

## Consumption of Coconut (*Cocos nucifera* L.) Water Improved Fertility Parameters in Male Wistar Rats

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### Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

### Article Information

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### ABSTRACT

**Background:** The need for fertility stimulation in men and women cannot be overemphasized especially when a marriage is childless in some communities in Nigeria. While chemical methods for fertility stimulation may have some side effects and are not readily available, remedy from natural sources can be used.

**Aim:** This present study is aimed to evaluate the effect of coconut water on fertility in male Wistar rats.

**Materials and Methods:** Coconuts of about 8 months old were harvested from Apata area of Ibadan in Oyo State, Nigeria. The coconuts were dehusked, broken carefully and the liquid endosperm was collected and preserved in the refrigerator. Thirty male Wistar rats weighing between 180 and 200 g were used for the experiment. They were acclimatized for 7 days during which they were fed *ad libitum* with standard feed and drinking water. They were randomly divided into 6 groups of 5 rats each. Animals in groups A, B and C were administered normal saline for 10, 20 and 30 days respectively via oral route. Those in groups D, E and F were similarly treated (for

10, 20 and 30 days respectively via oral route) but with 3 mL of undiluted coconut water. At the end of treatment, the animals were sacrificed by the cervical dislocation. The internal organs were exposed. Testes and cauda epididymis were removed and kept in sterilized watched glass. Male fertility parameters were determined using standard methods.

**Results:** Coconut water caused increased sperm count and sperm motility while mortality and abnormality of spermatozoa decreased significantly after 10, 20 and 30 days of treatment respectively. However, coconut water had no significant difference on seminal pH at  $P < 0.05$ .

**Conclusion:** The results of this present study showed that coconut water increased fertility in male Wistar rats. Men with fertility challenges are encouraged to consume coconut water as often as possible.

**Keywords:** Coconut water; sperm count; sperm motility; sperm mortality; sperm abnormality; seminal pH.

## 1. INTRODUCTION

Coconut belongs to the family of Arecaceae, an important member of monocotyledons. It is botanically known as *Cocos nucifera* [1]. Around the world, coconut fruit products have been used in popular medicine for the treatment of various diseases, such as arthritis and diarrhea [2]. Studies carried out with the coconut husk fiber have proven its antiproliferative activity against lymphocytes [3], and also determined its analgesic and antioxidant activities [4].



**Fig. 1. Coconut and its water**

Coconut water (CW), the liquid endosperm obtained from immature coconuts, in its natural form is a refreshing and nutritious beverage, widely consumed around the world due to its beneficial health properties [5]. Moreover, coconut water plays an important alternative role for oral rehydration and even for intravenous hydration of patients in remote regions [6]. In addition, CW protects against induction of myocardial infarction [7]. Antioxidant activities of polyphenolics derived from plants have claimed beneficial health functions for retarding aging and preventing cancer and cardiovascular diseases

[8]. Furthermore, the presence of ascorbic acid in the natural CW was correlated with antioxidant properties [9]. A previous study confirmed the presence of caffeic acid in the coconut oil from the copra [10]. Chakraborty and Mitra [11], proved the existence of chlorogenic, caffeoylshikimic and dicaffeoylquinic acids, three caffeic acid derivatives, in the methanolic extract of young, mature and old coconut mesocarp.

Infertility is defined as failure to conceive after regular sexual intercourse for two years in the absence of known reproductive pathology [12]. In low-resource settings such as Nigeria, accessing basic assisted reproductive technology treatments can be challenging or impossible for many couples who want to conceive. Many fear the negative consequences of childlessness resulting from societal pressure. Couples who cannot conceive often experience emotional and psychological trauma. Sadly, societal norms dictate that the woman is the cause of the infertility, ignoring male infertility. Infertility comes at a high price financially, emotionally and physically for many couples in Nigeria [13].

The prevalence of infertility is generally higher in sub-Saharan Africa compared to most other regions. Given the poverty that exists in Nigeria, where 92.4% of the population lives on less than 2 USD a day, the high cost of infertility treatments is associated with a significant risk of catastrophic health expenditure. For example, tubal disease, which is the most common cause of infertility in Nigeria, is best treated with in-vitro fertilization (IVF), and one cycle of IVF in Nigeria costs an average of 3,289 USD. This out-of-pocket payment has the potential to create or exacerbate poverty. Evidence suggests that many couples discontinue treatment for financial reasons [14]. This present study is

aimed at investigating the effect of coconut water in fertility parameters of male Wistar rats.

## 2. MATERIALS AND METHODS

### 2.1 Collection of Coconut Water

Coconuts of 7 to 8 months of age were harvested from the coconut trees grown Apata area of Ibadan in Oyo State, Nigeria. The coconuts were dehusked, broken carefully and the liquid endosperm (coconut water) was collected and was used in the experiment.

### 2.2 Experimental Design and Animal Treatment

Thirty male Wistar rats weighing between 180 and 200 g 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 [15]. They were randomly divided into six groups of five rats each. Animals in groups A, B and C were administered normal saline for 10, 20 and 30 days respectively via oral route. Those in groups D, E and F were similarly treated (for 10, 20 and 30 days respectively via oral route) but with 3 mL/100 g body weight of undiluted coconut water as recommended by Nnodim et al. [16]. At the end of treatment, the animals were sacrificed by the cervical dislocation. The internal organs were

exposed. Testes and cauda epididymis were removed and kept in sterilized watched glass.

### 2.3 Determination of Male Fertility Parameters

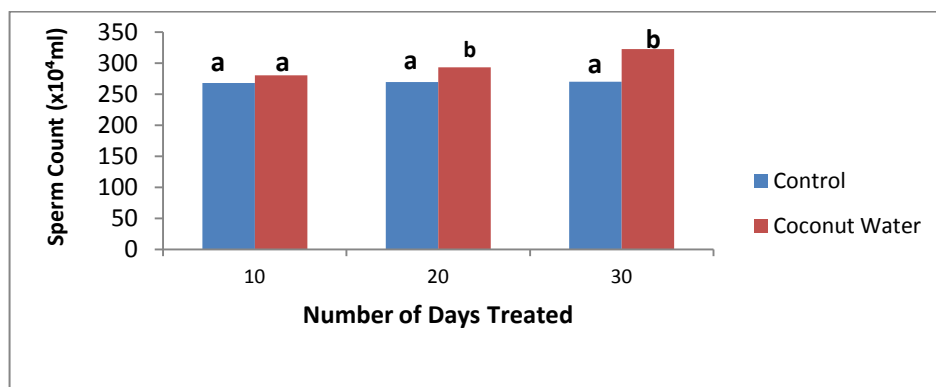
The cauda epididymis were separated from both testes and tinged with 2 mL of normal saline then teased the cauda epididymis of each rat. The suspension was mixed through a metallic net to avoid any other tissue contamination. Sperm counts were done with the aid of hemocytometer according to the method of Eliasson [17]. Motility of spermatozoa was determined according to the methods of Tijee and Oentoeng [18]. For the study of abnormality of spermatozoa, a film of semen was prepared on slide. These films on slide were fixed in methanol. Thereafter, the slides were stained in eosine for 40 minutes. The films were washed in tap water and after drying, the slides were examined under the microscope (x400) to see abnormality of spermatozoa. Seminal pH was measured using a pH meter.

### 2.4 Statistical Analysis

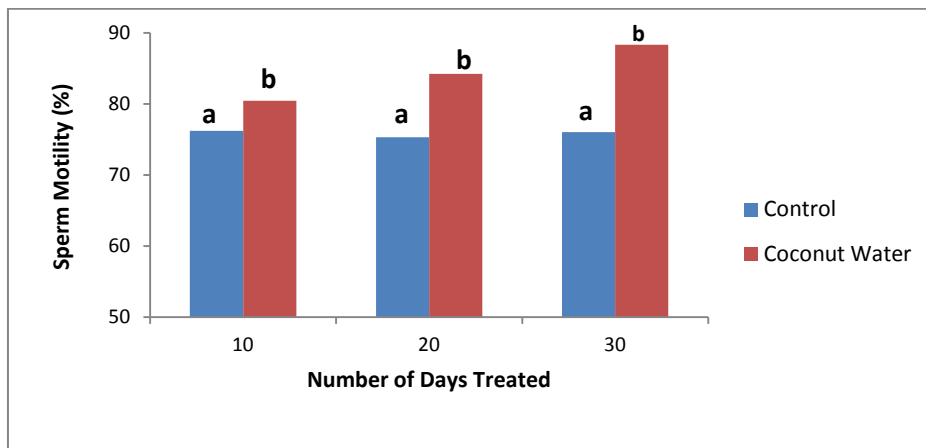
Data were subjected to analysis of variance using Graph Pad Prism. Results were presented as Mean  $\pm$  standard deviation. One way analysis of variance (ANOVA) was used for comparison of the means followed by Tukey's (HSD) multiple comparison tests. Differences between means were considered to be significant at  $p < 0.05$ .

## 3. RESULTS

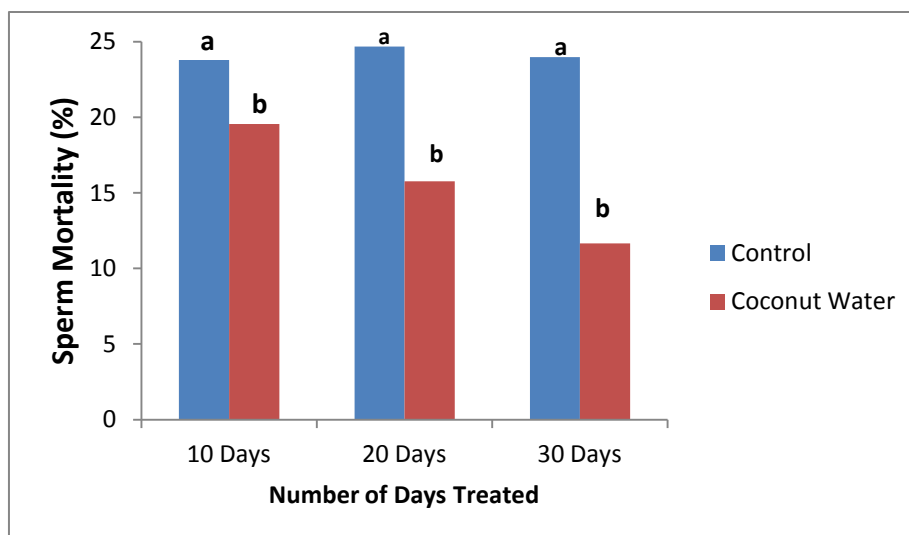
The results of the effect of coconut water on male fertility parameters of animals are presented in Figs. 2-6.



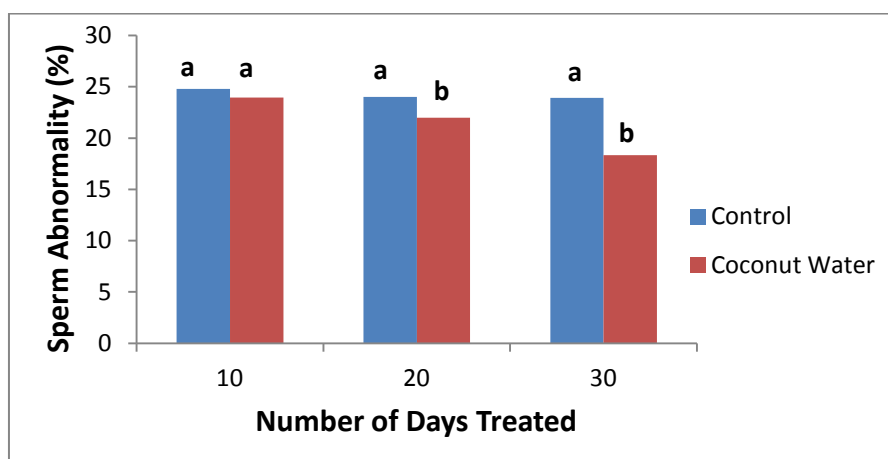
**Fig. 2. Effect of coconut water on sperm count for 10, 20, and 30 days of treatment**  
Results are presented as mean values of five rats. Bars with different letters are significantly different at  $p < 0.05$



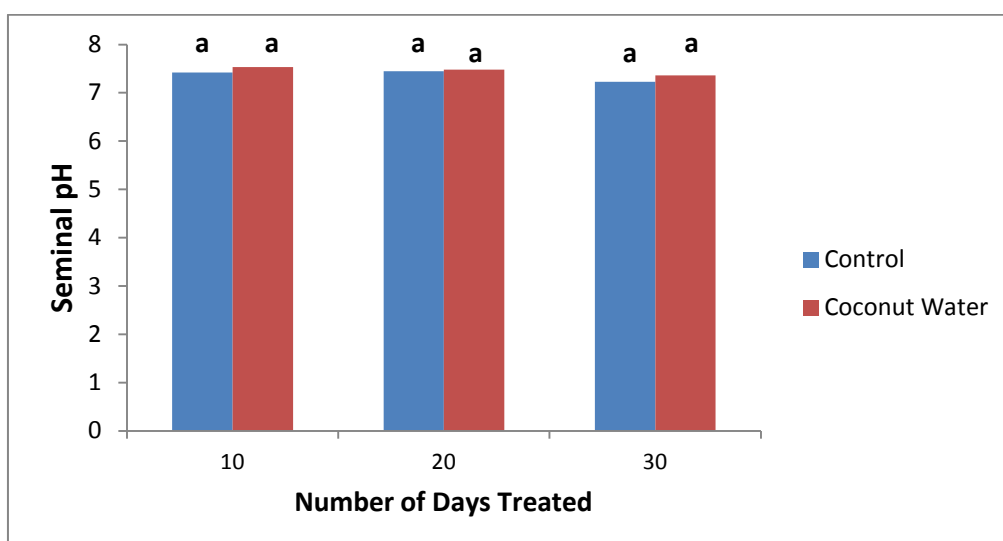
**Fig. 3. Effect of coconut water on sperm motility for 10, 20, and 30 days of treatment**  
Results are presented as mean values of five rats. Bars with different letters are significantly different at  $p < 0.05$



**Fig. 4. Effect of coconut water on sperm mortality for 10, 20, and 30 days of treatment**  
Results are presented as mean values of five rats. Bars with different letters are significantly different at  $p < 0.05$



**Fig. 5. Effect of coconut water on sperm abnormality for 10, 20, and 30 days of treatment**  
Results are presented as mean values of five rats. Bars with different letters are significantly different at  $p < 0.05$



**Fig. 6. Effect of coconut water on seminal pH for 10, 20, and 30 days of treatment**

Results are presented as mean values of five rats. Bars with different letters are significantly different at  $p < 0.05$

#### 4. DISCUSSION

Coconut water has many beneficial effects on health since it contains electrolyte, vitamins, sugar, protein, antioxidants, minerals, cytokinins and dietary fiber. Actually it is fat free and has zero cholesterol. It has antiviral and antibacterial properties, helps to lose weight, very beneficial to a person with kidney stones due to its minerals, potassium, and magnesium content and it has different effects in the sex organ [16]. The application of some plants constituents in pharmaceutical industries has gone long way in the elevation of the status of the herbal medicine in Nigeria [19]. The need for fertility stimulation in men and women cannot be overemphasized especially when a marriage is childless in some communities in Nigeria. While chemical methods for fertility stimulation may have some side effects and are not readily available. This present study is aimed at evaluating its effect on fertility parameters in male Wistar rats.

In this study, an increase was observed in sperm count when animals treated with undiluted coconut water were compared with the control groups throughout the period of administration as presented in Fig. 2. This increase was significant after 20 days of treatment and above. This result is in contrast with the findings of Airaodion et al. [20] and Ekenjoku et al. [21] who reported a significant decrease in sperm count when animals were treated with *C. papaya* leaf and *Vernonia amygdalina* leaf extracts respectively. This might be suggestive that coconut water stimulated steroid hormone biosynthesis, which

results in enhanced spermatogenesis [16]. Perturbation of steroid hormone biosynthesis as well as spermatogenesis may affect the seminal quality of animals. The enhanced spermatogenesis observed in this study following coconut water administration might have resulted from its mineral composition as well as antioxidant potential reported by Santos et al. [22].

In this study, a significant ( $p < 0.05$ ) increase was observed in sperm motility of animals treated with coconut water when compared with the control groups throughout the period of administration. This result also contradicts the findings of Airaodion et al. [20] and Ekenjoku et al. [21] who reported a significant decrease in sperm motility when animals were treated with *C. papaya* leaf and *Vernonia amygdalina* leaf extracts respectively. This probably implies that coconut water plays important role in regulation of sex hormonal level which in other words improves reproductive health [16]. The increased sperm motility observed in this study might also be an indicator that coconut water has the ability to stimulate the ATPase activity in all tissue of the animals [23]. This causes increase in energy metabolism. If ATPase activity is stimulated, it could up-regulate the motility rate of sperm, as ATP is the main energy source of sperm and it is directly related to sperm motility. Lohiya et al. [24] observed total inhibition of motility in human sperm after treatment with *C. papaya* seed extract. *C. papaya* seed extract has also shown inhibitory action on sperm motility in rats [25,26]. The stimulatory motility observed in the sperm of

rats treated with coconut water in this study might suggest that coconut water acts contrary to the mechanism of action of *C. papaya* on sperm motility. The increase in sperm motility observed in this study is dependent on the number of days treated. This is indicative that continuous consumption of coconut water will sustain increase in sperm motility.

In this study, coconut water was observed to decrease the number of abnormal spermatozoa when compared with the control animals after 10, 20 and 30 days treatment respectively. Decreased abnormality of spermatozoa in coconut water-treated animals might be as a result of protection of Sertoli cell [27]. For normal testicular function, Sertoli cell plays vital role in maintaining conducive environment for spermatogenesis. Protection of Sertoli cells may positively affect the maturation process of spermatozoa, which might result in decreased abnormality of sperms observed in this study.

No significant difference was observed in the seminal pH when animals treated with coconut water were compared with the control animals throughout the experiment. This result indicates that coconut water did not perturb the normal pH range. If the pH is decreased, the medium of seminal plasma becomes acidic which in turn makes sperms highly fragile, thus leading to higher rate of mortality.

In this study, a significant decrease was observed in sperm mortality when animals treated with coconut water were compared with the control animals throughout the period of administration. There is usually an inverse relationship between sperm mortality and sperm motility. As sperm mortality decrease, sperm motility, increases and vice versa [20,21].

## 5. CONCLUSION

The results of this present study showed that coconut water increased fertility in male Wistar rats. Men with fertility challenges are encouraged to consume coconut water as often as possible.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

Animal ethic Committee approval has been collected and preserved by the authors.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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