ORIGINAL ARTICLE

Evaluation of Uric Acid, Creatinine, and Plasma Ions in Rats Fed with High-fat Diet Mitigated by Wild, Edible Beans

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ABSTRACT

Aim and Objectives: It is a known fact that, consumption of fruits and vegetables rich in potassium and other ions is a critical component of the special diet approach to controlling hypertension and decrease cardiovascular disease. Less well documented are the effects of under-utilized wild beans which may help reduce the risk of metabolic diseases instigated by high fats diet. Hence this present study is to compare the biochemical effectiveness of some selected wild and edible beans on rats fed with high-fat diets. **Results and Conclusion:** Lipid profile result carried out in the blood showed high density lipoprotein to be significantly ($P \leq 0{,}05$) high in Pakala group with a value of 2.2±0.02 compare to other groups. While for low density lipoprotein (LDL); rats with Otili in their diet had the highest LDL with a value of 0.45±0.01. However, the group of rats fed with Feregede had the least cholesterol level compared to other groups of rats fed with respective wild beans and the negative control group. There, was a significant difference in the phosphorus level between the wild and edible beans and pronounced impact of High-fat diet in rats fed with Feregede compared to other rats fed with other wild beans.

Key words: Antilipidemic, dietary fibers, metabolic syndrome

INTRODUCTION

Beans have a nutritional profile that suits all ages, providing cholesterol-free protein, fiber, magnesium, potassium, B vitamins, resistant starch, and the more recently discovered phytonutrients.[1,2] Their nutrient profile fits with the dietary need of growing children and teenagers as well as adults. Protein is critical for growth and development in children and adolescents.[3,4] Beans cooked until tender is easy-to-chew protein source and appealing "finger food" for young children. Children who eat beans have significantly greater intakes of fiber, magnesium, and potassium than those who do not eat beans.[5,6] Bean eaters between the ages of 12 and 19 years also weigh significantly less and have smaller waist measurements compared with non-bean eaters. For adults who want to moderate their fat and cholesterol intakes, beans are a healthful alternative to meat. Several studies show that beans may help lower blood cholesterol.[7-9] Furthermore, soluble fiber and resistant starches in beans may help suppress appetite and manage blood sugar.[2,10-12] Beans contain several important minerals. One-half cup of beans supplies 10% or more of the daily values for potassium, magnesium, and iron. Cooked dry beans are very low in sodium, and rinsing canned beans reduce sodium content by approximately 40%.[13-15] Plasma electrolyte concentrations are among the most commonly used laboratory tests by

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clinicians for the assessment of a patient's clinical conditions and disease status.[16] In physiology, the primary ions of the electrolytes are sodium (Na^+), potassium (K^+), calcium (Ca^{2+}), chloride (Cl^-), hydrogen phosphate (HPO_4 2-), and hydrogen carbonate (HCO_3^-).[15] Electrolyte disorders are commonly encountered in the patient with cancer. In most cases, these disorders are associated with etiologies seen in all types of patients and are not specifically linked to the malignancy or its therapy, for example, diuretic-induced hyponatremia or hypokalemia.[14,17] The careful monitoring of the serum electrolytes plays very important role in the prognosis of diseases. Thus, proper recognition and treatment of these disorders is important in the overall care of the patient with cancer.[18-20] Likewise, the assessment of kidney functions tests (urea and creatinine) plays a key role in the diagnosis and management of cancer diseases as any deterioration of renal function results in elevations of these parameters in the blood. Elevated urea and creatinine levels in the blood signify impaired kidney function or kidney disease parenthesis.[6,13,20]

MATERIALS AND METHODS

Collection of cultivar

The legumes (beans) used in this work are of two types; wild-type beans *Sphenostylis stenocarpa* (*Otili* African yam bean), *Cajanus cajan* (*Feregede* Pigeon pea), *Phaseolus lunatus* (*Pakala* lima beans), and edible bean *Phaseolus vulgaris* (oloyin kidney bean). They are gotten from the farmers in Ado-Ekiti.

Experimental animals

Twenty-four albino rats were obtained from the College of Medicine Animal House, Ekiti State University, Ado Ekiti, Ekiti state. Their weight ranged between 50 and 100 g. The animals were acclimatized to the environment for 7 days. The rats were then randomly divided into six groups (four rats per group) according to average body weight, the groups were fed with a normal chow diet (NCD), a high dietary (HD) fiber diet containing 8% fiber supplement in total, a high-fat diet (HFD) which provided 45% of its energy from fat, or a HF and dietary fiber diet. The main nutritional ingredients in the HD diets were adjusted to levels similar to those of the NCD, and the main nutritional ingredients in the HFD diet were adjusted levels similar to those of the HF diet [Table 1]. The rats were observed every day and weighed every week, and the food intakes were recorded for each group throughout the experiment.

Dissection and tissue collection

All of the rats were anesthetized with chloroform and venous blood was collected from the orbital vein for hematology and blood biochemical analyses.

Hematology and blood biochemical analyses

For the biochemical analyses, the blood samples were maintained 4°C for 2 h and then centrifuged at 3000 r/min for 20 min at 4°C. 5 ml of venous blood were collected from each cancer patient and normal subject. The collected blood samples were dispensed into lithium heparin bottles and were centrifuged at 10,000 rpm for 10 min and separated to obtain plasma. The separated plasma was stored at −10°C for further analysis. Urea levels in plasma were estimated using the method described by Weatherburn (1967).[21] Creatinine levels were determined using the method of Bartels *et al.*[22] Plasma levels of electrolytes, namely, Na^+, K^+, and Cl^- were carried out by flame photometry technique, using Gallenkamp flame photometer (AOAC, 1990).[23]

RESULTS AND DISCUSSION

The result of the experimental rats showed differences in the weight [Figure 1]. The positive control showed higher differences in their weight from other samples because they were fed with standard rat chow. The negative control had a variance in weight due to the HF diet given. There was an increase in weight in the rats fed with Otili and Oloyin, respectively, in the diet compounded at the end of the 5-week experiment while there was a reduction in the weight of the rats fed with Feregede at the end of the experiment.

Electrolyte disorders are commonly encountered in the patient with cancer. In most cases, these disorders are associated with etiologies seen in all types of patients and are not specifically linked to the malignancy or its therapy (for example, diuretic-induced hyponatremia or hypokalemia).

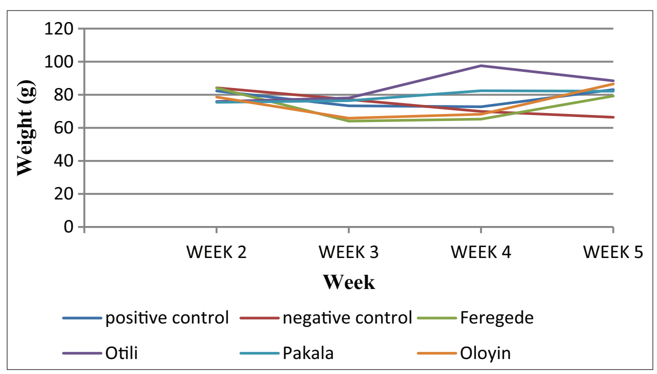

Figure 1: Weight of the experimental rats in the course of the experiment

Table 1: Experimental design

Experimental group	Composition
Basal/positive control	Chow
Negative control	Chow+High-fat diet
Feregede	Chow+HFD+*Feregede*
Otili	Chow+HFD+*Otili*
Pakala	Chow+HFD+*Pakala*

Table 2: Result of biochemical analyses

Experimental group	High-density lipoprotein	Low-density lipoprotein	PO_4^{2-}	K^+	Na^+	Uric acid	Creatinine
Positive control	0.3±0.3	0.35±0.01	138±1.0	125±1.0	13±1.2	0.43±0.01	89±1.7
Negative control	1.5±0.05	0.02±0.02	212±2.0	129±1.5	10±0.08	0.27±0.04	24±0.02
Feregede	0.8±0.06	0.35±0.07	47±0.3	140±1.0	6.8±0.05	0.29±0.05	25±1.3
Otili	1.3±0.01	0.45±0.01	188±0.9	148±1.0	11±0.01	0.2±0.02	2.9±0.02
Pakala	1.3±0.01	0.4±0.02	109±0.5	151±1.0	13±0.12	0.26±0.04	24±1.0
Oloyin (edible)	1.0±0.02	0.4±0.01	68±0.4	156±1.5	19±0.10	0.3±0.09	16±1.4

The careful monitoring of the serum electrolytes plays a very important role in the prognosis of diseases. Thus, proper recognition and treatment of these disorders is important in the overall care of the patient with cancer.[15,18] Likewise, the assessment of kidney functions tests (creatinine) plays a key role in the diagnosis and management of cancer diseases as any deterioration of renal function results in elevations of these parameters in the blood. Elevated creatinine levels in the blood signify impaired kidney function or kidney disease parenthesis.[24] Result of the blood biochemical test for phosphorus (PO_4), potassium (K^+), sodium (Na^+), and creatinine carried out on the wild and edible bean [Table 2] showed that phosphorus level was higher in the negative control which was animal fed with HF diet while Group 3 had the lowest phosphorus level. The high phosphorus level in negative control group may be due to the inability of the kidney to excrete phosphate as it occurs in renal failure while the low level of phosphorus in group fed with Feregede may be caused by decreased intestinal absorption. Potassium level was higher in group of animal fed with HF diet and oloyin while the positive control group had the lowest potassium level. The high potassium level in oloyin may be caused by a decrease in renal excretion of potassium while the low level of potassium in positive control group might be due to poor dietary intake or increased potassium loss from the body.[3,25,26] Potassium measurements are used to monitor electrolyte balance in the diagnosis and treatment of hypokalemia, hyperkalemia, and diseases involving electrolyte imbalance. Hypokalemia with normal total body potassium, by definition, is due to a shift of potassium into the cell. This shift could occur in alkalemia states of high endogenous or exogenous insulin. Hypokalemia associated with low total body potassium is either due to poor dietary intake or increased potassium loss from the body. Hyperkalemia with normal total body potassium is caused by the shift of potassium out of the cell and is commonly seen in acidemia, sudden increase in plasma osmolality, massive tissue breakdown and in very rare circumstances, adrenergic blockade and hyperkalemic periodic paralysis. Hyperkalemia with increase in total body potassium is almost always caused by a decrease in renal excretion of potassium.

A phosphate test measures the amount of phosphate in a blood sample. Phosphate is a charged particle (ion) that contains the mineral phosphorus. The body needs phosphorus to build and repair bones and teeth, helps nerves function, and makes muscles contract. Most of the phosphorus contained in phosphate is found in bones the rest of it is stored in tissues throughout the body. The kidney helps control the amount of phosphate in the blood extra phosphate is filtered by the kidneys and passes out of the body in the urine. Phosphate measurements are used to monitor electrolyte balance in the diagnosis and treatment of hypophosphatemia, hypophosphatemia, and diseases involving electrolyte imbalance. Hypophosphatemia is usually secondary to the inability of the kidney to excrete phosphate as it occurs in renal failure.[27,28]

Sodium had higher value in group of rats fed with oloyin while group of rats fed with Feregede had the lowest sodium value. This condition in oloyin group is also known as hypernatremia which occurs whenever free water loses exceed sodium loses. The increase in plasma sodium level observed in Group 6 might be due to a decrease fluid intake.[29,30] This may be attributable to excessive insensible loses with an impaired thirst mechanism. Pitchford *et al.*,[31] also, reported that high plasma sodium may be associated with tumors that invade the lateral hypothalamus, the tumors which may destroy the thirst center with the subsequent development of severe dehydration and hypernatremia. Sodium measurements are used in the diagnosis and treatment of aldosteronism (excessive secretion of the hormone aldosterone), diabetes insipidus (chronic excretion of large amounts of dilute urine, accompanied by extreme thirst), adrenal hypertension, Addison's disease (caused by destruction of the adrenal glands), dehydration, inappropriate antidiuretic hormone secretion, or other diseases involving electrolyte imbalance.

Creatinine level was higher in positive control group while group fed with *Pakala* had the lowest creatinine level. The high level of creatinine in positive control group may be due to deficiency in filtration of the kidney while the low level of creatinine in Group 4 might be related to increased dietary intake of creatinine or eating a lot of protein which can increase daily creatinine excretion.[32,33] Serum creatinine is an important indicator of renal health because it is an easily measured byproduct of muscle metabolism that is excreted unchanged by the kidneys.

CONCLUSION

In blood biochemical test, there was a significant difference in the phosphorus level between the wild and edible bean. From the data of the analysis provided, it was an evidence that the consumption of beans diet such as wild – Otili which was rich in protein affects the filtration of the kidney by increasing the daily excretion of creatinine out of the body.

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