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COMPARATIVE EFFECTS OF CITRULLUS LANATUS AND CAJANUS CAJAN DIETS ON THE LIPID PROFILE AND BODY WEIGHT OF ALBINO RATS

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ABSTRACT
This study evaluated the comparative effects of diets containing 50 and 70% Citrullus lanatus or Cajanus cajan on the serum lipid profile and body weight of albino rats. Thirty male albino rats randomly assigned into five groups (A – E) of six each were used for the study. The groupings and their diets were as follows: A – Standard rat feed (control), B – diet containing 50% C. lanatus, C – diet containing 70 % C. lanatus, D - diet containing 50% C. cajan, and E - diet containing 70% C. cajan. The rats were fed their group specific diets for 28 days during which they were weighed at weekly intervals. At the end of the 28 days of feeding, blood was collected from the rats and the serum lipid profile was assayed following standard procedures. Results showed that the rat groups fed diets containing 50 and 70 % C. lanatus had a significantly higher ($p < 0.05$) serum total cholesterol (TC), high density lipoprotein cholesterol (HDL-C) and low density lipoprotein cholesterol (LDL-C) but significantly lower ($p < 0.05$) serum triglyceride when compared to the control group fed on standard rat feed. The rat group diet fed containing 70% C. cajan however had a significantly lower serum TC, HDL-C, VLDL-C and triglyceride when compared to the control group fed standard rat feed. The rat group fed diet 70% C. cajan also had a significantly higher ($p < 0.05$) weight gain all through the study period when compared to all other groups. It was concluded that findings in this study suggest that diets containing 70% C. cajan can be recommended for its ability to lower serum cholesterol and triglycerides, and thus can possibly be used to prevent and manage atherosclerosis.

KEY WORDS
Serum lipid profile, body weight, rats, Citrullus lanatus, Cajanus cajan

INTRODUCTION
Citrullus lanatus and Cajanus cajan are legume staples widely consumed in Nigeria and other parts of the world. Legumes are edible seeds of leguminous plants, belonging to the *Leguminosae* family. Legumes can be divided into two main broad classes, pulses and oil seeds. Pulses are the dried edible seeds of cultivated legumes and they include peas, beans, pigeon pea (*Cajanus cajan)* etc. (Olusanya, 2008). The oil seeds are legume seeds that contain appreciable amount of oil and they include soya beans, melon (*Citrullus lanatus*) and groundnut. Legumes constitute the second largest family of seed plants and contain about 600 genera with 13 species. Apart from their nutritive value to human beings, they are also

important in fixing atmospheric nitrogen, thereby making the element available to other plants in the soil (Olusanya, 2008). Legumes are rich in protein, but their protein has a well-recognized deficiency of the sulphur amino acids, methionine and cystein but is comparatively rich in lysine (Ihekoronye and Ngoddy, 1987). Cereals on the other hand contain these amino acids which legumes lack. Hence a combination of legumes and cereals such as beans and maize would provide an ideal source of dietary protein for human beings.

Cajanus cajan (pigeon pea) is a tropical legume grown mainly in India. The true origin of pigeon pea is still disputable. However, immigrants who moved to Africa to become railway workers and storekeepers (Hillocks *et al.,* 2000) most likely introduced the crop into East Africa from India in the 19th century. The legume is increasingly becoming an important sustenance crop in the whole of Africa (Johansen *et al.,* 1993). Some potential uses of pigeon pea in Africa include the production of noodles (Singh *et al.,* 1989) and other fermented products (Onofiok *et al.,* 1996). Pigeon pea leaves have been used to treat malaria (Aiyeoloja and Bello, 2006) in Nigeria, while in the Southern African; pigeon pea is currently one of the indigenous crops being promoted for potential medicinal uses (Mander *et al.,* 1996). Also, clinical studies have reported the seed extracts to inhibit red blood cell sickling and as potential benefit for people with sickle cell anaemia (Akinsole and Solanke, 2011).

Citrullus lanatus (melon) is a creeping annual legume which belongs to the *Eucurbitaceae* family (Olusanya, 2008). It is a water-loving crop and therefore is cultivated predominantly in the southern part of Nigeria (Olusanya, 2008). The flat seeds are embedded in white fleshy material in a circular fruit. Melon seed is rich in protein and oil (Fuller and Harvey, 2006; Olusanya, 2008) and low in carbohydrate but contains good amounts of minerals especially phosphorus, magnesium and potassium and a fair amount of carotene and vitamin D (Olusanya, 2008). Melon is a high calorie source because of its high oil content. Melon seeds are an excellent source of tryptophan and arginine (Olusanya, 2008; Ojieh *et al.,* 2008).

Cholesterol and triglycerides are the major blood/serum lipids of clinical significance in humans and animals (Ononogbu, 1988; Oslon, 1998; Nelson and Cox, 2000). Cholesterol is an essential component of mammalian cell membranes which play major roles in membrane permeability and fluidity and also as precursor of bile acids, steroid hormones and fat soluble vitamins (Oslon, 1998; NCEP, 2002). Triglycerides play important role in metabolism as energy sources and transporters of dietary fat (Ononogbu, 1988; Nelson and Cox, 2000). Though cholesterol and triglycerides are physiologically important in the body, high levels of them in the blood have been found to be a major risk factor for the development of atherosclerosis (Brown and Goldstein, 1992; Oslon, 1998; Schoen, 2004; Brunzell *et al*., 2008). The possible pathological consequences of atherosclerosis include myocardial infarction (heart attack), cerebral infarction (stroke), aortic aneurysms, peripherial vascular disease, sudden cardiac death, chronic ischaemic heart disease etc (NCEP, 2002; Schoen, 2004; Brunzell *et al*., 2008).

The consumption of food items that will significantly reduce the overall blood levels of cholesterol and triglyceride and / or those components of cholesterol that have been associated with increased risk of atherosclerosis is one of the major strategies at prevention and management of atherosclerosis (Law, 1999; NCEP, 2002; Brunzell *et al*., 2008). Hence the present study, which evaluated the comparative effects of feeding diets containing 50 or 70 %

Citrullus lanatus or *Cajanus cajan* on the serum lipid profile and body weight gain of albino rats.

MATERIALS AND METHODS

The rats used for the study were mature male Sprague-Dawley albino rats weighing 150 – 250 grams, procured from the Laboratory Animal House of Faculty of Veterinary Medicine University of Nigeria, Nsukka. The rats were randomly assigned to five groups (groups A – E) of six each and acclimatized for seven days before the commencement of the study. The rats were kept in clean cages in a fly-proof animal house and provided with feed and water *ad libitum* all through the study. Guidelines for the humane use and handling of laboratory animals for research (NAS, 2011) were followed all through the study. The standard rat feed used in this study was sourced from Grand Cereals and Oil Mills Ltd., Jos Nigeria. The *C. lanatus* and *C. cajan* seeds were procured and processed into a mash.

The proximate composition of the standard rat feed, *C. cajan* and *C. lanatus* used for the study were determined following standard procedures. The protein content was determined by micro Khjelldahl method, while the ash, moisture and fat contents were determined by gravimetric method (AOAC, 2000; Changsam, 2003). The total carbohydrate was then estimated using the standard formula (Bemiller, 2003).

After acclimatization, the rats were weighed and the different groups were fed their group-specific diets for 28 days. The group specific diets were as follows: Group A – Standard rat feed (control), Group B – diet containing 50% *C. lanatus,* Group C – diet containing 70 % *C. lanatus*, Group D - diet containing 50% *C. cajan*, and Group E - diet containing 70% *C. cajan*. The rats were further weighed at weekly intervals and weight gain was computed by comparing with the body weight before commencement of feeding of the experimental diets. After the 28 days of feeding the experimental diets, 3 ml of blood was collected from the orbital sinus of the retrobulbar plexus of the rats following the orbital technique (Bolliger and Everds, 2010). The blood dispensed into clean plain glass test tubes and allowed to stand for 30 minutes to clot. After clotting, it was centrifuged at 3,000 revolutions per minute to separate the serum from clot. The clear serum was aspirated into clean labeled sample bottles and used immediately for the lipid profile assay following standard procedures.

The serum lipid profile was assayed using Quimica Clinica Aplicada (QCA) test kits (QCA, Spain). The serum total cholesterol (TC) was determined by the enzymatic colorimetric method (Allain *et al*., 1974). The serum high density lipoprotein cholesterol (HDL-C) was determined by the dextran sulphate-magnesium (II) precipitation method (Albers *et al*., 1978). The glycerol phosphate oxidase enzymatic method was used to determine the serum triglyceride (Bucolo and David, 1973). The very low density lipoprotein cholesterol (VLDL-C) was calculated by dividing the serum triglyceride by 5, while the serum low density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald formular (Friedewald *et al*., 1972; Warnick *et al*., 1990).

Data generated from the study were subjected to one way analysis of variance and variant means were compared with the control post hoc using the least significant difference (LSD) method. Significance was accepted at $p < 0.05$.

RESULTS

Results of the proximate analysis for the standard feed, *C. cajan* and *C. lanatus* showed that *C. cajan* had the highest percentage composition of crude protein (26.52%) when compared to that of the standard feed (19.53%) and that of the *C. lanatus* (23.4%) (**Table 1**). The proximate analysis also showed that *C. lanatus* had the highest percentage composition of fat (45.7%) when compared to that of the standard feed (7.86%) and *C. cajan* (3.14%) (**Table 1**). The standard rat feed had the highest percentage composition of carbohydrate (56.91%) while *C. lanatus* has the least (10.6%) (**Table 1**).

Table 1. The proximate composition of the rat feed, *Cajanus cajan* and *Citrullus lanatus* used for the study.

Composition	Means ± standard deviation.		
	Standard rat feed	*Cajanus cajan*	*Citrullus lanatus*
Crude protein	19.53 ± 0.44	26.52 ± 0.43	23.40 ± 0.20
Moisture	6.11 ± 0.26	7.46 ± 0.25	5.80 ± 0.18
Ash	5.76 ± 0.44	4.25 ± 0.31	4.60 ± 0.30
Crude fibre	3.83 ± 0.11	6.99 ± 0.34	12.00 ± 0.11
Fat	7.86 ± 0.27	3.14 ± 0.28	45.70 ± 0.17
Carbohydrate	56.91 ± 0.62	51.64 ± 0.54	10.60 ± 0.20

Table 2. The serum lipid profile of albino rats fed for 28 days with diets containing varied percentages of *Cajanus cajan* or *Citrullus lanatus*.

Groups (Diets fed)	Means ± standard deviation.				
	Total cholesterol (mg/dl)	HDL-C (mg/dl)	LDL-C (mg/dl)	VLDL-C (mg/dl)	Triglyceride (mg/dl)
Group A (Standard rat feed)	56.10 ± 11.63	27.15 ± 1.92	16.85 ± 7.83	12.10 ± 3.37	60.49 ± 18.66
Group B (50% *C. lanatus*)	85.61 ± 8.64*	49.41 ± 14.60*	28.95 ± 7.78*	7.24 ± 3.94	36.20 ± 19.68*
Group C (70% *C. lanatus*)	75.96 ± 11.04*	39.61 ± 9.20*	30.38 ± 6.31*	5.96 ± 1.84*	29.80 ± 9.20*
Group D (50% *C. cajan*)	50.82 ± 5.55	21.64 ± 0.63*	20.79 ± 8.05	8.30 ± 3.36	41.94 ± 16.80*
Group E (70% *C. cajan*)	43.71± 7.52	20.83 ± 0.95*	16.62 ± 5.18	6.27 ± 1.48*	31.34 ± 7.41*

*** Asterisk superscript on any mean indicates that it is significantly different from the control group (A) fed standard rat feed ($p < 0.05$).**

Table 3. The body weight gain of albino rats fed for 28 days with diets containing varied percentages of *Cajanus cajan* or *Citrullus lanatus*.

Groups (Diets fed)	Means ± standard deviation.			
	Day 7	Day 14	Day 21	Day 28
Group A (Standard rat feed)	10.06 ± 3.29	24.12 ± 9.27	35.05 ± 5.64	38.69 ± 3.89
Group B (50% *C. lanatus*)	7.34 ± 2.86	18.68 ± 7.87	35.87 ± 6.30	39.94 ± 5.94
Group C (70% *C. lanatus*)	7.77 ± 3.62	19.54 ± 8.46	32.17 ± 4.18	36.77 ± 4.80
Group D (50% *C. cajan*)	14.67 ± 5.91	33.34 ± 8.14	36.17 ± 4.18	36.77 ± 4.80
Group E (70% *C. cajan*)	28.03 ± 8.87*	60.06 ± 7.94*	65.53 ± 9.83*	69.16 ± 6.41*

*** Asterisk superscript on any mean indicates that it is significantly different from the control group (A) fed standard rat feed ($p < 0.05$).**

The rat groups fed diets containing 50% and 70% *C. lanatus* (Groups B and C) had a significantly higher ($p < 0.05$) serum TC, HDL-C and LDL-C when compared to the control group fed standard rat feed, while the group fed 70% *C. cajan* (Group E) had a significantly lower ($p < 0.05$) serum TC, and HDL-C when compared to the control group fed standard rat feed (**Table 2**). The serum VLDL-C of the rat groups fed 70% *C. lanatus* (Group C) and 70% *C. cajan* (Group E) were significantly lower ($p < 0.05$) than that of the rat group fed standard rat feed (Table 2). However, the serum triglyceride of groups B, C, D and E rats were significantly lower ($p < 0.05$) than that of the rat group fed the standard rat feed (**Table 2**).

The body weight gain computations showed that the rat group fed with 70% *C. cajan* diet (Group E) had significantly higher ($p < 0.05$) body weight gain when compared to all other rat groups all through the study (**Table 3**).

DISCUSSION

The significantly higher total serum TC, HDL-C and LDL-C recorded for the rat groups fed diets containing 50% and 70% *C. lanatus* can be attributed to the high fat composition of *C. lanatus* as indicated by its proximate composition. This suggests that consumption of diets with up to 50 and 70 % *C. lanatus* could predispose the consumer to development of atherosclerosis and its associated pathological consequences (Brown and Goldstein, 1992; Oslon, 1998; Schoen, 2004; Brunzell *et al.*, 2008). In contrast, the significantly lower serum TC, VLDL-C and triglyceride recorded for the rat group fed 70% *C. cajan* could be as a result of its low fat composition, and by implication, consumption of diets with up to 70% *C. cajan* could be used therapeutically to reduce blood TC, VLD-L and triglyceride and thus prevent/manage atherosclerosis. The findings in this study of the ability of diet containing 70% *C. cajan* to reduce blood cholesterol is in agreement with the reports of Luo *et al.* (2008) that showed that administration of extracts of *C. cajan* was able to significantly reduce serum total cholesterol of hyperlipidemic mice.

The findings in this study of significantly higher serum HDL-C in the rat groups fed 50 and 70 % *C. lanatus* is a positive finding as HDL-C, often referred to as "good cholesterol", is known to facilitate the removal of "bad cholesterol" (LDL-C and VLDL-C) from the blood vessels and transferring them to the liver where they are metabolized and excreted (Libby *et al*., 1998; NCEP, 2002; Barter *et al*., 2007). The significantly lower serum triglyceride recorded for the rat groups fed diets containing 50 and 70% *C. lanatus* and *C. cajan* and also the significantly lower serum VLDL-C recorded for the rat groups fed 50 and 70% *C. cajan* are considered positive developments when viewed against the background of the role that LDL-C and VLDL-C play in the development of atherosclerosis and its pathological consequences (Libby *et al*., 1998; Barter *et al*., 2007). These findings in the *C. cajan* fed rats is in agreement with the reports of Luo *et al*. (2008)

Results of the body weight gain computation which showed that the rats fed with 70% *Cajanus cajan* diet (Group E) had significantly higher body weight gain all through the study when compared to other groups is believed to be as a result of the high carbohydrate and protein content of *C. cajan* when compared to the standard feed and *C. lanatu*. It was worthy of note that the higher weight gain was not associated with a corresponding higher serum TC, rather the *C. cajan* fed rats had a lower serum TC.

Based on the results of this study, it was concluded that rats fed diets containing 50 and 70 % *C. lanatus* had significantly higher serum TC, HDL-C and LDL-C but significantly lower serum triglyceride when compared to the control fed standard rat feed, while the rat group fed 70 % *C. cajan* had significantly lower serum TC, HDL-C, VLDL-C and triglyceride. In addition, rats fed diets containing 70% *C. cajan* had a significantly higher body weight gain when compared to all other groups.

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