ISSN: 2474-9206

Research Article

Journal of Anesthesia & Pain Medicine

Effect of Orange Fleshed Sweet Potato Leaves on Liver Function and Kidney Function Parameters in Experimental Rats

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Submitted: 2024, May 28; **Accepted:** 2024, Jul 25; **Published:** 2024, Aug 10

Citation: Aluyor, A., Lucky, I. O., Asezebhobor, E. (2024). Effect of Orange Fleshed Sweet Potato Leaves on Liver Function and Kidney Function Parameters in Experimental Rats. *J Anesth Pain Med, 9*(3), 01-05.

Abstract

Orange fleshed sweet potato leaves (OFSP) are special type of bio-fortified sweet potato that contains high level of beta-carotene. It is a good source of dietary fiber, minerals, vitamins, and antioxidants. This study evaluated the liver status and kidney status of rats fed with orange fleshed sweet potato leaves (OFSP) and fluted pumpkin (Telfairia occidentalis). Thirty (30) Wistar rats were used for this experiment. The rats were categorized into five (5) groups; group 1 is the control (0% orange fleshed sweet potato leaves), group 2, 3 and 4 received 25%, 50% and 100% of orange fleshed sweet potato leaves (OFSP) formulated diet respectively and group 5 received 100% Pumpkin leaves supplemented diet which in turn served as the positive control group. After six weeks samples were collected and assayed for liver function enzymes; Alkaline Phosphatase (ALP), Alanine Transaminase (ALT), Aspartate Aminotransferase (AST) and renal function parameters; Creatinine, urea, sodium (Na^+), potassium (K^+), bicarbonate(HCO-3) and chloride (Cl^-). The result from the biochemical studies showed that there was a significant increase ($P< 0.05$) in the levels of total protein and albumin in rats fed with 50% and 100% orange fleshed sweet potato leaves. However, group 2 (25% OFSP formulated diet) induced a statistical decrease and not a significant difference in the enzyme activity of Alkaline Phosphatase (ALP). In addition, there was also a statistical difference in ALT levels between rats fed with 50% and 100% OFSP.

There was a significant difference ($P< 0.05$) in potassium and bicarbonate ions levels between the group fed 50% OFSP as compared to the others groups. Thus, orange fleshed sweet potato leaves can be used to manage hepatocellular damage and kidney disease.

Keywords: Orange Fleshed Potato, Kidney Function Test Liver Function Test

1. Introduction

Sweet Potato (*Ipomoea batatas*) is a dicotyledon associated with convolvulaceae family and ranks worlds' seventh most important food crop [1]. It is a potential energy contributor and considered as fifth essential crop (fresh weight basis) after rice, wheat, maize, and sorghum [2]. Scientific studies reported the diversity in orange fleshed sweet potato leaves color and how it pertains to nutritive and palatable quality. Due to its high carotenoids concentration and appealing sensory qualities with color, Orange Fleshed Sweet Potato (OFSP) leaves has been attracting food technologists and nutritionists in particular. Orange fleshed sweet potato leaves are special type of bio-fortified sweet potato that contains high level of beta-carotene. It is a good source of dietary fiber, minerals, vitamins, and antioxidants [3]. The liver is the large internal organ in the body and it is responsible for removing toxins from the body and metabolize and regulates nutrients such as glucose. The kidney is the body filtering unit, it removes waste and extra fluid and helps to ensure the body has adequate nutrient.The kidneys play a vital role in the excretion of waste products and toxins such as urea, creatinine and uric acid. Scientists established the role of orange fleshed sweet potato leaves in health, and this accredited to its rich nutritional components with anti-carcinogenic and cardiovascular

disease preventing attributes [4,5]. Wills and Asha, (2006) reported that plants can serve as hepatoprotective agents and due to OFSP phenolic acid components it is beneficial in managing liver and kidney diseases [6]. Some conditions, such as diabetes or high blood pressure (hypertension), affect how well the kidneys and liver work.Thus, using orange fleshed sweet potatoes leaves is a wise strategy to tackle kidney and liver disease.

Figure 1: Orange Fleshed Sweet Potato Leaves

2. Materials and Methods

Chemicals: Diagnostic kits for serum alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, creatinine, urea, sodium, potassium, and chloride were purchased from Randox (UK).All other reagents were commercially available andof reagent grade.

2.1 Plant Collection and Processing

Fresh leaves of Orange fleshed sweet potatoes and pumpkin was obtained from the national root crop research institute (NRCI), Umudike, Abia State, Nigeria. The plant was verified at the University of Benin's Department of Plant Biology and Biotechnology in Benin City, Nigeria and a herbarium specimen, with voucher number UBH-1493 was deposited at the department. The leaves were separated from the vine after harvesting, washed with clean water, dried to constant weight and ground into a fine powder using an electric grinder.

2.2 Experimental Animals

Thirty (30) albino rats were purchased from the department of anatomy animal house, University of Benin, Benin City. The rats were randomly divided into five groups, six of the rats were placed in five standard steel cages. The rats were acclimatized for two weeks, during which period they were maintained ad libitum on commercial diet. The body weights of the rats were measured at the beginning and through the experiment.

2.3 Experimental Design

The experimental rats were acclimatized for two weeks at 25°C, on a 12-hr light/12-hr dark cycle. After two weeks of acclimatization, the rats were randomly divided into five groups (n =6).

Groups1: (Control Diet) experimental rats were fed with formulated diet including grade maize, corn flour, fish meal, groundnut meal, bone meal and vitamin premix.

Groups 2: Experimental rats fed with formulated diet incorporated with 25% OFSP leaves.

Group 3: Experimental rats fed with formulated diet incorporated with 50% OFSP leaves.

Group 4: Experimental rats fed with formulated diet incorporated with100% OFSP leaves.

Group 5: (Positive Control) Experimental rats fed with formulated diet incorporated with 100% ugwu leaves (Telfairiaoccidentalis).

2.4 Rats Feed Composition

Constituents (g)	Group 1	Group 2	Group 3	Group 4	Group 5
MAIZE	22	22	22	22	22
WHEATBRAN	38	38	38	38	38
SOYBEANMEAL	5	5	5	5	5
PALM KERNELCAKE	20	20	20	20	20
BREWERSDRIEDGRAIN	10	10	10	10	10
BONEMEAL	2	2	2	2	2
LIMESTONE	1	1	1	1	1
SALT	0.3	0.3	0.3	0.3	0.3
VIT-MINPREMIX	1	0.75	0.5	0	0
OFSP	0	0.25	0.5	1	0
PUMPKIN	0	0	0	0	1
LYSINE	0.2	0.2	0.2	0.2	0.2
METH+CYSTEINE	0.5	0.5	0.5	0.5	0.5
TOTAL(g)	100	100	100	100	100

Table 1: Composition of Experimental Diet (g/100g)

2.5 Blood Collection, Organs and Tissue Samples

At the end of the 180 days of feeding, six animals from each group were anesthetized and decapitated. Blood samples were collected in labeled sample bottles with drops of Ethylenediaminetetraacetic Acid (EDTA). Serum samples were collected in sample bottles without EDTA, allowed to clot and centrifuged at 5000 pm for 10min. The liver, intestines and testes were promptly excised soon after decapitation and stored in 10%formylsaline.

2.6 Biochemical Analysis

Randox kits was used for the biochemical analysis of serum to determine quantitative levels of serum alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, creatinine, urea, sodium, potassium, and chloride.UV-VIS Spectrophotometer was used for the quantitative analysis to get the absorbance which is directly proportional to the concentration. Diagnostic kits for serum alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, creatinine, urea, sodium, potassium, and chloride were purchased from Randox (UK).

2.7 Statistical Analysis

The data were expressed as means of 4 to 7 determinations ± S.E.M. The differences among groups were analyzed by one-way analysis of variance (ANOVA). Inter-group comparisons were done by the Duncan's post hoc test. A value of $P < 0.05$ was accepted as significant. IBM SPSS statistics version 26 was used for the analysis.

3. Result and Discussion

3.1 Effects of OFSPExtracts on Serum Liver Enzyme Levels

The activities of ALP, ALT, AST, total protein, albumin, globulin, total and direct bilirubin are shown in table 2.

	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	F value	P value
ALP	250.833±23.00abcde	216.333±16.00bcde	257.500±49.00cde	318.000±67.00de	224.167±43.00e	0.845	0.510
ALT	71.500±7.00abcde	147.167±86.00bcde	65.500±10.00cde	51.500±10.00de	59.167±7.00e	0.976	0.438
AST	161.667±15.00abcde	208.333±76.00bcde	136.833±11.00cde	145.000±17.00de	127.667±7.00e	0.782	0.547
TP	7.533±0.20abcde	7.500±0.30bcde	6.600±0.40cde	6.683±0.30de	7.167±0.10e	2.804	0.047
ALB	3.717±0.10abghij	3.533±0.20bij	3.033±0.10cdegij	2.967±0.09dj	3.383±0.10efghi	5.142	0.004
GLO	3.817±0.10abcde	3.967±0.20bcde	3.700±0.20cde	3.717±0.30de	3.783±0.10e	0.319	0.863
TB	0.267±0.03abcde	0.283±0.05bcde	0.267±0.02cde	0.283±0.03de	0.217±0.02e	0.742	0.573
DB	0.133±0.02abcde	0.133±0.03bcde	0.117±0.02cde	0.117±0.02de	0.117±0.02e	0.174	0.949

Table 2: The Effect of OFSP Supplemented Diet (0%, 25% 50%, 100%) and 100% Pumpkin Leaves on the Serum Proteins and Liver Function test Parameters of Experimental Rats.

Mean± standard deviation of triplicates. Means with no common letters within a row significantly differ ($p \leq 0.05$)

There was no significant difference ($P < 0.05$) in the activities of ALP, ALT, AST, globulin and bilirubin in the rats fed with different doses of orange fleshed potato and the positive control fed with ugwu leaf. However, there was a statistical difference inthe ALP serum levels in rats fed 25% OFSP as compared to the other groups including the control group, therefore 25% of OFSP reduced the levels of alkaline phosphatase (ALP) significantly.In addition, there was a statistical difference in alanine aminotransferase (ALT) levels between rats fed 50% and 100% OFSP as compared to the control group, therefore group 3 and 4 have a positive effect in reducing ALT levels.This therefore suggest that the plant has some statistical hepatoprotective properties.

There was a significant difference ($P < 0.05$) in total protein and Albumin levels in rats fed 50% and 100% OFSP as compared to the control group and other groups, as there was an increased in the production ofalbumin and total proteins in group 3 and 4 as compared to the normal control group and the positive control group fed with ugwu. This implies that 50% and 100% of OFSP can increase the livers ability to synthesize protein and can therefore help in fighting infections.

3.2 Effects of OFSP Extracts on Renal Function Parameters

	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	F value	P value
Na+	143.667±0.70abcde	145.000±0.90bcde	144.500±1.00cde	146.167±1.00de	148.167±2.00e	2.276	0.089
K+	6.733±0.30abcde	6.700±0.20bcde	6.450±0.20cde	6.883±0.30de	6.717±0.30e	0.450	0.772
HCO-3	19.500±2.00abcdfg	19.333±1.00bcdefg	17.833±0.60c	21.833±0.60def	19.333±0.80eg	1.631	0.198
CL-	106.000±0.70abh	108.333±0.60bcdegh	109.000±0.90cdeh	107.500±0.80degh	109.333±1.00eg	2.303	0.087
UREA	78.167±4.00abcf	75.333±7.00bcdef	71.667±6.00cdef	65.000±4.00de	73.833±5.00ef	0.919	0.469
CREATININE	0.800±0.06abcf	0.750±0.10bcdef	0.667±0.07cdef	0.633±0.05de	0.767±0.03ef	1.099	0.379

Table 3: The Effect of OFSP Supplement Diet (0%, 25%, 50%, 100%) and 100% Pumpkin Leaves on Renal Function and Serum Electrolyte Parameters of Experimental Rats

Mean± standard deviation of triplicates. Means with no common letters within a row significantly differ ($p \leq 0.05$).

There was no significant difference in the levels of chloride ion between the rats fed OFSP and the normal control and positive control group. However, there was a significant difference in the levels of K+ and HCO -3 between the group fed 50% OFSP as compared to the others groups which indicate that 50% of OFSP has a positive effect on the levels of potassium ion and bicarbonate ion.

There was a statistical difference in creatinine and urea levels between rats fed OFSP and the normal control animals this indicate that OFSP can help in glomerular function [7-27].

4. Conclusion

The result obtained from this study has showed that orange fleshed sweet potato leaves can help in some extent repair liver and kidney damage if the right amount is used. OFSP can alter the liver's ability to synthesize proteins by increasing the secretion of protein and albumin in the liver, therefore OFSP can help fight liver infection and inflammation. It can also help to decrease blood creatinine levels and help in acute renal impairment as it reduces the levels of urea in the blood. OFSP can therefore help in loss of glomerular function caused by a long-standing renal parenchymal disease as it can help the kidneys effectively clear waste from your system. OFSP can only help in acute renal impairment or acute kidney injury (AKI) which refers to the sudden onset of kidney injury for a short period of time that if not tackled can lead to Chronic kidney disease (CKD). However, future investigations are still necessary to obtain a deeper understanding of the effect of orange fleshed sweet potato on kidney and liver diseases.

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