RESEARCH ARTICLE

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Evaluation of Dietary Turmeric (*Curcuma longa* Linn.) Supplement for Fecundity in Female Wistar Rats

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ABSTRACT: Plants have a long-time history in medicine and turmeric is named among the wonder plants with numerous pharmacological properties. Due to inadequacies in healthcare and high cost of managing infertility especially in the developing countries, it has become crucial to source for biologically active fertility agents from plants which are safe and can interfere with the natural process of reproduction. It is on this premise and the paucity of information on fertility effect of turmeric that this study was designed to ascertain if turmeric supplement can enhance the fecundity of females using Wistar rat as model. Fifteen sexually mature female rats with regular oestrous cycle were randomly divided into 3 groups (5 rats per group) and treated by oral gavage daily for two weeks and throughout the period of mating as follows; Group 1 (Control) = 1mL of distilled water, Group 2 = 250 mg/kg turmeric and Group 3 = 500 mg/kg turmeric. For mating, proven male rats were paired with the females in the ratio of 1:1 and confirmation of mating was designated as gestation day (GD) 0. On GD 20, laparotomy was done to assess the fecundity markers - total number of uterine implants, corpora lutea and viable pups as well as the foetal indices – foetal crown-rump length and weight. Turmeric produced no significant ($p > 0.05$) effect on the fecundity markers and foetal indices relative to the control. It is concluded that turmeric supplement has no effect on female fecundity at the doses and duration used in this study. It may therefore not be a pro-fertility herb and may not contain biologically active fertility agents. The study will provide insight to the populace and traditional medicine practitioners on the effect of turmeric on female fertility. It will also fill the gap in literature where there is paucity of information.

Keywords: Corpora lutea, fecundity markers, foetal indices, gestation, uterine implant.

INTRODUCTION

Infertility is becoming a major cause of concern for many women and men, and is considered a global issue for childbearing couples who are unable to conceive. The major treatment for infertility is medical and it involves the use of fertility drugs or surgery. However, the medical treatment for infertility is highly costly. Due to the fact that complementary and alternative therapies seems to be more effective, safe and affordable, the majority of women chose them instead (Vincent and Furnham, 1996). Hence in recent time, women are more likely to adopt herbal remedies due to the high expense of conventional medications, the negative effects of chemical drugs on reproductive health, and the advancements in modern fertility treatments. On the other hand, because herbal medicine has a variety of chemicals with phytoestrogen, antioxidant, and nutritional benefits, it is seen as a viable alternative to chemical medications (Akbaribazm et al., 2021).

Fertility issues have traditionally been treated using herbal medicine. Undoubtedly, there is proof that male and female fertility problems were treated with herbal medicine as early as 200 A.D (Kashani and Akhondzadeh, 2017). These herbal medicines for fertility which are derived from special plants, either whole plants or plant parts such as roots, stems, leaves, fruits an seeds, are thought to enhance sex drive and also have a positive impact on the reproductive system and endocrine system. Herbal medicine can improve female infertility in various ways such as improving follicular development, increasing the number of high-quality oocytes and embryos, and enhancing ovulation, clinical pregnancy rates, live birth rate and endometrial receptivity (Mohamed Noor Khan et al., 2022).

Turmeric (*C. longa*) is named among the 'wonder plants' with numerous pharmacological properties (Obinna and Zitte, 2023) and its use in herbal medicine is widespread. Turmeric rhizomes are useful in folk medicine against a wide range of ailments (Bulus et al., 2017; Sharifi-Rad et al., 2020) and are considered safe herbal medicine because no significant side effect has yet been described using it as a dietary supplementation.

Due to inadequacies in healthcare and the high cost of managing infertility especially in the developing countries, it has become crucial to source for biologically active fertility agents from plants that are safe and can interfere with the natural process of reproduction. It is on this premise and the paucity of information on fertility effect of turmeric that this study was designed to evaluate the effects of dietary turmeric (*C. longa*) supplement on fecundity in female Wistar rats.

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MATERIAL AND METHODS

Plant Material and Preparation

Fresh rhizomes of turmeric (*Curcuma longa* Linn.) were purchased from the popular Fruit Market, Kaduna Street, D-line, Port Harcourt, Rivers state. The Authentication was carried out at the University of Port Harcourt Reference Herbarium for Research and Germplasm Conservation by a plant taxonomist. The herbarium number of the plant is UPH/P/259.

The turmeric rhizomes were dried under shade at room temperature (25°C). The dried rhizomes were pulverized and weighed. The pulverized powder was further shade-dried to remove any residual moisture, before passing it through a fine sieve. The obtained turmeric powder was used for the study.

Animals

Fifteen sexually mature female Wistar rats with regular oestrous cycle, and 15 proven male Wistar rats were used in this study. The males were strictly procured for mating. The rats were housed in clean cages in the Experimental Animal House of the Department of Pharmacology, University of Port Harcourt under ambient temperature of 25-30°C; daylight of approximately 12 hours of natural light per day and relative humidity of 50-60%. The rats were allowed two weeks for acclimatization and were fed rat chow and supplied tap water ad libitum within the period and throughout the study. All experimental animals were humanely handled in accordance with the Ethics and Regulation guiding the use of research animals as approved by the institution.

Experimental Design

The 15 female rats were randomly assigned to three groups designated 1, 2 and 3. Each group had five rats. The dietary turmeric supplement (DTS) in powder form was reconstituted with distilled water to get a stock solution of 100 mg/mL. Group 1 was the control and received only the vehicle (1 mL distilled water); whilst groups 2 and 3 received 250 mg/kg and 500 mg/kg body weight respectively. The rats were dosed orally 24 hourly for 2 weeks and during the period of mating with the aid of a gavage needle.

After 2 weeks of administration with DTS, the female rats in proestrus phase of oestrous cycle were paired with the males overnight in a ratio of 1:1 for mating. Mating was confirmed the following morning by the presence of sperm cells in the vaginal aliquot and / or copulatory plug and is referred to as day 0 of gestation (Assayed et al., 2010; Obinna and Agu, 2016; Obinna et al., 2019). All administrations ceased once mating was confirmed.

On day 20 of gestation, laparotomy was carried out under diethyl ether anesthesia. The uterine horns were incised at the greater curvature, and the following were evaluated;

1. Fecundity Markers - Total uterine implants, Total corpora lutea and Number of viable pups
2. Foetal indices – Foetal crown-rump length and Foetal weight.

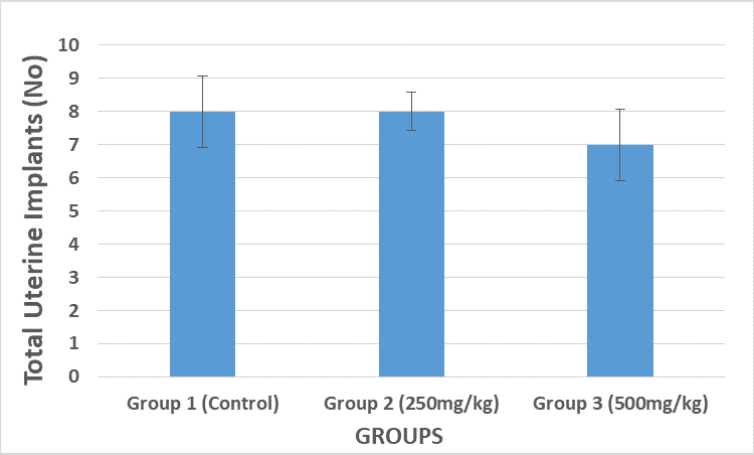
Data analysis

Data generated in the study were subjected to one-way Analysis of Variance (ANOVA), and variant means were separated by the Tukey's post-hoc test. The statistical analyses were performed using IBM SPSS statistics 25. Significance was accepted at probability value of less than 0.05 ($P < 0.05$). The results were presented as Means ± Standard Error of Mean (SEM).

RESULTS

The ingestion of dietary turmeric supplement by female wistar rats at the doses of 250 and 500 mg/kg for 2weeks and throughout the period of mating did not have any significant ($p > 0.05$) effect on the fecundity markers and foetal indices relative to the control as seen in figures 1-5.

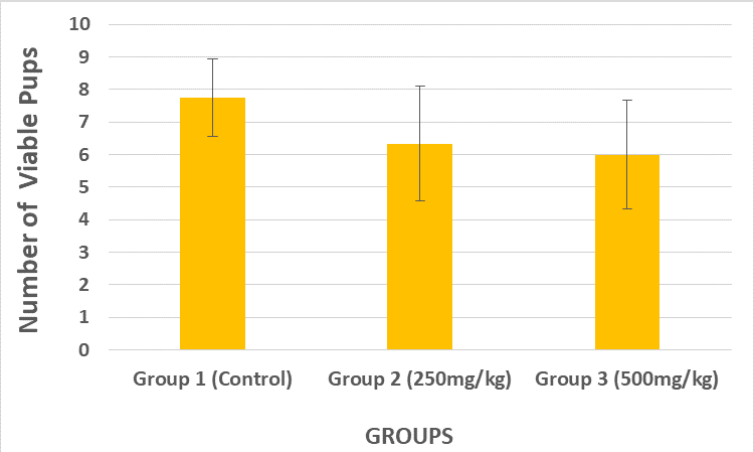
Figure 1 showed that the total uterine implants of DTS treated groups 2 and 3 at the doses of 250mg/kg and 500mg/kg respectively were not significantly ($p > 0.05$) altered in comparison with the control (group 1).



* Values are given as mean ± SEM for 5 rats in each group. Experimental groups (Groups 2 and 3) are compared with group 1 (control). No significant difference at a 95% confidence interval (P >0.05). P: statistical level of significance as determined by one-way Analysis of Variance (ANOVA) followed by Tukey's post-hoc test

Figure 1. *Effect of Dietary Turmeric Supplement on Total Uterine Implant*

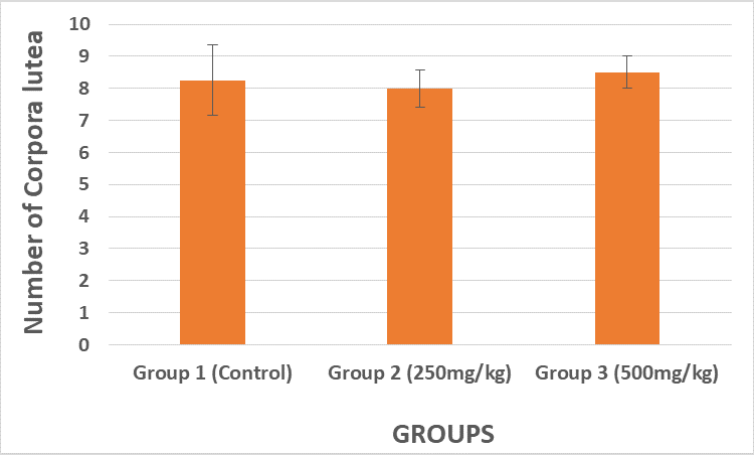
From figure 2, it can be seen that 250 and 500mg/kg DTS treated rats (groups 2 & 3) had a dose-dependent non-significant (p> 0.05) decrease in the number of viable pups relative to the control rats (group 1).



* Values are given as mean ± SEM for 5 rats in each group. Experimental groups (Groups 2 and 3) are compared with group 1 (control). No significant difference at a 95% confidence interval (P >0.05). P: statistical level of significance as determined by one-way Analysis of Variance (ANOVA) followed by Tukey's post-hoc test

Figure 2. *Effect of Dietary Turmeric Supplement on Number of Viable Pups*

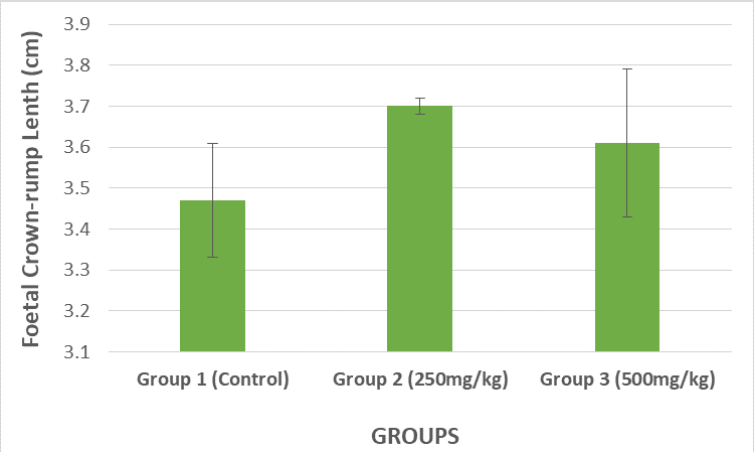
The number of corpora lutea of 250 and 500 mg/kg DTS treated rats (groups 2 and 3) were not different (p> 0.05) from those of the control rats (group 1) (Figure 3).



* Values are given as mean ± SEM for 5 rats in each group. Experimental groups (Groups 2 and 3) are compared with group 1 (control). No significant difference at a 95% confidence interval (P >0.05). P: statistical level of significance as determined by one-way Analysis of Variance (ANOVA) followed by Tukey's post-hoc test

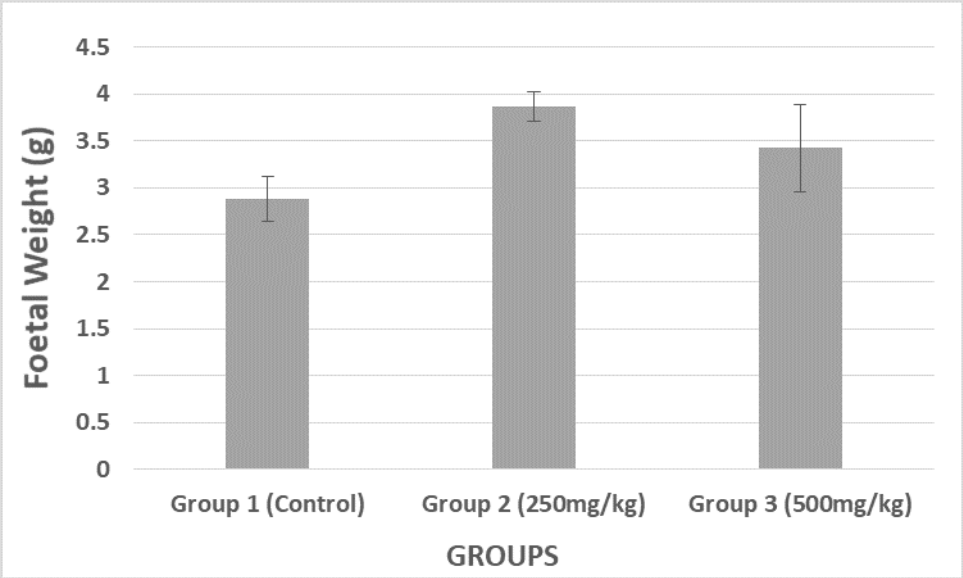
Figure 3. *Effect of Dietary Turmeric Supplement on Number of Corpora lutea*

The foetal crown-rump length and foetal weights of pups from groups 2 and 3 (250 and 500mg/kg DTS treated rats) did not vary markedly (p> 0.05) from those of group 1 (control) (Figures 4 and 5)



* Values are given as mean ± SEM for 5 rats in each group. Experimental groups (Groups 2 and 3) are compared with group 1 (control). No significant difference at a 95% confidence interval (P >0.05). P: statistical level of significance as determined by one-way Analysis of Variance (ANOVA) followed by Tukey's post-hoc test

Figure 4. *Effect of Dietary Turmeric Supplement on Foetal Crown-Rump Length*



* Values are given as mean ± SEM for 5 rats in each group. Experimental groups (Groups 2 and 3) are compared with group 1 (control). No significant difference at a 95% confidence interval (P >0.05). P: statistical level of significance as determined by one-way Analysis of Variance (ANOVA) followed by Tukey's post-hoc test

Figure 5. *Effect of Dietary Turmeric Supplement on Foetal Weight*

DISCUSSION

Herbs and plants with medicinal properties are fast substituting modern conventional therapy in the treatment of infertility and other ailments. Since turmeric has shown great potential in the management and treatment of many illnesses and health challenges, this study examined the impact of turmeric on female fertility using rat model. Total uterine implant, number of viable pups, and the number of corpora lutea were markers used to assess the female fecundity (Ishii et al., 2012; Wise et al., 2008). The foetal crown-rump length and foetal weight were also measured to ascertain if the dietary turmeric supplement impacted the maternal follicles that developed into the foetuses after fertilization.

The results of this study showed that dietary turmeric supplement did not increase the total uterine implant, number of viable pups, and the number of corpora lutea. The foetal crown-rump length and foetal weights were not also enhanced by the turmeric supplement.

In mammals generally, corpora lutea are the ovarian structures that occurs after ovulation and signify successful ovulation. Since the corpora lutea are formed from the follicular cells that remain in the ovary after ovulation (Accialini et al., 2017), the number of corpora lutea has become a crucial criterion for the evaluation of the fertility of female rats. The number of ovulatory follicles that eventually ovulate during each reproductive cycle determines the number of corpora lutea formed. However, due to the short oestrous cycle of 4-6 days, rodents do not have functional corpus luteum except during copulatory ovulation, pregnancy or pseudopregnacy. According to Hennebold (2018), a functional corpus luteum does not form during the ovarian cycle in species like rodents with ultrashort-lived corpora lutea unless ovulation is triggered after copulation, as in the case of rabbits, and/or pseudopregnancy or pregnancy, as in the case of rats and mice. Contrary to pseudopregnancy, which results in the development of functional corpora lutea that secrete progesterone for 12–14 days, fertilization and implantation cause the corpus luteum to continue secreting progesterone for at least 21 days during gestation, which is essential for sustaining pregnancy.

The uterine implants are the areas in the uterine endometrium where the fertilized egg implants. In human in vitro fertilization, pregnancy depends on embryo implantation (Paulson et al., 1990). The endometrium which is a hormone-responsive mucosa that lines the uterine cavity and undergoes cyclic proliferation and differentiation to support embryo implantation, is a highly dynamic tissue that plays essential role in the establishment and maintenance of normal pregnancy (Fox et al., 2016; Lessey and Young, 2012). Impaired endometrial expression is associated with decreased implantation (Fox et al., 2016) and by extension the total uterine implant, hence its role in assessing female fertility. The number of viable pups can be used to estimate the number of successful pregnancies, and by implication, the fertility of the dam.

Dietary turmeric supplements as used in this study may be said to lack the potential to increase the fecundity markers and foetal indices of rats. Studies have shown that curcumin which is the main biologically active component of turmeric has different effects in female reproductive processes (Azami et al., 2020; Inano et al., 2000; Japheth et al., 2021), though very few reported on its effect on fecundity (Sirotkin, 2022). Koca et al. (2020) reported that dietary curcumin promoted ovarian

follicullogenesis and ovulation in the fish Pseudotropheus socolof. Although feeding turmeric powder to rabbits increased the number and diameter of ovarian follicles, it did not affect the size of the ovary. Nevertheless, it improved the viability of the rabbits' pups but had no effect on their fecundity (Sirotkin and Harrath, 2014).

CONCLUSION

Although turmeric is safe and has several medicinal benefits, this study demonstrated that itt has no effect on the female fecundity of rats at the doses and duration used in this study. This finding shows that turmeric may not be a pro-fertility herb, and as such may not contain biologically active fertility agents that can interfere with the natural process of reproduction. This study will provide insight to the populace and traditional medicine practitioners on the effect of turmeric on female fecundity. It will also fill the gap in literature where there is paucity of information.

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CONFLICT OF INTEREST

The authors have not declared any conflict of interest

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