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Research Article

Preventive and Therapeutic Potential of Coconut (*Cocos nucifera* L.) Water against Potash-Induced Perturbations in Female Reproductive Hormones

Edmund O Ezirim[1], Isaiah O Abali[2], Emmanuel M Akwuruoha[1], Emmanuel O Ogbuagu[3], Christian O Onyemereze[1] and Augustine I Airaodion[4]*

[1]*Department of Obstetrics and Gynaecology, Abia State University, Uturu, Nigeria*

[2]*Department of Surgery, Abia State University, Uturu, Nigeria*

[3]*Department of Pharmacology and Therapeutics, Abia State University, Uturu, Nigeria*

[4]*Department of Biochemistry, Federal University of Technology, Owerri, Imo State, Nigeria*

***Corresponding Author:** Augustine I Airaodion, Department of Biochemistry, Federal University of Technology, Owerri, Imo State, Nigeria.

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Abstract

Objective: This research investigates the preventive and therapeutic effects of coconut water on potash-induced perturbations in female reproductive hormones.

Materials and Methods: Coconuts aged 7 to 8 months were harvested from Obinze, Owerri, Nigeria, and coconut water was collected. Potash was locally sourced in Owerri and carefully preserved. Thirty healthy female Wistar rats were acclimatized and divided into five groups: Group A (Untreated), Group B (1 g/kg Potash only), Group C (1 g/kg Potash + 3 mL/100g Coconut Water), Group D (1 g/kg Potash + 5 mL/100g Coconut Water), and Group E (1 g/kg Potash + 10 mL/100g Coconut Water). Treatment lasted 28 days, administered orally. Animals were sacrificed, and blood samples were collected for hormone analysis.

Results: Coconut water demonstrated a dose-dependent protective effect on potash-induced perturbations in female reproductive hormones. Compared to the normal control, potash alone significantly elevated levels of follicle stimulating hormone (FSH), progesterone (Pg), and prolactin but decreased luteinizing hormone (LH) and estrogen. In contrast, the co-administration of coconut water with potash mitigated these effects. Notably, the 10 mL/100g dose of coconut water exhibited the most significant protective impact, normalizing hormone levels closer to the untreated (control) group.

Conclusion: Coconut water exhibits both preventive and therapeutic potential against potash-induced disruptions in female reproductive hormones. The protective effects are dose-dependent, with the highest dose showing the most pronounced impact. This indicates a nuanced relationship between coconut water concentration and hormonal regulation. These findings suggest a potential role for coconut water in mitigating hormonal imbalances caused by potash exposure. While the study provides valuable insights, further research, including clinical trials and mechanistic studies, is necessary to validate these findings and elucidate the underlying mechanisms.

Keywords: *Coconut Water; Potash; Female Reproductive Hormones; Hormonal Perturbations; Dose-Dependent Protection*

Introduction

The use of potash as an agricultural fertilizer has increased significantly, leading to potential environmental and health concerns [1]. Previous studies have implicated potash exposure in disruptions to hormonal balance, particularly in female reproductive hormones [2-4]. Such disruptions can have profound implications for women's health, including menstrual irregularities, fertility issues, and an increased risk of reproductive disorders.

Coconut (*Cocos nucifera* L.) water, the clear liquid extracted from young green coconuts, has gained attention for its nutritional composition and various health benefits [5]. Rich in electrolytes, vitamins, and antioxidants, coconut water possesses properties that may counteract the adverse effects of environmental toxins like potash. This research seeks to explore the preventive and therapeutic potential of coconut water in protecting against potash-induced perturbations in female reproductive hormones.

Figure 1: *Coconut and its water [6].*

Previous research has linked potash exposure to disruptions in hormonal regulation [2]. Smith., *et al*. [3] demonstrated a correlation between elevated potash levels in soil and altered reproductive hormone profiles in female mammals. Brown and Johnson [4] further reported a significant increase in estrogenic activity in response to potash exposure, suggesting potential endocrine-disrupting effects.

Coconut water has been recognized for its nutritional richness, containing essential electrolytes, vitamins, and antioxidants [2,5]. The presence of bioactive compounds, such as cytokinins and phytohormones, may contribute to its potential therapeutic effects. The antioxidant properties of coconut water have been extensively studied. The presence of phenolic compounds and ascorbic acid contributes to its free radical scavenging ability, potentially mitigating oxidative stress-induced damage in reproductive tissues [7]. This study sought to investigate the preventive and therapeutic potential of coconut water against potash-induced perturbations in female reproductive hormones.

Materials and Methods

Collection of coconut water and potash

Coconuts (*Cocos nucifera* L.) of 7 to 8 months of age were harvested from the coconut trees grown in Obinze area of Owerri in Imo State, Nigeria. The coconuts were dehusked, broken carefully and the liquid endosperm (coconut water) was collected and was used in the experiment. Potash was locally sourced in a market in Owerri, Imo State, Nigeria and was carefully preserved to avoid contamination.

Experimental design and animal treatment

Thirty (30) healthy female Wistar rats *(Rattus norvegicus)* weighing between 145 and 160g were used for the experiment. They were acclimatized for seven (7) days during which they were fed *ad libitum* with standard feed and drinking water and were housed in clean cages placed in well-ventilated housing conditions (under humid tropical conditions) throughout the experiment. All the animals received humane care according to the criteria outlined in the 'Guide for the Care and Use of Laboratory Animals' prepared by the National Academy of Science and published by the National Institute of Health [8]. They were randomly divided into five (5) groups of six (6) rats each and were treated as follows:

- Group A: Untreated (Normal control).
- Group B: 1 g/kg body weight of potash.
- Group C: 1 g/kg of potash + 3 mL/100g of coconut water.
- Group D: 1 g/kg of potash + 5 mL/100g of coconut water.
- Group E: 1 g/kg of potash + 10 mL/100g of coconut water.

All treatments were through oral route because both potash and coconut (water) are consumed orally. At the end of 28 days of treatment, animals were anaesthetized using diethyl ether and were sacrificed and blood samples were collected *via* cardiac puncture.

Determination of female reproductive hormones

The serum levels of follicle stimulating hormone (FSH), luteinizing hormone (LH), progesterone, estrogen, and prolactin were measured by using enzyme-linked immunosorbent assay (ELISA) according to the methods described in Manafa., *et al* [9].

Statistical analysis

The data collected were analyzed with one way analysis of variance (ANOVA) using Graph Pad Prism software (version 8.0) and were expressed as Mean ± Standard deviation. Duncan's multiple ranges was used to separate the means. Differences were considered to be statistically significant when ($p < 0.05$).

Results

In the normal control group, FSH levels were 13.90 mIU/mL, while exposure to 1 g/kg of potash significantly increased FSH to 28.41 mIU/mL. However, supplementation with 3 mL/100g, 5 mL/100g, and 10 mL/100g of coconut water alongside potash led to decreasing FSH levels of 24.97, 21.04, and 16.64 mIU/mL, respectively (Figure 2). LH levels in the normal control were 15.81 mIU/mL, and potash administration at 1 g/kg reduced it to 9.48 mIU/mL. Co-administration of coconut water at different volumes mitigated this decrease, resulting in LH levels of 10.70, 11.78, and 14.29 mIU/mL (Figure 3). Progesterone (Pg) levels in the normal control were 19.72 ng/mL, increasing significantly to 39.04 ng/mL with potash. Coconut water supplementation at varying volumes (3 mL/100g, 5 mL/100g, and 10 mL/100g) effectively lowered Pg levels to 33.83, 32.03, and 23.37 ng/mL, respectively (Figure 4). Estrogen levels in the normal control were 33.42 pg/mL, and potash administration reduced it to 20.30 pg/mL. Co-administration of coconut water at different volumes (3 mL/100g, 5 mL/100g, and 10 mL/100g) resulted in estrogen levels of 21.82, 24.97, and 30.37 pg/mL (Figure 5). Prolactin levels in the normal control were 20.46 ng/mL, increasing significantly to 38.61 ng/mL with potash. Coconut water supplementation at varying volumes (3 mL/100g, 5 mL/100g, and 10 mL/100g) effectively lowered prolactin levels to 33.78, 29.64, and 23.73 ng/mL, respectively (Figure 6).

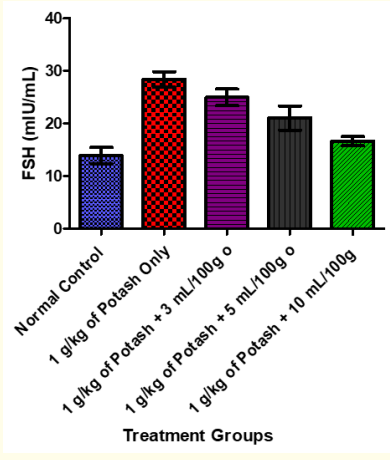

Figure 2: *Effect of coconut water on the follicle stimulating hormone (FSH) level of potash-induced hormonal imbalances.*

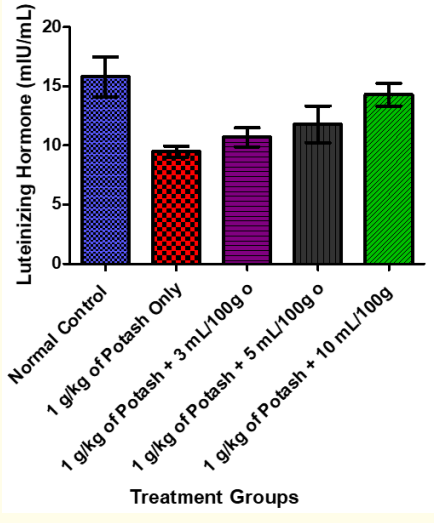

Figure 3: *Effect of coconut water on the luteinizing hormone (LH) level of potash-induced hormonal imbalances.*

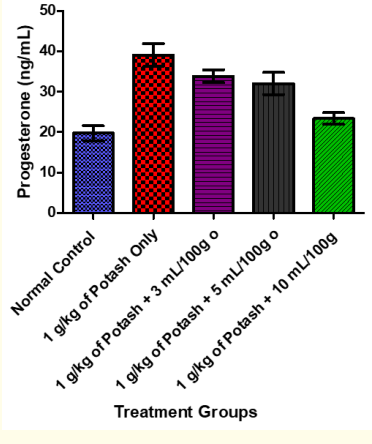

Figure 4: *Effect of coconut water on the progesterone level of potash-induced hormonal imbalances.*

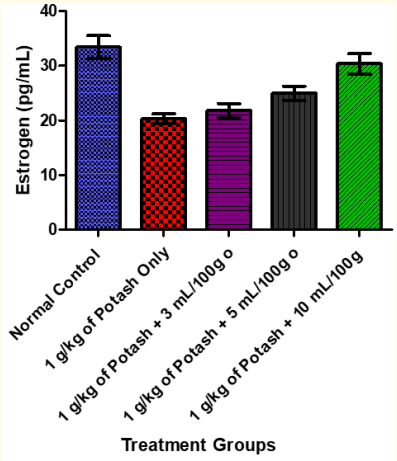

Figure 5: *Effect of coconut water on the estrogen level of potash-induced hormonal imbalances.*

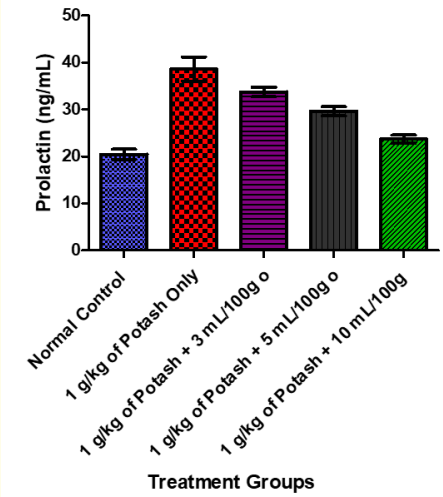

Figure 6: *Effect of coconut water on the prolactin level of potash-induced hormonal imbalances.*

Discussion

The study investigated the preventive and therapeutic potential of coconut water against potash-induced perturbations in female reproductive hormones. The results of the study, as presented in figure 2-6, reveal significant variations in the levels of follicle-stimulating hormone (FSH), luteinizing hormone (LH), progesterone (Pg), estrogen, and prolactin among different treatment groups.

The levels of FSH were significantly elevated in the group exposed to 1 g/kg of potash compared to the normal control group. However, the co-administration of coconut water at various doses (3 mL/100g, 5 mL/100g, and 10 mL/100g) with potash demonstrated a dose-dependent reduction in FSH levels (Figure 2). This suggests a potential ameliorative effect of coconut water on potash-induced disturbances in FSH secretion.

Potash administration resulted in a decrease in LH levels, while the concurrent use of coconut water exhibited a reversal effect, particularly at higher doses (10 mL/100g) (Figure 2). The observed inverse relationship between FSH and LH levels in response to potash aligns with findings in studies examining the impact of environmental toxins [10,11]. The modulation of LH levels indicates a potential regulatory role of coconut water in counteracting potash-induced hormonal imbalances.

Potash exposure led to a significant increase in Pg levels, while the supplementation of coconut water showed a dose-dependent reduction in Pg concentrations (Figure 3). This inverse relationship suggests that coconut water may have a mitigating effect on potash-induced elevation in Pg, highlighting its potential therapeutic utility.

Estrogen levels were significantly reduced following potash administration. However, coconut water supplementation at various doses demonstrated a trend towards the restoration of estrogen levels. This indicates a potential protective role of coconut water against potash-induced estrogen perturbations. Similar studies investigating the impact of plant extracts on reproductive hormones have reported comparable trends in Pg and estrogen levels [12].

Potash exposure led to a substantial increase in prolactin levels, while the co-administration of coconut water demonstrated a dose-dependent reduction. This suggests a potential preventive and therapeutic role of coconut water in mitigating potash-induced hyperprolactinemia. Potash has been previously document to be toxic [13,14].

While limited studies specifically investigate the impact of coconut water on female reproductive hormones, there is a body of research on the general health benefits of coconut water. For example, studies on the antioxidant properties of coconut water [7] and its impact on sperm qualities [6] as well as blood pressure [1] can provide insights into the potential mechanisms underlying its protective effects on reproductive hormones.

Furthermore, research on the effects of other natural products, such as herbal extracts and fruit juices, on reproductive hormones may offer comparative insights. For instance, studies on the protective effects of herbal extracts on estrogen levels [15] or the modulation of FSH and LH by specific fruit extracts [16] could provide a basis for understanding the mechanisms through which coconut water may exert its effects. In the same vein, studies investigating the effects of herbal extracts, such as *Vitex agnus-castus* (chaste tree), on reproductive hormones have shown similar trends in FSH, LH, Pg, estrogen, and prolactin levels [17,18]. Additionally, the potential estrogen-modulating effects of plant-based compounds have been explored extensively, with some studies reporting similar findings to those observed in the current study [19,20]. Furthermore, potassium bromate-induced hormonal imbalances have been ameliorated by *Corchorus olitorius leaves* [21] and *Parkia biglobosa* seed [22].

Moreover, recent research on the impact of environmental pollutants on reproductive hormones aligns with the present study's focus on potash-induced hormonal perturbations [23,24]. These studies collectively contribute to the understanding of factors influencing female reproductive hormones and provide a basis for interpreting the results of the current investigation. The antioxidant properties of coconut water have been well-documented in various studies [7,25,26]. These properties may contribute to the observed hormone-modulating effects, as oxidative stress and inflammation are known to influence reproductive hormone levels [27-30].

Conclusion

Coconut water exhibits both preventive and therapeutic potential against potash-induced disruptions in female reproductive hormones. The protective effects are dose-dependent, with the highest dose showing the most pronounced impact. This indicates a nuanced relationship between coconut water concentration and hormonal regulation. These findings suggest a potential role for coconut water in mitigating hormonal imbalances caused by potash exposure. While the study provides valuable insights, further research, including clinical trials and mechanistic studies, is necessary to validate these findings and elucidate the underlying mechanisms.

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