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SPICES DIETS AND THEIR EFFECTS ON THE RENAL FUNCTIONS OF WISTAR RAT

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ABSTRACT: *The effects of selected spices (Aframomum danielli, rough skin plum and country onions) on the renal functions of wistar rats fed for 28 days with feed substituted with the three aforementioned spices at different concentrations (5%, 10%, 15%) were evaluated. The values obtained for the parameters evaluated ranged from 18.42 mg/dL to 21.87 mg/dL (Blood Urea Nitrogen – BUN); 9.26% to 9.81% (creatinine); 9.02 to 9.23x109/L (White Blood Cell Count – WBCC); and 7.00 to 7.17x1012/L (Red Blood Cell Count – RBCC) for the 28 days. The partial substitution of the rats' feed with proportions of the spices increased the BUN, creatinine, WBCC and RBCC levels of the rats The BUN levels were within the 15–40 mg/dl for normal adult human blood. The increment observed in the creatinine levels was also within the biochemical reference range of 7.68–70.72 mol/L. The WBCC of the test animals fed with control feed reduced as the feeding period progressed. White blood cells are responsible for fighting infections or diseases in the body. Low counts of WBC may indicate that the body is immuno-compromised; too high WBC counts might be an indication of many underlying diseases or the introduction of a foreign body responsible for the upsurge of WBC counts. The WBC count in this study was within the SI reference range of 4.5–11.0 x 109/L. The RBC count of all the test samples were higher than the SI reference range of 4.3–5.9 x 1012/L (male) and 3.5–5.5 x 1012/L (female).*

KEYWORDS: Spices, blood urea nitrogen, blood cells, creatinine, renal function.

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INTRODUCTION

Herbs and spices have been a vital component of human life for thousands of years in both home and industrial settings, being used as flavouring, preservatives, and colouring agents in food and pharmaceutical products (Dini, 2018). Spices and culinary herbs have been defined as aromatic vegetable products which are of tropical origin that are used in a pulverized state, basically for seasoning, garnishing foods and beverages.

The majority of known herbs and spices are native to Asia, Africa, and Europe. Spices are obtained from the dry parts of the plant, such as creeping rootstalk, twigs, and leaves, fruits, vegetables, nuts, flower buds, entire and crushed seeds, and outermost layers of stems and roots. In addition, they are essential in the development of new food items (Peter, 2004). Spices and herbs are classified on the basis of botanical analogies or families or parts of the plant. Chili or hot pepper, dry white and black peppercorns, ginger root, mustard seeds, and cilantro belong to the category of hot spices. Aromatic spices include Pimenta, myrtle pepper, Elettaria, Chinese cinnamon, Cinnamon, clove, fenugreek, and white and black cumin (Van Wyk, 2014). These spices are most commonly used in the food processing for different purposes on a domestic and large scale (Peter & Shylaja, 2012).

The manufacture of various processed goods, such as pickles, flavour sauces, salad dressings, bakery goods, vinegar, drinks, meat products, and sausages, most frequently uses spices and herbs. Additionally, phenolic and polyphenolic compounds with bioactive properties and phytochemicals are abundant in spices and herbs which make them great sources of these compounds (Rathore & Shekhawat, 2008). Since many herbs and spices have qualities linked to lowering the risk of chronic diseases, there has been a noticeable surge in the study regarding their health benefits, ways to maintain the spice crop, and ways to incorporate them into the diet over the past several decades (Jiang, 2019). Kurian (2012) reported that spices and herbs possess some antimicrobial effects while Rabia et al. (2021) stated that the antioxidant properties of spices and herbs act as food preservatives against oxidative degradation and also improve the stability of food products. The use of herbs and spices as natural preservatives is gaining more attention. The antioxidants present in spices and herbs also help the body to fight cardiovascular disease, some types of cancers (epithelial), and other ailments including arthritis and asthma (Yashin et al., 2017).

***Aframomum danielli*:** *Aframomum danielli*, also known as African cardamom, is a species in the ginger family, Zingiberaceae. *Aframomum danielli* is a perennial plant with seeds used for flavouring traditional dishes, in addition to having laxative, anti-helmintic and anti-fungal properties; juice extracts of its rhizomes are effective in the treatment of body odour and toothache (Tane et al., 2005). It is used medicinally and to flavor foods while its essential oil is used in perfumery and dye manufacturing (Menut et al., 1991). Previously, Olajide et al. (1999) demonstrated the anti-inflammatory activity of essential oil of *A. danielli* seeds.

Rough Skin Plum (*Parinari curatellifolia*): *Parinari curatellifolia* is a tree of the family Chrysobalanaceae that grows in tropical Africa from Senegal to Kenya with the highest concentration in Zimbabwe and the low-end region of South Africa (Sonogo et al., 2006). The seeds are also gathered from the wild for local use, while the plant is utilized for its wood and medicinal virtues (Barmick, 2004). The seeds of *Parinari curatellifolia*, commonly called Mobola, are widely employed in traditional medicine for the management of various diseases including hypertension (Olaleye et al., 2010), diabetes and liver-related illnesses (Ogbonnia et

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al., 2011). Phytochemicals in the seed include polyphenols, glycosides, alkaloids and anthraquinones.

***Afrostyrax lepidophyllus* (country onion):** Country onion is a non-timber forest product from the Huaceae family found in the green forest in Ghana, Cameroon and Republic of Congo (Moukette et al., 2015). The leaves and fruits have a strongly offensive smell of onion or garlic. This fruit is used as spice in traditional African cuisine. In folk medicine, the root and bark decoctions are drunk as anthelmintic against vomiting or as enema against urinary infections; the essential oils from the seeds demonstrated cytotoxic and antimicrobial activities (Kambu, 1990). In the light of this information, it is obvious that a large amount of scientific data is still needed in order to promote the use of *A. lepidophyllus* for the management of health problems.

The numerous uses of spices (*Aframomum danielli*, rough skin plum and country onion) have thus informed the need to study their effects on various body organs. This present research work was designed to evaluate the effects of *Aframomum danielli*, rough skin plum and country onion on the renal functions of adult wistar rats.

MATERIALS AND METHOD

Materials Procurement: The *Aframonum danielli*, rough skin plum and country onion were purchased from relief market Owerri, Imo State, Nigeria while the adult wistar rats of comparable sizes and weight ranging from 150–200 g were purchased from the animal farm of Ceslab Global Service, kilometer 7, Ikot Ekpene road, Umuahia, Abia State, Nigeria.

Preparation of Samples: The test spices purchased were carefully sorted, cleaned, measured, milled, sieved, packaged in small plastic containers and stored pending usage. The test animals were allowed to acclimatize for 1 week in a wire mesh cage.

Table 1: Formulation of Feed Indicating Percentage of the Spices in the Wistar Rat Diet

Sample	growers mash (%)	A. danielli (%)	Plum (%)	Onion (%)
A (Control)	100	-	-	-
B_1	95	5	-	-
B_2	90	10	-	-
B_3	85	15	-	-
C_1	95	-	5	-
C_2	90	-	10	-
C_3	85	-	15	-
D_1	95	-	-	5
D_2	90	-	-	10
D_3	85	-	-	15

where A = Control (100% growers mash), 1 = Treatment at 5% concentration, 2 = Treatment at 10% concentration, 3 = Treatment at 15% concentration. B = *Aframonum danielli*: B_1 = 95% feed: 5% *A. danielli*; B_2 = 90% feed: 10% *A. danielli* and B_3 = 85% feed:15% *A. danielli*, C = rough skin plum: C_1 = 95% feed: 5% plum; C_2 = 90% feed: 10% plum and C_3 = 85% feed: 15% plum, D = country onion: D_1 = 95% feed: 5% C. onion; D_2 = 90% feed:10% C. onion and D_3 = 85% feed:15% C. onion.

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Animal Grouping: The adult wistar rats of comparable sizes and weights ranging from 150–200 g were divided into ten (10) groups of six rats each and allowed to acclimatize for one (1) week in a wooden-wire gauze cage, being fed with growers' mash and water ad libitum. The animals were maintained and utilized in accordance with the standard guide for the care and use of laboratory animals. Group A served as the control while B_1, B_2 and B_3 served as the groups fed with feed spiced with 5%, 10% and 15% concentration of *Aframomun danielli* respectively.

C_1, C_2 and C_3 served as groups fed with spiced feed of 5%, 10% and 15% concentration of rough skin plum respectively, and D_1, D_2 and D_3 served as groups fed with spiced feed of 5%, 10% and 15% country onion concentration respectively. The respective spices were prepared by mixing with feed at 5%, 10% and 15% substitutions respectively. Group A received normal feed and water only. The animals were starved for a period of 12 hours before feeding with formulated feed commenced. The feeding period lasted for a period of 28 days.

Blood Sample Collection: The blood samples (5 ml) of each rat were obtained by sacrificing the rat at the end of every 7 days and dispensed into a plain container labeled appropriately: A, B_1, B_2, B_3, C_1, C_2, C_3, D_1, D_2 and D_3; they were then frozen until the time of analysis. Laboratory analysis was carried out for blood urea nitrogen (BUN), serum creatinine and blood counts of the wistar rats.

Determination of Renal Function Test: The blood urea nitrogen (BUN) and the serum creatinine was determined using the method described by Hatem (2021) while the red and white blood cells counts were done by direct haemocytometric count under a microscope with the sustaining guidelines of the World Health Organization on recommended methods for visual determination of blood cell count and platelet count (WHO, 2000).

Statistical Analysis: Statistical analysis was done using SPSS version 20. Data obtained were expressed as mean ± standard deviation and subjected to analysis of variance (ANOVA) to test the difference among means. Significant value was placed at $P<0.05$.

RESULTS AND DISCUSSIONS

Table 2: Blood Urea Nitrogen Level of Wistar Rats Fed with Spiced Feed

	Feeding Days				
Sample	0	7	14	21	28
A. danielli					
C_1	$18.34^{c}\pm0.00$	$19.10^{d}\pm0.04$	$19.18^{c}\pm0.11$	$19.24^{c}\pm0.21$	$21.64^{a}\pm0.36$
C_2	$18.34^{c}\pm0.00$	$19.20^{cd}\pm0.07$	$19.40^{b}\pm0.14$	$19.53^{a}\pm0.19$	$21.87^{a}\pm0.36$
C_3	$18.34^{c}\pm0.00$	$19.37^{bc}\pm0.22$	$19.49^{a}\pm0.22$	$19.40^{b}\pm0.39$	$21.76^{a}\pm0.01$
Plum C_1	$19.13^{a}\pm0.01$	$19.37^{bc}\pm0.22$	$19.49^{a}\pm0.22$	$19.40^{b}\pm0.39$	$20.93^{bc}\pm0.10$
C_2	$19.13^{a}\pm0.01$	$19.49^{ab}\pm0.22$	$19.57^{a}\pm0.08$	$19.55^{a}\pm0.09$	$21.48^{ab}\pm0.35$
C_3	$19.13^{a}\pm0.01$	$19.51^{ab}\pm0.23$	$19.45^{b}\pm0.19$	$19.44^{b}\pm0.07$	$21.46^{ab}\pm0.04$
Onion					
C_1	$18.54^{b}\pm0.17$	$19.07^{d}\pm0.09$	$19.20^{c}\pm0.07$	$19.48^{ab}\pm0.00$	$20.86^{c}\pm0.39$
C_2	$18.54^{b}\pm0.17$	$19.20^{cd}\pm0.07$	$19.36^{b}\pm0.21$	$19.41^{b}\pm0.11$	$20.69^{c}\pm0.14$
C_3	$18.54^{b}\pm0.17$	$19.63^{a}\pm0.02$	$19.59^{a}\pm0.10$	$19.19^{c}\pm0.10$	$20.78^{c}\pm0.14$

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Control	$18.33^{c}\pm0.01$	$18.41^{e}\pm0.02$	$18.39^{d}\pm0.06$	$18.42^{d}\pm0.58$	$18.42^{d}\pm0.10$
LSD	0.15	0.19	0. 11	0.11	0.61

Values show means of triplicate analysis ± standard deviation. Figures with different superscripts in the column are significantly different (P<0.05).

Table 3: Creatinine Content of Wistar Rats Fed with Spiced Feed.

	Feeding Days				
Sample	0	7	14	21	28
A. danielli					
.C_1	$9.28^{a}\pm0.04$	$9.36^{a}\pm0.04$	$9.49^{a}\pm0.03$	$9.64^{a}\pm0.00$	$9.63^{a}\pm0.32$
C_2	$9.28^{a}\pm0.04$	$9.37^{a}\pm0.01$	$9.51^{a}\pm0.02$	$9.65^{a}\pm0.03$	$9.81^{a}\pm0.04$
C_3	$9.28^{a}\pm0.04$	$9.40^{a}\pm0.02$	$9.53^{a}\pm0.01$	$9.66^{a}\pm0.01$	$9.79^{a}\pm0.01$
C_1	$9.17^{a}\pm0.20$	$9.27^{b}\pm0.01$	$9.33^{b}\pm0.01$	$9.33^{bc}\pm0.03$	$9.42^{b}\pm0.02$
C_2	$9.17^{a}\pm0.20$	$9.30^{b}\pm0.04$	$9.33^{b}\pm0.01$	$9.35^{b}\pm0.02$	$9.43^{b}\pm0.02$
C_3	$9.17^{a}\pm0.20$	$9.31^{b}\pm0.03$	$9.35^{b}\pm0.01$	$9.35^{b}\pm0.01$	$9.43^{b}\pm0.01$
Onion					
C_1	$9.23^{a}\pm0.04$	$9.27^{b}\pm0.01$	$9.29^{bc}\pm0.01$	$9.31^{bc}\pm0.04$	$9.37^{b}\pm0.01$
C_2	$9.23^{a}\pm0.04$	$9.27^{b}\pm0.01$	$9.31^{bc}\pm0.01$	$9.33^{bc}\pm0.02$	$9.39^{b}\pm0.01$
C_3	$9.23^{a}\pm0.04$	$9.29^{b}\pm0.01$	$9.32^{b}\pm0.00$	$9.35^{b}\pm0.01$	$9.40^{b}\pm0.14$
Control	$9.22^{a}\pm0.02$	$9.22^{c}\pm0.12$	$9.25^{c}\pm0.08$	$9.24^{c}\pm0.03$	$9.26^{b}\pm0.10$
LSD	0.08	0.05	0.07	0.10	0.20

Values show means of triplicate analysis ± standard deviation. Figures with different superscripts in the column are significantly different (P<0.05).

Table 4: White Blood Cell Count of the Wistar Rats (x 10^9/L)

	Days of Feeding				
Sample	0	7	14	21	28
A. danielli					
C_1	$8.90^{a}\pm0.25$	$9.05^{ab}\pm0.02$	$9.05^{bc}\pm0.02$	$9.15^{ab}\pm0.01$	$9.23^{a}\pm0.05$
C_2	$8.90^{a}\pm0.25$	$9.07^{a}\pm0.05$	$9.13^{ab}\pm0.01$	$9.17^{a}\pm0.01$	$9.27^{a}\pm0.02$
C_3	$8.90^{a}\pm0.25$	$9.11^{a}\pm0.01$	$9.15^{a}\pm0.01$	$9.23^{a}\pm0.01$	$9.30^{a}\pm0.03$
Plum C_1	$8.88^{a}\pm0.10$	$8.94^{c}\pm0.03$	$8.97^{c}\pm0.01$	$9.11^{ab}\pm0.03$	$9.13^{ab}\pm0.02$
C2	$8.88^{a}\pm0.10$	$8.96^{bc}\pm0.02$	$9.08^{ab}\pm0.02$	$9.14^{ab}\pm0.01$	$9.16^{ab}\pm0.02$
C_3	$8.88^{a}\pm0.10$	$9.02^{abc}\pm0.02$	$9.13^{ab}\pm0.01$	$9.19^{a}\pm0.12$	$9.22^{a}\pm0.03$
Onion C_1	$9.08^{a}\pm0.04$	$9.09^{a}\pm0.01$	$9.11^{ab}\pm0.02$	$9.14^{ab}\pm0.01$	$9.13^{ab}\pm0.02$
C_2	$9.08^{a}\pm0.04$	$9.09^{a}\pm0.01$	$9.13^{ab}\pm0.01$	$9.15^{ab}\pm0.01$	$9.21^{a}\pm0.01$
C_3	$9.08^{a}\pm0.07$	$9.12^{a}\pm0.00$	$9.13^{ab}\pm0.01$	$9.15^{ab}\pm0.01$	$9.15^{ab}\pm0.01$
Control	$9.07^{a}\pm0.08$	$9.06^{ab}\pm0.07$	$9.07^{ab}\pm0.06$	$9.02^{b}\pm0.07$	$9.02^{b}\pm0.07$
LSD	0.32	0.11	0.09	0.14	0.19

Values show means of duplicate analysis for each sample ± standard deviation. Figure with different superscripts in the column are significantly different (p<0.05).

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Table 5: Red Blood Cell Count of Wistar Rats (x 10^{12}/L)

	Days of Feeding				
Sample	0	7	14	21	28
A. danielli					
C_1	6.81^{ab}±0.09	6.84^{ab}±0.09	7.03^{abcd}±0.01	7.05^{b}±0.01	7.10^{b}±0.04
C_2	6.81^{ab}±0.09	6.94^{ab}±0.07	7.01^{bcd}±0.06	7.16^{a}±0.00	7.17^{a}±0.01
C_3	6.81^{ab}±0.09	6.97^{a}±0.05	7.03^{abcd}±0.12	7.10^{ab}±0.04	7.14^{a}±0.04
Plum C_1	6.81^{ab}±0.09	6.89^{ab}±0.14	7.07^{abc}±0.04	7.07^{b}±0.10	7.14^{ab}±0.02
C2	6.81^{ab}±0.09	6.93^{ab}±0.15	7.10^{a}±0.35	7.13^{ab}±0.01	7.15^{ab}±0.01
C_3	6.81^{ab} ±0.09	6.93^{ab}±0.01	7.09^{ab}±0.02	7.11^{ab}±0.03	7.13^{ab}±0.01
Onion C_1	6.71^{b}±0.03	6.89^{ab}±0.02	7.00^{cd}±0.35	7.08^{ab}±0.04	7.12^{ab}±0.04
C_2	6.71^{b}±0.03	6.94^{ab}±0.00	7.10^{a}±0.05	7.09^{ab}±0.03	7.12^{ab}±0.04
C_3	6.71^{b}±0.03	6.80^{b}±0.08	6.97^{de}±0.01	7.06^{b}±0.04	7.12^{ab}±0.01
Control	6.89^{a}±0.02	6.89^{ab}±0.01	6.91^{e}±0.01	6.96^{c}±0.12	7.00^{c}±0.02
LSD	0.11	0.17	0.09	0.09	0.06

Values show means to duplicate analysis ± standard deviation. Figures with different superscripts in the column are significantly different (P<0.05).

Blood Urea Nitrogen (BUN): Table 2 shows the changes in blood urea nitrogen (BUN) of the rats fed with spiced diets. The rats BUN levels after 0, 1, 2, 3 and 4 weeks of feeding them with spiced feed were in the range of 18.33 mg/dL to 19.13 mg/dL, 18.41 mg/dL to 19.63 mg/dL, 18.39 mg/dL to 19.59 mg/dL, 18.42 mg/dL to 19.55 mg/dL, and 18.42 mg/dL to 21.87 mg/dL, respectively. There were significant differences (P>0.05) amongst the BUN levels of wistar rats fed with spiced feed and those fed with the control feed at 1, 2, 3 and 4 week feeding periods. The data obtained revealed that there were increases in their BUN levels at the end of the 28 days of the feeding. The BUN level of rats fed with *A. danielli* spiced diets increased more from 18.34 mg/dL (Day 1) to 21.64 mg/dL, 21.87 mg/dL and 21.76 mg/dL (28 days) in the rats feed with 5%, 10% and 15% *A. danielli* concentration diets respectively. Increases were also recorded in the BUN level of wistar rats fed with rough skin plum spiced diets, from 19.13 mg/dL (Day 1) to 20.93 mg/dL, 21.48 mg/dL and 21.46 mg/dL (28 days) in the rats fed with 5%, 10% and 15% rough skin plum concentration diets respectively. The BUN of the rats fed with country onion spiced diets also increased from 18.54 mg/dL (Day 1) to 20.86 mg/dL, 20.69 mg/dL and 20.78 mg/dL for 5%, 10% and 15% country onion concentration diets respectively. The control feed fed wistar rats also had slight variations in their BUN level over the 28 days feeding period ranging from 18.33 mg/dL (Day 1) to 18.41 mg/dL, 18.39 mg/dL and 18.42 mg/dL at (28 days).

The data obtained thus revealed that the partial substitution of the rats fed with *A. danielli*, rough skin plum and country onion spice increased the BUN level of the rats. However, the levels of increases varied significantly within the three spices on one hand and between the same spice at different concentrations. The increase could be attributed to conditions such as dehydration or shock (Hatem, 2021). Furthermore, the increase in the BUN level was found to be within 15–40 mg/dL for normal adult human blood (Hatem, 2021). Furthermore, the increase in the BUN level of the test spices were within the normal range of 15–40 mg/dml.

Creatinine Content: The effect of species on the creatinine content of albino wistar rats were shown in Table 3. At all levels (5%, 10% and 15%) of *Afromomum danielli*, rough skin plum

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and country onion spice inclusion in the feed, the creatinine levels were similar as at the onset of the experiment. There were however increases in the creatinine levels of the rats which differed with the type and concentration of spice fed them. The creatinine levels in the rats fed with *A. danielli* increased from 9.28 mol/L to 9.63, 9.81 and 9.79 mol/L at C_1, C_2 and C_3 concentrations of spice respectively after 28 days of feeding—this means increases of 3.77%, 5.71% and 5.50% respectively at the three levels of the spice inclusion.

In the rats fed with the rough skin plum supplemented diets, the increase in creatinine levels was less than that observed due to the inclusion of *A. danielli*. The creatinine levels increased from 9.17 mol/L to 9.42, 9.43 and 9.43 mol/L at 5%, 10% and 15% substitution levels. The percentage increment in the creatinine level of rats fed with rough skin plum spiced feed were 2.73%, 2.84% and 2.84% respectively. Also, no significant difference ($p>0.05$) was observed in the blood creatinine level of the rats fed with rough skin plum spiced feed. In spite of the increments, they were still within the biochemical reference range of 7.68–70.72 mol/L (K-Assay, 2017). However, the slight increment in blood creatinine level is an indication that the test spice has little or no interference with the renal function.

Blood Count of the Wistar Rats

White Blood Cell: The white blood cell counts of wistar rats fed with *Aframomum danielli*, rough skin plum and country onions substituted feeds were presented in Table 4 below in the range of 8.20 x 10^9/L to 9.30 x 10^9/L, 8.88 x 10^9/L to 9.22 x 10^9/L, and 9.08 x 10^9/L to 9.21 x 10^9/L, while the control decreased from 9.07 x 10^9/L to 9.02 x 10^9/L. The country onion fed rats had the highest white blood cell (WBC) count while the rough skin plum fed rats had the lowest**.** However, there were no significant differences ($p<0.05$) in the white blood cell count of the wistar rats fed with the spiced diets. The WBC of the test animals fed with control feed reduced as the feeding period progressed. White blood cells are responsible for fighting infections or diseases in the body. Low counts of WBC may indicate that the body is immuno-compromised; likewise, too high WBC counts might be an indication of many underlying diseases or the introduction of a foreign body responsible for the upsurge of WBC counts (Oluwabummi et al., 2020). The WBC count in this study was found to be within the SI reference range of 4.5–11.0 x 10^9/L (Dean, 2005).

Red Blood Cell: The red blood cell counts of the wistar rats fed with partially substituted diets for 28 days were presented on Table 5 in the range of 6.81 x 10^{12}/L to 7.17 x 10^{12}/L, 6.81 x 10^{12}/L to 7.15 x 10^{12}/L, and 6.71 x 10^{12}/L to 7.12 x 10^{12}/L respectively. The red blood count of the rats (control) ranged from 6.89 x 10^{12}/L to 7.00 x 10^{12}/L. The red blood counts of the spiced diets and control fed rats all increased subsequently with feeding time but significantly differed ($p<0.05$) from each other. The red blood counts of all the test samples were found to be higher than the SI reference range of 4.3–5.9 x 10^{12}/L (male) and 3.5–5.5 x 10^{12}/L (female) (Dean, 2005). The increase in the red blood count could be attributed to high calcium and iron levels in the feed (Pincus et al., 2022).

CONCLUSION

The three selected spices (*Aframomum danielli*, rough skin plum and country onion) in this study increased the BUN level, creatinine content and the white and red blood counts of the test animals. Nonetheless, the increments in the BUN level of the wistar rats blood were within

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15–40 mg/dl for normal adult human blood. Furthermore, the increments observed in the blood creatinine level of these wistar rats were within the biochemical reference range of 7.68–70.72 mol/L; the WBC counts were also found to be within the SI reference range of 4.5–11.0 x 10^9/L. The RBC counts of the rats were found to be higher than the SI reference range of 4.3–5.9 x 10^{12}/L (male) and 3.5–5.5 x 10^{12}/L (female). From these results so far, it is concluded that the inclusion of these spices in the rats' diets improved their renal function; thus, similar effects are expected in humans. Therefore, their inclusion in human diets are encouraged the most to ensure adequate renal functions and probably prevent certain disease conditions associated with the kidneys.

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