Effects of Raw and Cooked Aqueous and Methanol Extracts of *Phaseolus Vulgaris* (Kidney Beans) on Renal Function in albino *Wistar* Rats

ABSTRACT

Phaseolus vulgaris, like other beans, is endowed with rich economical nutritional contents, which can improve the quality of diet and provides lasting health benefits to consumers. This study evaluated the effects of raw and cooked aqueous and methanol extracts of *P. Vulgaris* on serum electrolytes and renal function in albino *Wistar* rats. Oral acute toxicity (LD_{50}) study of both raw and cooked kidney beans was conducted in two phases. In the main design, a total of thirty six (36) Wistar albino rats were used and divided into nine groups of four rats each and oral administration lasted for 7 days. Group 1 served as normal control, groups 2 – 9 are treated groups. Groups 2 and 3; 4 and 5 were administered 350mg/kg and 550mg/kg body weight aqueous extract of raw and cooked kidney bean respectively, groups 6 and 7; 8 and 9 were administered 350mg/kg and 550mg/kg body weight methanol extract of raw and cooked kidney bean respectively. Results of LD_{50} of all extracts were found to be greater than 5000mg/kg. Results showed a significant ($P<0.05$) increase in concentrations of urea and chloride across test groups administered raw and cooked aqueous extracts, in a non dose dependent pattern than methanol extracts. There was a significant ($P<0.05$) increase in the concentration of serum creatinine in test groups administered methanol extracts, not necessary in a dose dependent pattern. A a significant ($P<0.05$) increase of serum total protein of test groups was observed when compared to control. There was no significant ($P<0.05$) increase in the concentration of potassium in test groups administered both aqueous and methanol extracts (raw and cooked) as compared to control group. Generally, there was a significant ($P<0.05$) increase in all urea, chloride and creatinine concentrations in both extracts (methanol and aqueous, cooked and raw) compared to control. It may be concluded that *P. vulgaris* portrays potentials capable of improving renal function and its consumption may also contribute to the general wellness of a person due to its rich nutrients (proteins) composition, and based on the duration of this work and standard scale of toxicity; the extracts are practically non- toxic since the LD_{50} was greater than 5000mg/kg.

Keywords: Kidney Function, *Phaseolus Vulgaris,* Creatinine, Urea, Potassium, Chloride

INTRODUCTION

The legume family is a large plant family including edible peas, peanuts, lentils, chickpeas and beans. Bean such as kidney bean, black eyed bean, pinto, pink and navy beans have been reported[1,2]. Like other beans, *P. Vulgaris* (kidney beans) is a nutrient rich food containing minerals, vitamins, and useful nutrients, which supply a reasonable amount of calories to the body. Generally, beans contain little or no total fat, trans fat, sodium and cholesterol and it is a good source of iron, potassium, magnesium, fiber and folate[3]. Electrolytes in food are present in the form of essential minerals such as potassium, chloride, sodium, phosphorus, magnesium and bicarbonate. Thus, foods and drinks contain electrolytes which are essential minerals, indispensable for vigorous performance of the muscles and nerves. When levels of electrolyte in the blood become abnormally low or high, imbalances set in, which may possibly be due to dehydration, vomiting, diarrhea, kidney disease, eating disorders and severe burns[4]. Chloride is an anion that is richly found in the compartment of extracellular fluid (ECF). The concentration

of chloride in the serum may abnormally become high (hyperchloremia) or low (hypochloremia). Kidney failure and acute kidney injury are reported to be associated with hyperchloremia[5]. Potassium is a cation that is abundantly found in intracellular fluid, performing an essential function in nerve and muscle cells. It is reported to be richly distributed in plant foods including kidney beans[6]. Potassium is reduced and exchanged for sodium in foods by addition of salt and disposal of the liquid broth. In adults with hypertention, increase consumption of potassium is associated with a resultant decrease in blood pressure, which could lower the risk of stroke and cardiovascular diseases[7].

Kidney bean is rich in soluble fiber and its consumption is reported to be helpful in the synthesis of propionate and butyrate, short chains fatty acids capable of lowering LDL and total cholesterol, therefore reducing risk factors for hepatic disease[8]. The rich source of flavonols in kidney bean as antioxidant is linked to its function as anti-cancer food; its anti-diabetes ability is linked to its lower glycemic index as compared to other carbohydrate sources[9,10]. The rich nutrients content of fiber and protein in kidney bean are very vital nutrients in considering diet in weight loss. The feeling of satiety is enhanced by fiber and protein is reported to excite hunger by decreasing levels the hormone, ghrelin[11].

Kidney function is promoted in the absence of factors such as diabetes, infections, cancer, toxic chemicals, autoimmune disease and endocrine disorders[12]. Kidney function can be badly affected by high blood pressure, which may result in the damage of blood vessels in the kidney and hampering the effective removal of excretory waste products[12]. Glomerular filtration rate (GFR) is a useful parameter that defines renal function. It can be evaluated in the blood through creatinine and urea ratio. In renal failure, GFR is decreased. In the case of kidney failure, the kidney replacement therapy often used is hemodialysis which is very significant in the removal of urea, creatinine and water as waste products from the blood. Creatinine that is produced in muscles is removed from the body as excretory non toxic waste product by the kidneys. The production and excretion of creatinine by the kidneys help to equilibrate its concentration in the blood[12]. Serum creatinine concentration is said to be affected by sex, ethnicity, age, diet and life style[13]. Creatinine clearance, which is a 24hour collection of urine test, is used as an effective measurement of kidneys function. Result from creatinine clearance test reveals the quantity of creatinine that passed through the kidneys into the urine. The use of serum creatinine test alone cannot measure the effectiveness of the kidneys[13]. Urea is an organic compound excreted as waste product of dietary protein and needed in the metabolism of nitrogen containing molecules. Blood urea concentration increases in kidney failure. Though urea and creatinine are metabolic waste products but are not directly toxic as they are only used to measure kidney function[14].

MATERIALS AND METHODS

Materials

Collection and Authentication of Bean Seeds

The bean seeds were purchased from a commercial market (Ogbete main market) in Enugu state, Nigeria. The seeds were identified and authenticated and a voucher number of UNH no 452 (UNH stands for University of Nigeria Herbarium), was given by Mr. Onyeukwu Chijioke John a plant Taxonomist, Department of Plant Science and Biotechnology, University of Nigeria, Nsukka, Enugu state.

Preparation of Raw and Cooked Aqueous Extract of Kidney Bean

Dried seeds were prepared by winnowing, hand picking of stones and removal of dirt and then lightly washed to remove dust and were air dried. For raw sample, 500g of the dried bean seeds was weighed and homogenized into powder. Similarly, cooked sample was prepared

appropriately by hand picking to remove all foreign particles followed by washing and cooked with enough water until soft and without broth to prevent the loss of some phytochemicals in the bean broth. This was dried under mild sunlight for two weeks under strict supervision. Then, 500g of the dried bean seeds was weighed and ground into powder. The measured quantity was stored in a clean grease free airtight container with proper labeling.

Preparation of dry extract from samples

Methanol and aqueous extracts of raw and cooked samples were prepared from the powdered samples, by weighing 200g of powder into 700ml of the appropriate and respective solvent and soaked, carefully sealed, left standing for two days (for thorough extraction), before filtering with whatman filter paper. Concentration of the filtrate was achieved in a water bath at temperature of 70ºC. The evaporated extracts were reconstituted with distilled water relative to the weight of the evaporated extract. The volumes of the extracts to be administered were calculated according to the body weight of the rats using the formula:

$$\text{Volume to be administered (ml)} = \frac{\text{weight of rats (kg)} \times \text{Concentration Dose (mg/kg)}}{\text{Concentration of the extract(mg/ml)}}$$

Collection and Preparation of Blood Sample

The rats were made unconscious and 3milliters (3mls) of blood was collected through cardiac puncture into plain bottles and EDTA bottles. Serum and plasma collection were collected by refraction and stored in the refrigerator for biochemical analysis.

Study Animal

Wistar albino rats of 68-217kg weight, of female sex were obtained from university of Nigeria Nsukka. Animals were housed at an ambient temperature and relative humidity in the animals' house of natural sciences, Caritas University, Amorji-Nike Enugu. The rats were allowed to acclimatize for one week prior to the experiment and had access to standard pelletized finisher feed and clean water within the period of acclimatization. The principle of laboratory animals care and ethical guidelines for investigation of experimental pain in conscious animals were followed respectively[15,16].

Acute Oral Toxicity (LD_{50}) Study

Lethal Dose (LD_{50}) of the aqueous and methanol extracts of raw and cooked kidney bean was determined using the method of Lorke[17] on Wistar albino rats. This study was carried out in two phases respectively. At phase 1, a total of twenty four (24) albino wistar rats were used. The rats were divided into twelve (12) groups of two (2) rats per cage. Doses of 10mg/kg, 100mg/kg, and 1000mg/kg were administered to 2 rats each. The body weight of rat was noted before and after extract administration. Single dose of extracts was administered orally and observed from the time of administration, for toxic symptoms, such as behavioral changes, loco-motion, convulsion and mortality, then overnight. In the absence of mortality in the first phase, higher doses were used at phase 2. A total of twenty four (24) albino wistar rats were used. The rats were divided into twelve (12) groups of two (2) rats per cage. Here the dosages were increased to 1600, 2900 and 5000mg/kg of the various extracts. These rats were observed for the signs of toxicity which includes; paw licking, salvation, rubbing of nose on floor, change in body weight and death within 24 hours. LD_{50}, the amount or lethal dose of materials given all at once, which causes the death of 50% of a group of test animals was calculated with the formula below;

$$LD_{50} = \sqrt{\text{Min. Conc. that caused death} \times \text{Max. conc. that result to no death}}$$

Experimental Design

A total of thirty six (36) Wistar albino rats were used and divided into nine (9) groups of four (4) rats per cage and were treated with aqueous and methanol extracts for one week and at the end, all rats were euthanized with chloroform, blood sample was collected for biochemical analysis. The rats were arranged and treated as follows;

Group 1: Control group no extract was administered.

Group 2 and 3: Group two and three rats were treated with aqueous extract of raw kidney bean with doses of 350mg/kg and 550mg/kg respectively.

Group 4 and 5: Group four and five rats were administered with aqueous extract of cooked kidney bean with doses of 350mg/kg and 550mg/kg respectively.

Group 6 and 7: Group six and seven rats were treated with methanol extract of raw kidney bean with doses of 350mg/kg and 550mg/kg respectively.

Group 8 and 9: Group eight and nine rats were treated with methanol extract of cooked kidney bean with a dose of 350mg/kg and 550mg/kg respectively.

Statistical Analysis

Results were expressed as mean ± standard deviation and analyzed using one-way ANOVA (analysis of variance, p value ($p<0.05$) was considered significant. A component of graph pad prism instat 3 software version 3.05 by graph pad Inc. was employed[18].

RESULTS

Acute Toxicity Results

The results of the acute toxicity of aqueous and methanol extracts of fresh and cooked kidney bean are shown in table 1. In the 1st phases, doses of 10mg/kg, 100mg/kg, and 1000mg/kg were administered to 2 rats each of which no mortality was observed. In the absence of mortality in the 1st phases, higher doses of 1600mg/kg, 2900mg/kg and 5000mg/kg were then administered on 2 rats each for the 2nd phases of which no mortality observed as well with strict observance on paw licking, salvation, rubbing of nose on floor, change in body weight and death within 24 hours. Results of LD_{50} of all extracts were found to be greater than 5000mg/kg and based on the duration of this work and standard scale of toxicity; the extracts are practically non- toxic.

Table 1: Phase I and II Acute Toxicity of Aqueous and Methanol Extracts of Raw Kidney Bean and Cooked Kidney Bean.

Study	Dose (mg/kg)	Number of dead rats after 24 hours			
		RKBAE	CKBAE	RKBME	CKBME
Phase I	10	0/2	0/2	0/2	0/2
		0/2	0/2	0/2	0/2
	100	0/2	0/2	0/2	0/2
		0/2	0/2	0/2	0/2
	1000	0/2	0/2	0/2	0/2
Phase II	1600	0/2	0/2	0/2	0/2
		0/2	0/2	0/2	0/2
	2900	0/2	0/2	0/2	0/2
		0/2	0/2	0/2	0/2

5000	0/2	0/2	0/2	0/2

Key: RKBME= Raw kidney bean methanol extract, CKBME= Cooked kidney bean methanol extract, RKBAE = Raw kidney bean aqueous extract, CKBAE = Cooked kidney bean aqueous extract.

The renal function test of rats after administration of raw and cooked kidney bean Aqueous extracts on serum urea, creatinine, chloride and potassium is shown in table 2. There was a significant ($p<0.05$) increase in urea, creatinine and chloride concentrations between test groups of raw and cooked extracts as compared to control group but there was no significant ($p<0.05$) difference in the concentration of potassium between test groups of raw and cooked extracts as compared to control group. However, the values of urea and chloride of rats administered cooked extracts is significantly ($p<0.05$) higher than those of raw extracts irrespective of the dose and rats administered raw extracts had a significantly ($p<0.05$) higher value of creatinine than those administered cooked extracts, in a non dose dependent manner.

Table 2 shows rats administered with (350mg/kg and 550mg/kg body weight of rat) raw and Cooked Aqueous Extracts

	Control	**350mg Aqueous Extract**		**550mg Aqueous Extract**		
Group	**1**	**2**$_{\text{Raw Extract}}$	**4**$_{\text{Cooked Extract}}$	**3**$_{\text{Raw Extract}}$	**5**$_{\text{Cooked Extract}}$	**Reference Range**
UREA(mg/dl)	8.335 ± 11.52^{abcde}	5.325 ± 0.09192^{b}	33.28 ± 13.10^{c}	12.13 ± 2.199^{d}	16.25 ± 2.044^{e}	10-40
CREA(µmol/L)	94.76 ± 62.42^{abcde}	55.73 ± 30.50^{b}	36.53 ± 5.812^{c}	40.15 ± 3.882^{d}	35.29 ± 4.752^{e}	
CHL(mEq/l)	95.40 ± 8.280^{abcd}	67.83 ± 3.663^{b}	96.38 ± 6.767^{a}	67.83 ± 5.431^{c}	54.20 ± 3.097^{d}	95-105
POT(mEq/l)	4.035 ± 0.03536^{a}	3.615 ± 0.1909^{a}	3.845 ± 0.219^{a}	3.650 ± 0.1273^{a}	3.695 ± 0.1768^{a}	3.4-5.0

Results are mean ± standard deviation, Values in the same row bearing different superscripts are significantly different at $P<0.05$. (n=4). *Key: 1: Control Group, Crea=Creatinine, CHL= Chloride, POT= Potassium.*

Results show a significant ($P<0.05$) increase between control and test groups of Urea and a significant ($P<0.05$) decrease between test and control group of Creatinine, Chloride, and Potassium.

Table 3 reveals result of kidney function test of rats administered 350mg/kg and 550mg/kg body weight of raw and Cooked Methanol Extracts. A significant ($p<0.05$) increase in the concentrations of urea, creatinine and chloride of test groups when compared with control group. While there was no significant ($p<0.05$) increase in the concentration of potassium in test groups as compared to control group. Meanwhile, concentrations of urea and chloride of rats administered raw extracts were significantly ($p<0.05$) higher than those administered cooked extracts, in a non dose dependent pattern and the concentration of creatinine of rats administered cooked extract was significantly ($p<0.05$) higher than those administered raw extract not in a dose dependent pattern.

Table 3 shows rats administered with (350mg/kg and 550mg/kg body weight of rat) raw and Cooked Methanol Extracts

	Control	**350mg Methanol Extract**		**550mg Methanol Extract**		
Group	**1**	**6**$_{\text{Raw Extract}}$	**8**$_{\text{Cooked Extract}}$	**7**$_{\text{Raw Extract}}$	**9**$_{\text{Cooked Extract}}$	**Ref. Range**
UREA(mg/dl)	8.335 ± 11.52^{abcd}	44.04 ± 23.77^{b}	20.81 ± 0.000^{c}	43.92 ± 46.44^{b}	34.40 ± 3.422^{d}	10-40
CREA(mg/dl)	94.76 ± 62.42^{abcde}	29.67 ± 21.86^{b}	25.68 ± 11.29^{c}	20.70 ± 7.757^{d}	40.40 ± 10.23^{e}	
CHL(mEq/l)	95.40 ± 8.280^{abcde}	109.9 ± 6.640^{b}	80.21 ± 11.31^{c}	64.83 ± 1.329^{d}	101.1 ± 36.84^{e}	95-105
POT(mEq/l)	4.035 ± 0.04^{a}	3.695 ± 0.11^{a}	3.490 ± 0.09^{a}	3.600 ± 0.01^{a}	3.525 ± 0.22^{a}	3.4-5.0

Results are mean ± standard deviation, Values in the same row bearing different superscripts are significantly different at P<0.05. (n=4). *Key: 1: Control Group, Crea=Creatinine, CHL= Chloride, POT= Potassium.*

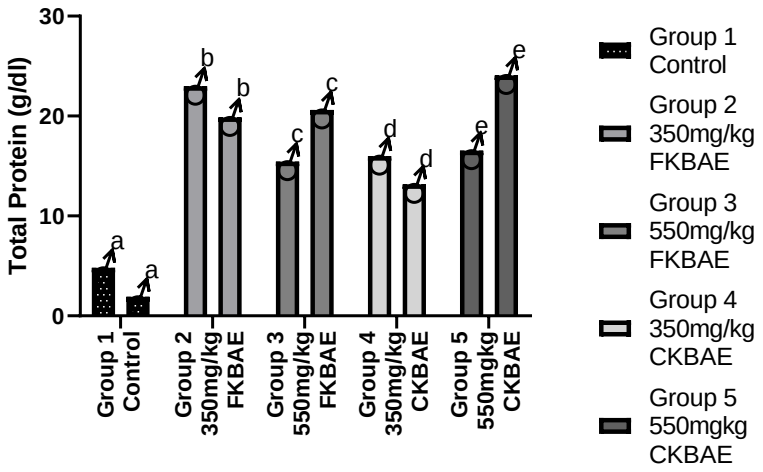

Figure 1: Concentration of Total Protein of Rats Treated with 350mg/kg and 550mg/kg FKBAE and CKBAE

Results are expressed as Mean ± Standard Deviation (*n*=4). FKBAE = Fresh (Raw) kidney bean aqueous extract, CKBAE = Cooked kidney bean aqueous extract.
Letters a, b, c, d, and e indicates significant difference (P < 0.05) when group 1 was compared with groups 2, 3, 4 and 5, respectively.

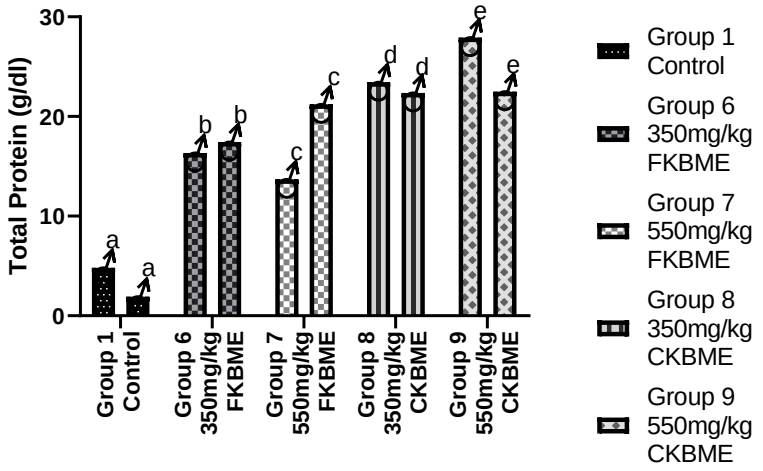

Figure 2: Concentration of Total Protein of Rats Treated with 350mg/kg and 550mg/kg FKBME and CKBME

Results are expressed as Mean ± Standard Deviation (*n*=4). FKBME = Fresh (Raw) kidney bean methanol extract, CKBME= Cooked kidney bean methanol extract, Letters a, b, c, d, and e indicates significant difference (P < 0.05) when group 1 was compared with groups 6, 7, 8 and 9, respectively.
Figure 1 and 2 show results of total protein of rats administered 350mg/kg and 550mg/kg body weight of raw and cooked aqueous and methanol extracts. There was a significant (p<0.05) increase between test groups (2,3,4,5,6,7,8 and 9) and control group as shown in figures 1 and 2 respectively.

DISCUSSION

Results of LD_{50} (table1) of all extracts (raw and cooked aqueous and methanol) of *P. vulgaris* were found to be greater than 5000mg/kg and no mortality was observed in both phases of the study. While there was no mortality recorded with the use of both extracts of *P. vulgaris* even up to 5000mg/kg body weight, it could be associated to the rich beneficial antioxidant activities it possesses[19,20]. Thus, based on the duration of this study and standard scale of toxicity; the extracts of *P. vulgaris* (raw and cooked aqueous and methanol) are established to be practically non- toxic on the absence of coma, convulsion, restlessness and death[21,22].

Observations made (tables 2 and 3) after administration of cooked and raw aqueous and methanol (350mg/kg and 550mg/kg body weight of rat) extracts to all groups revealed that administration of cooked extract of *P. vulgaris* resulted in a significant ($p<0.05$) increase in concentrations of urea and chloride than those of raw extracts not minding the dose, and rats administered raw extracts had a significantly ($p<0.05$) higher value of creatinine than those administered cooked extracts, in a non dose dependent manner. There was no significant ($p<0.05$) difference in the concentration of potassium between test groups and control group. Increased serum urea concentration could be due to dietary protein content of the cooked bean, since urea is synthesized from protein catabolism as a nitrogenous waste product of metabolism and because dietary protein influences the amount of blood urea[23,24]. In a kidney disease condition, consumption of protein, vitamins, minerals and calories in the proper and healthy measure is vital to keep the kidney condition from getting worse[25]. When urea is reabsorbed and secreted by the kidney, via glomerular filtrate, the resultant is extreme concentrated urine. This action makes urea to perform two physiologically linked functions; conservation of water and ammonia detoxification functions[23]. Urea in blood is transported into glomerular filtrate in kidney undergoing glomerular filtration. Serum urea concentration is contributive of the equilibrium between its production by the liver and removal by the kidneys, via urine. Thus, serum urea concentration can be due to over production by the liver, decreased excretion by the kidneys or both[26]. Serum urea balance is also affected by loss of small amount through sweat and the gut[26]. Clinically, kidney function is significantly measured by glomerular filtrate rate (GFR), a parameter that is rationally measured using blood creatinine and urea. In the presence of normal kidney function (normal GFR), serum urea concentration may be high, thus in testing for renal function, urea cannot be recommended for routine measurement because it is not a better choice for assessing GFR compared to creatinine since other non renal conditions, such as dietary protein can also increase the level of serum urea[26]. Glomerular filtration rate is lowered in renal failure, with a very important relationship between aggravation of renal disease. The rate at which GFR decreases provides distinctions between acute renal injury and chronic renal disease. Decrease in glomerular filtration rate in chronic renal disease is a somewhat permanent or very slow in reverting, taking a period of months, years, or decades; while in acute renal injury, GFR can revert within a period of hours or days[23]. In tables 2 and 3, the concentration of creatinine in test group is significantly ($p<0.05$) lower when compared with control. Consistently, increase in serum creatinine is a consequence of decreased GFR and subsequent reduced kidney function or renal disease. However, since creatinine level in the blood is affected by gender, age, body size and race; assessing kidney function with how much creatinine is in the blood is not the best option either but glomerular filtration rate, which is a concurrent measurement of creatinine and estimation of urea/creatinine ratio[12].

There was significant ($p<0.05$) difference in serum level of chloride (tables 2 and 3) between test groups and control group. However, in comparison, the levels of chloride of rats administered

(350mg/kg and 550mg/kg body weight) aqueous extracts (table 2) were lower than those of methanol extracts (table 3) of the same dose. Chloride is reported to be found in foods and drinks in appreciable content, thus, the high content of chloride in *P. vulgaris* in this study is consistent with available records, since the chloride levels in this study falls within standard reference value[6]. The metabolism of chlorine and sodium are closely associated, as chloride is subsequently released as a component of sodium chloride. In the regulation of acid-base equilibrium, osmotic pressure and balancing of fluid, chloride is involved by its interaction with sodium ion (Na^+) and potassium ion (K^+). It is physiologically involved in the generation of HCl in gastric juice and activation of salivary amylase[5]. The transport of chloride is often coupled with sodium, in the maintenance of chloride balance in the body; the role of the kidneys may involve a selective separate function of chloride transport. Thus high serum chloride levels in the kidneys are unreservedly filtered by the membranes of the glomeruli compartment. Elimination of chloride by the kidneys into urine is chiefly dependent on the amount of chloride filtered by the glomeruli and its repeated transportation down the nephron[5]. Kidney failure may result in hyperchloremia, a condition of abnormally high blood chlorine concentration. In a normal working kidney, more than 50% of the filtered chloride is absorbed shortly after the absorption of a relative portion of sodium and water in the proximal tubule, keeping the concentration of sodium nearly constant. However, bicarbonates and some anions other than chloride are rapidly being absorbed with sodium and eventually excreted from the filtrate[27].

There was no significant ($p<0.05$) difference in serum level of potassium between test groups and control group, administered 350mg/kg and 550mg/kg body weight of raw and cooked aqueous and methanol extracts (tables 2 and 3). However, the concentrations of potassium in this study is within the standard reference range, which depict the claim that *P. vulgaris*, is a very rich dietary source of potassium that can furnish the body with this essential nutrient[28]. Potassium is a metal, a mineral, an essential nutrient and electrolyte that abound in foods and naturally produced in the body, which aids in the conduction of electrical signals all over the body. It is the major intracellular cation[29]. Diseases of the kidneys, heart and lung tend to aggravate when there is imbalance and deviation from normal range of serum potassium concentrations in the body[30]. Potassium loss in urine due to too much consumption of sodium and consequence increase in blood pressure can be controlled by the kidneys by controlling and maintaining stored amount of fluid in the body. Through a unique balance of potassium and sodium, for the absorption of water, the kidney keeps blood pressure at balance by filtering and removing excess fluid from the blood and store the waste as urine in the bladder. Dietary intake of potassium plays a vital role in hypertensive and normal conditions, in predisposing one to blood pressure. While reduction of dietary potassium increases blood pressure (high blood pressure) and vasoconstriction, raised levels will result in decreased blood pressure (low blood pressure). In muscle cells, the generation of electrical impulse by potassium excites the movement of calcium ions across the cell membrane, activating the contraction of muscle cells to enable movement. Depletion of potassium hampers relaxation of muscle after contractions, resulting in rigidity, weaken function and tension in the muscles. Since hypokalemia affects peristalsis, results in stomach upset, intestinal paralysis, abdominal cramps and constipation, impairment of glucose tolerance and decreases secretion of insulin in response to high level of glucose; consuming *P. vulgaris* may be able to furnish potassium into affected cells, to make up for the shortage[31]. There was a significant ($p<0.05$) difference in the concentration of total protein in test groups compared to control group administered cooked and raw, aqueous and methanol extracts irrespective of dose. A close consideration of this study (figures 1 and 2),

reveals that methanol and aqueous cooked extracts gave higher protein. This is consistent with Idoko et al.[1], who reported that cooking of *P. vulgaris* increased the concentration of protein. Protein and other nutrients in beans serve as alternative to meat to vegan because of the content of complementary amino acids when cooked with grains[32]. It is reported that beans' proteins are naturally free from gluten and could serve a good combination in the diet of those who are at risk of the deficiency in vitamins B production, since they can supply these vitamins[33]. Protein function in beans is associated to weight loss, reduction in circumference of the waist, body fat mass, and reduction in blood pressure, and decrease in cholesterol[34]. Dietary protein deficiency is associated with interrupted transport of potassium into and away from the cell[31].

CONCLUSION

P. vulgaris cooked and raw aqueous and methanol extracts affected kidney function irrespective of the dose administered. It is obvious that *P. vulgaris* possesses potential ability to serve as a reliable plant source of chloride, urea, creatinine and potassium as assayed in this study. It may be concluded that *P. vulgaris* portrays potentials capable of improving kidney function and its consumption may also contribute to the general wellness of a person due to its rich nutrients (proteins) composition, and based on the duration of this work and standard scale of toxicity; the extracts are practically non- toxic since the LD_{50} was greater than 5000mg/kg.

CONFLICT OF INTEREST

Authors declare that no conflict of interest exists as touching this work.

AUTHOR'S CONTRIBUTION

This work was carried out in collaboration between all authors. Authors AI, POC, BNO and ATA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AI, POC, NON, APN and UPO managed the analyses of the study, the literature searches. All authors read and approved the final manuscript.

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