverse effects on the bucks and does that were treated. Litter size at kindling was better with 500 mg/kg *per os* administration, but pup body weight in all the groups did not significantly vary. The spice increased the crown-rump length of the pups from all the treated groups. 500 mg/kg dose of *C. longa* improved reproductive performance more than when given at a higher dosage (1000) mg/kg.

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