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Boosting Blood Health: The Role of Tender Coconut Water in Leukocyte and Thrombocyte Modulation in Rats

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ABSTRACT

Background and Objective: Tender coconut water (TCW) is a natural beverage rich in bioactive compounds, known for its potential health benefits, including immune modulation and blood health improvement. The TCW from the Malayan green dwarf hybrid was administered in varying doses to assess its impact on blood cell parameters. This study explores the effects of tender coconut water on leukocyte and thrombocyte modulation in Wistar rats, highlighting its potential benefits for immune function and blood health. **Materials and Methods:** Forty Wistar rats were divided into four groups: Group A (control) received no treatment, while Groups B, C and D were treated with 10, 20 and 30 mL/kg of TCW, respectively. Blood samples were analyzed using a hematology analyzer and statistical evaluation was performed using SPSS version 26. **Results:** The results showed a significant increase in total white blood cell counts, including lymphocytes, eosinophils, basophils and platelets in the treated groups. A significant decrease in neutrophil counts was also observed ($p<0.05$). Notably, the group that received 20 mL/kg of TCW exhibited the highest platelet count, surpassing the effects observed at the 30 mL/kg dose. **Conclusion:** This study suggests that tender coconut water, particularly at a dose of 20 mL/kg, may have immunomodulatory and hemostatic effects, making it a promising natural supplement for enhancing immune function and blood health in Wistar rats. Further research is warranted to explore its potential applications in clinical settings.

KEYWORDS

Leukocytes, thrombocytes, tender coconut water, haematological modulation, Wistar rat model

INTRODUCTION

Many developing countries of the world are endowed with vast resources of natural products. The priceless heritage which includes indigenous fruits has served as food and medicine by rural people for centuries. Coconut is a part of the Arecaceae family, which includes monocotyledons[1]. Its botanical name is *Cocos nucifera*. Coconut fruit preparations have been used in popular medicine all across the world to cure a variety of ailments, including arthritis and diarrhea[2]. Studies on coconut husk fibre have

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demonstrated its antiproliferative effect against lymphocytes, as well as its analgesic and antioxidant properties. In Nigeria, coconut is known by many names: 'Agbon' in Yoruba, 'Aku-beke' in Igbo, 'Mosara' in Hausa and 'Ukpu' in Uzebba (Edo State)[3].

Coconut water (CW), the liquid endosperm collected from immature coconuts, in its natural form is a delicious and nutritious beverage, widely enjoyed around the world for its excellent health characteristics[4]. Furthermore, coconut water serves as an important option for oral rehydration and even intravenous hydration of patients in distant areas, as well as protecting against myocardial infarction. Antioxidant properties of polyphenolics generated from plants have claimed favourable health functions for slowing ageing and avoiding cancer and cardiovascular illnesses[5].

White blood cells, also known as leukocytes or leucocytes, are immune system cells that protect the body from both infectious disease and foreign invaders[6]. All white blood cells are created and developed from hematopoietic stem cells, which are multipotent cells found in the bone marrow. Leukocytes are present throughout the body, including the blood and lymphatic systems. All white blood cells have nuclei, which set them apart from other blood cells such as anucleated red blood cells (RBCs) and platelets. White blood cells are typically classified according to their cell lineage (myeloid or lymphoid)[7].

Thrombocytes, commonly known as platelets, are microscopic cell fragments that are essential for the process of blood clotting or haemostasis. Despite their modest size, these cells play an important role in keeping the circulatory system functioning properly. When blood arteries are injured, platelets rush to the location to begin the clotting process. They cling to the injured vessel wall, aggregate and release chemicals that aid in the creation of a stable blood clot. This clotting mechanism avoids excessive bleeding; therefore, thrombocytes are an important part of our body's defense against injury and haemorrhage. While platelets are well known for their role in clotting, they also contribute to immunological responses and tissue regeneration, demonstrating their multifaceted importance in general health and well-being[8].

This study is therefore aimed at boosting blood heath: The role of tender coconut water on leukocyte and thrombocyte modulation in Wistar rats, in order to determine the immunological and clotting properties of coconut water.

MATERIALS AND METHODS

Study area: This complete blood count was carried out at Niger Delta University Teaching Hospital, Okolobiri. The study was carried out from August 2022 to January 2023.

Study population: The 24 Wistar rats were bred in animal house of Department of Pharmacology, Niger Delta University, Amassoma, Bayelsa State were used in this study.

Ethical approval: College Health Research Ethics Committee, College of Health Sciences, Niger Delta University, Amassosoma, Bayelsa State, provided ethical clearance and approval.

Experimental design: This study used 24 Wistar rats (170-200 g) bred in the animal house of the Department of Pharmacology, Niger Delta State, Wilberforce Island, Bayelsa State. Prior to the experiment, the animals were allowed to acclimate in the animal house for approximately 7 days. They were housed in well-ventilated cages that were cleaned and food was replaced on a daily basis at a room temperature of about 37°C. The animals were fed with commercially prepared vital feed libitum and tap water. They were chosen at random and divided into 4 groups, each with 6 rats. Group A serves as the

negative control while group B,C and D were given 10, 20 and 30 mL/kg body weight fresh coconut water daily, respectively via orogastric intubation for 4 weeks.

- **Group A:** Vital feed+water (Negative control)
- **Group B:** Coconut water (10 mL/kg body weight)+Vital feed
- **Group C:** Coconut water (20 mL/kg body weight)+Vital feed
- **Group D:** Coconut water (30 mL/kg body weight)+Vital feed

Collection of blood samples: After 4 weeks of coconut water treatment, the rats were anesthetized by placing them in a glass chamber containing cotton wool soaked in chloroform and they were then humanely sacrificed one by one. Blood samples (5 mL) were collected from the animals using cardiac puncture and dispense into EDTA bottle for complete blood count. The Complete blood counts were analysed 8 hrs after sample collection.

Method of analysis: Leucocytes and thrombocytes were done by Automated haemtology Analyzer (SYSMEX XP-300)[9].

Statistical analysis: Data analysis was conducted using Statistical Package for Social Science (SPSS) version 22 windows 10, the result were express in Mean±SD(Standard Deviation). Data obtained from the analysed using paired samples t-test. Values were considered significant at $P<0.05$ and not significant at $P>0.05$.

RESULTS

Table 1 compares haematological parameters in Wistar rats without coconut water (negative control) to those who received 10 mL/kg body weight of malayan green dwarf hybridised immature coconut water. Wistar rats with coconut water administration had significantly higher total white blood cell count, lymphocytes and platelets than the negative control group ($p<0.05$), but significantly lower neutrophils ($p<0.05$). However, other types of white blood cells (monocytes, eosinophils and basophils) reveal no significant difference ($p>0.05$).

Table 2 shows comparison of platelets, total white blood cell count and differentials between control Wistar rats and those given 20 mL/kg Malayan green dwarf hybrid coconut water. The total white blood cells count and Platelets were significantly higher in Wistar rat with coconut water administration group compared to the negative control ($p<0.05$) while the neutrophils were significantly lower in Wistar rat with coconut water administration group compared to the negative control ($p<0.05$). However, different white blood cells types (monocytes, eosinphil, basophil) and lymphocytes show no significant ($p>0.05$).

Table 3 shows comparison of platelets, total white blood cell count and differentials between control Wistar rats and those given 30 ml/kg Malayan green dwarf hybrid coconut water. The total white blood cells count, white blood cells types (monocytes, eosinophil, basophil) and platelets were significantly higher in Wistar rat with coconut water administration group compared to the negative control ($p<0.05$) while the neutrophils and lymphocytes show no significant ($p>0.05$).

Table 4 shows the comparison of 10, 20 and 30 mL/kg Malayan green dwarf coconut water on platelets, WBCs and WBC differentials. The effect of doses of Malayan green dwarf hybridized immature coconut water on the treatment groups on the haematological parameters showed significant difference ($p<0.05$) in some parameters, however, the doses 20 mL/kg showed significantly higher in most parameters when compared with the doses of 30 and 10 mL/kg ($p<0.05$) indicating that 20 mL/kg of body weight of Malayan green dwarf hybridized immature coconut water can be prefer as appropriate dose.

Table 1: Comparison of platelets, WBC count and differentials between control rats and those given 10 mL/kg Malayan green dwarf hybrid coconut water

Haematology parameters	Group A	Group B	t-value	p-value
White blood cells (10^9/L)	6.06±1.86*	8.53±1.23*	-3.01	0.030
Lymphocytes(%)	74.50±9.90*	89.33±0.816*	-3.62	0.015
Neutrophils(%)	21.17±8.93*	5.83±0.753*	4.12	0.009
Mixed(%)	5.00±4.56	5.00±0.894	0.00	1.000
Platelets(10^9/L)	580.17±147.66*	740.67±18.73*	-2.81	0.038

Control Wistar rats were compared with those administered 10 mL/kg Malayan green dwarf hybrid coconut water (N = 24), *Significant differences at p<0.05 level, Group A: Negatives control, Group B: Coconut Water administration (10 mL/kg body weight) and Mixed: Monocytes, eosinophils and basophils

Table 2: Comparison of platelets, WBC count and differentials between control rats and those given 20 mL/kg Malayan green dwarf hybrid coconut water

Haematology parameters	Group A	Group C	t-value	p-value
White blood cells (10^9/L)	6.06±1.86*	12.17±2.91*	-4.26	0.008
Lymphocytes(%)	74.50±9.90	84.67±2.07	-2.22	0.077
Neutrophils(%)	21.17±8.93*	6.82±0.96*	3.60	0.016
Mixed(%)	5.00±4.56	8.33±1.51	-1.59	0.172
Platelets(10^9/L)	580.17±147.66*	738.33±36.88*	-2.58	0.049

Control Wistar rats were compared with those administered 20 mL/kg Malayan green dwarf hybrid coconut water (N = 24), *Significant differences at p<0.05 level, Group A: Negative control, Group C: Coconut water administration (20 mL/kg body weight) and Mixed: Monocytes, eosinophils and basophils

Table 3: Comparison of platelets, WBC count and differentials between control rats and those given 30 mL/kg Malayan green dwarf hybrid coconut water

Haematology parameters	Group A	Group D	t-value	p-value
White blood cells (10^9/L)	6.06±1.86*	8.42±0.60*	-3.89	0.012
Lymphocytes(%)	74.50±9.90	73.50±3.83	0.30	0.776
Neutrophils(%)	21.17±8.93	15.50±2.74	1.73	0.144
Mixed(%)	5.00±4.56 *	11.00±1.10*	-3.32	0.021
Platelets(10^9/L)	580.17±147.66*	758.50±14.43*	-2.96	0.032

Control Wistar rats were compared with those administered 30 mL/kg Malayan green dwarf hybrid coconut water (N = 24), *Significant differences at p<0.05 level, Group A: Negative control, Group D: Coconut water administration (30 mL/kg body weight) and Mixed: Monocytes, eosinophils and basophils

Table 4: Comparison of 10, 20 and 30 mL/kg Malayan green dwarf coconut water on platelets, WBCs and WBC differentials (n = 24)

Group	N	White blood cells	Lymphocytes	Neutrophils	Mixed	Platelets
B	6	8.53±1.23*	89.33±0. 2*	5.83±0.75	5.00±0.89*	740.67±18.7*
C	6	12.17±2.90*	84.67±2.07*	6.82±.96	8.33±1.51*	738.33±36.88
t-value		3.63	4.67	-0.98	-3.33	2.333
p-value		0.004	0.006	0.341	0.000	0.875
B	6	8.53±1.23*	89.33±0. 82*	5.83±0.75	5.00±0.89*	740.67±18.7*
D	6	8.42±0.60	73.50±3.83	15.50±2.74	11.00±1.10	758.50±14.43
t-value		0.12	15.83	-9.67	-6.00	17.83
p-value		0.92	0.000	0.000	0.00	0.241
C	6	12.17±2.90*	84.67±2.07*	6.82±.96	8.33±1.51*	738.33±36.88
D	6	8.42±0.60	73.50±3.83	15.50±2.74	11.00±1.10	758.50±14.43
t-value		3.75	11.17	-8.683	-2.667	20.17
p-value		0.003	0.000	0.000	0.002	0.188

*Significant differences at p<0.05 level, Mixed: Monocytes, eosinphil, basophils, Group B: 10 mL/kg of body weight Malayan green dwarf hybridized immature coconut water, Group C: 20 mL/kg of body weight malayan green dwarf hybridized immature coconut water, Group D: 30 mL/kg of body weight Malayan green dwarf hybridized immature coconut water and Mixed: Monocytes, eosinophils and basophils

DISCUSSION

In this study, Wistar rats receiving 10 and 20 mL/kg of Malayan green dwarf hybrid coconut water showed significantly higher white blood cells (WBC) counts compared to the control group (p<0.05). A similar observation was made by a recent study where coconut water supplementation in

Wistar rats resulted in an increased WBC count, indicating its potential immunomodulatory effects[10]. Another study by Adeleye *et al*.,[11] reported elevated WBC levels in rats administered coconut water, which suggests a stimulation of the immune system. This agreed with the current study's findings. Furthermore, this study indicated a significant increase in lymphocytes in the groups receiving 10 mL/kg coconut water ($p<0.05$) but not in the 30 mL/kg group. This was consistent with the findings in which lymphocyte increases at moderate doses of coconut water in rats but noted a plateau or decrease at higher doses[12]. Another study observed a dose-dependent response in lymphocyte levels when coconut-derived compounds were administered[13], suggesting an optimal dose for immunological effects, which aligns with observation that 20 mL/kg appears to be the most effective dose. There was significant reduction in neutrophil count in rats given coconut water ($p<0.05$) in this study. Carrera-Quintanar *et al*.[14] found similar reductions in neutrophil levels in Wistar rats treated with natural antioxidants, suggesting coconut water might exert a neutrophil-modulating effect, potentially due to its antioxidant properties. Another study by Bhagya *et al*.,[15] also highlighted a reduction in neutrophil activity in rats administered natural coconut water reinforcing the consistency of this finding with the current study.

The increase in platelet counts observed in the study ($p<0.05$) aligns with the findings of other studies, where rats administered coconut water had significantly higher platelet levels[16]. The study attributed this to coconut water's rich composition of vitamins and minerals, which may enhance platelet production and overall haematopoiesis. Another study also noted increased platelet counts in rats administered coconut water, corroborating the findings[7].

No significant differences were found in monocytes, eosinophils or basophils in this study. This was consistent with the findings in which no significant alterations in these parameters following the administration of moderate doses of coconut water in rats[10].

The study found that the 20 mL/kg dose resulted in more pronounced changes in haematological parameters compared to 10 and 30 mL/kg doses. Onuoha *et al*.[16] also found a dose-dependent effect of coconut water on blood parameters in rats, with moderate doses showing more significant results than higher or lower doses. Onuoha *et al*.[16] further supported the idea of optimal dosing, indicating that exceeding a certain threshold in natural compound administration might reduce efficacy, as observed in your 30 mL/kg group.

Furthermore, lymphocyte changes were not significant at 30 mL/kg. Zulaikhah *et al*.[18] observed similar trends, where excessive doses of natural supplements led to a dampening of the immune response, further supporting the findings that moderate dosing is more effective. The 20 mL/kg appears to be the most effective dose agrees with the study by Elekwa *et al*.[10] which suggested that moderate doses of coconut water yielded the best haematological responses in Wistar rats without overwhelming the system.

The study indicates that coconut water, particularly at moderate doses (20 mL/kg), has a significant immunomodulatory effect in Wistar rats, enhancing certain immune parameters such as white blood cell (WBC) count, lymphocytes and platelets, while reducing neutrophil count. This suggests that coconut water may have potential therapeutic benefits for enhancing immune function and supporting hematopoiesis, likely due to its antioxidant properties and nutrient-rich composition. However, excessively high doses (30 mL/kg) seem to reduce these benefits, indicating that there is an optimal dosage for achieving these effects.

These findings can be applied to the development of natural, coconut water-based supplements aimed at boosting the immune system or supporting hematological health. In practical terms, moderate doses of coconut water could be explored for use in both animal and possibly human health, especially in conditions where immune support is needed. Further research might investigate its applications in treating

immune-related conditions or improving recovery after illness. Further studies are recommended to explore the mechanisms by which coconut water exerts its immunomodulatory effects. Research on humans is needed to assess if the observed immunological benefits translate across species. Dose-optimization studies should continue, focusing on finding the most effective coconut water doses for various applications without reducing efficacy. Consider long-term studies to evaluate the sustained effects of coconut water supplementation on immune function and blood parameters.

The study is limited to Wistar rats, so the findings may not directly apply to humans without further research. The effects of long-term use of coconut water were not investigated, leaving its prolonged impact on immune and blood parameters unclear. The study only measured certain hematological parameters and did not explore other potential immune or systemic effects.

CONCLUSION

This study highlights the immunomodulatory effects of Malayan green dwarf hybrid coconut water, particularly at a moderate dose of 20 mL/kg, which significantly enhanced WBC, lymphocyte and platelet counts. These findings suggest that coconut water could potentially support immune function and hematopoiesis, with its antioxidant properties possibly modulating neutrophil levels. Future research should focus on optimizing dosing to maximize the benefits while minimizing any diminishing effects observed at higher doses. This could pave the way for its therapeutic use in immune and blood-related conditions.

SIGNIFICANCE STATEMENT

This study investigates the immunomodulatory and hemostatic effects of Malayan green dwarf hybridized immature coconut water on leukocytes and thrombocytes in Wistar rats. Coconut water demonstrated a significant increase in white blood cell and platelet counts, highlighting its potential to modulate immune function and support blood clotting. The 20 mL/kg dose exhibited the most pronounced platelet enhancement. These findings suggest that coconut water may hold promise as a natural therapeutic agent for enhancing blood health, particularly in conditions requiring immune support and hemostasis regulation. The results provide a foundation for future research into the medicinal benefits of coconut water in managing blood-related disorders.

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