Original Research Article

COMPARATIVE EFFECTS OF SWEET POTATO (*Ipomoea batatas*) LEAF AND TUBER ON MALE ALBINO RATS.

ABSTRACT

Aim: The comparative effects of sweet potato (*Ipomoea batatas*) leaf and tuber extract on the weight of testes and epididymes, epididymal sperm count, motility, viability, semen pH and sperm head abnormality in albino rat models was examined.

Place and duration of the study: This study was carried out in the Animal house of the Department of Genetics and Biotechnology, University of Calabar, Calabar and lasted for 65 days.

Methodology: Forty two male rats were randomly divided into seven groups of six rats each using a completely randomized design. Group A served as control and received only water and pellet feed while group B, C and D received 200mg/kg, 400mg/kg and 600mg/kg body weight of the aqueous extract of *Ipomoea batatas* leaves, respectively. Groups E, F and G received 200mg/kg, 400mg/kg and 600mg/kg of the aqueous extract of the tuber, respectively. Administration was done orally.

Results: Results obtained revealed a significant (P=.05) decrease in the weight of epididymes, sperm motility, sperm viability and sperm count while sperm head abnormalities significantly increased in animals treated the leaves extract. Meanwhile, the tuber extract had no significant effect on the sperm parameters of the animals. Also, no significant differences were observed in semen pH and weight of testes in rats treated with both the leaves and tuber extracts.

Conclusion: Comparatively, the aqueous leaves extract of *I. batatas* leaf had deleterious effect on sperm profile of male albino rats in a dose – dependent manner while on the other

INTRODUCTION

Globally, plant parts have been used for several purposes such as medicinal additives and food supplement. This is not unconnected to the fact that one or more parts of almost all plants contain active ingredients with medicinal and therapeutic properties [1-3].

Sweet potato (*Ipomoea batatas*) belongs to the family Convolvulaceaewith nearly 1650 predominately tropical species. The genus Ipomoea has approximately 500 - 600 species and makes up the largest number of species within the Convolvulaceaefamily. The family is dominated by climbing or twinning woody or herbaceous plants that usually have heart-shaped leaves and funnel-shaped flowers [4].

Ipomoea batatas is a tuberous-rooted perennial plant mainly grown annually. The roots are adventitious, mostly located within the top 25 cm of the soil. Some of the roots produce elongated starchy tubers. Tuber flesh colour can be white, yellow, orange and purple while skin colour can be red, purple, brown or white. The stems are creeping slender vines, up to 4m long. The leaves are green or purplish, cordate, palmately veined, borne on long petioles [5]. *Ipomoea batatas* leave extracts have alterative, astringent, bactericide, aphrodisiac, laxative and tonic properties [6]. More so, a variety of white sweet potato is eaten raw to treat hypertension, anaemia and diabetes [7] while the root of Ipomoea species is used in the treatment of constipation [8]. Sweet potatoes and it derivatives are powerful antioxidant and may be potent in boosting the immune system and treating fever, asthma, bug bites, burns, catarrh, ciguatera, convalescence, diarrhoea, nausea, stomach distress, tumors and whitlows [4, 5].

Sweet potato leaves are used as vegetables for cooking.The tuber is also fried and eaten as food. Sweet potatoes can be used fresh, dried or ensiled. Like cereal grains, sweet potato root are rich in highly digestible starch and sugar and as such used a vital component of feed for ruminant [9].The leaves are also used in the treatment of diabetes, hookworm, hemorrhage and abscesses [10]. According to Udoh *et al*. [11], *Ipomoea batatas* contains

University of Calabar, Calabar while the tubers were purchased from Watt market, Calabar, Cross River State. Both were authenticated at the Department of Botany, University of Calabar, Calabar. The leaves were washed in tap water to remove debris and sun dried for 72hours. The tubers were peeled, washed thoroughly and sliced into tiny pieces, sun-dried for 72 hours also. The dried tubers and leaves were then pulverized using an electric blender.

A weighed quantity (100g) of the leaf and tuber powder sample was soaked in 500ml of cold distilled water, respectively and allowed to stand for 48h. The aqueous extract was obtained after filtering the suspension and stored in a refrigerator until used.

Experimental animals

Forty two healthy and sexually mature male albino rats of 12 weeks old were used in this study. The rats were obtained from the Experimental Animal Unit of Department of Genetics and Biotechnology, University of Calabar, Calabar. The rats were housed in conventional wire mesh cages under standard laboratory conditions. They were allowed free access to water and pellet feed throughout the period of the experiment. Generally, the study was conducted in accordance with the recommendation from the declarations of Helsinki on guiding principles in care and use of animals with permission from the University ofCalabar Ethical Committee (UCEC).

Experimental design and procedure

The forty two male rats were randomly divided into seven groups of six rats each using a completely randomized design. The animals were acclimatized for one week before the commencement of the treatment. Group A served as control and received only water and pellet feed while group B, C and D received 200mg/kg, 400mg/kg and 600mg/kg body weight of the aqueous extract of *Ipomoea batatas* leaves, respectively. Groups E, F and G received 200mg/kg, 400mg/kg and 600mg/kg of the aqueous extract of the tuber, respectively. The rats were sacrificed under chloroform anaesthesia 24h after the last treatment. The epididymes and testes were dissected out and weighed using Scout Pro SPU

on a microscope slide and cover slip was placed. The number of progressively motile cells was divided by the total number of spermatozoa counted under x40 lenses and expressed as a percentage [12].

Sperm viability

The sperm viability test was determined using "Eosin-Nigrosine-step staining technique" [12]. A portion of the sperm suspension was mixed with equal volume of Eosin-Nigrosin stain and seven (7) air-dried smears were prepared on glass slides for each sample. The slides were examined for percentage viability. Normal live sperm cells excluded the stain and appeared whitish, whereas dead sperm cells took up stain and appeared pinkish. Percentage viability was calculated based on the number of live sperm cells out of the total number of sperm cells observed

Sperm count

The epididymal sperm samples were obtained by macerating known weights of caudal epididymes in physiological saline in the ratio of 1:10 weight by volume. After vigorous pipetting to release the sperm cells. The suspension was filtered using an 80µm stainless mesh. Epididymal sperm count was obtained by cytometry using the improved Neubauer cytometer and was expressed as million/mL of suspension [13].

Sperm head abnormality test

A portion of the sperm suspension was mixed with 1% eosin Y solution (10:1) for 30 min and air-dried smears were prepared on glass slides for the sperm head abnormality test. The slides were examined for percentage sperm head abnormalities in every 200 spermatozoa observed on each slide and five air-dried smears were prepared on glass slides for each sample. The percentage of sperm head abnormality was calculated according toEkaluo*et al*. [14].

Statistical analysis:

Data from weight of testes and epididymes, epididymal semen pH, motility, viability, count and sperm head abnormality were subjected to the Analyses of Variance

RESULT AND DISCUSSION

Results

Weight of testes and epididymes

There was no significant differences (*P*=.05) in the weight of the testes of animals treated with both the leaf and tuber extracts when compared with the control. However, significant difference was observed in the weight of epididymes. A dose – dependent decrease in the weight of epididymes was obtained in animals treated with the leaf extract; 0.64, 0.54, and 0.40g for 200, 400 and 600mg/kgBW, respectively when compared to the control (0.58g) and animals treated with tuber extract shown in Table 1. On the other hand, the tuber extract did not significantly (*P*=.05) affect the epididymal weight. The values were statistically similar to the control (0.52, 0.54 and 0.57g for 200, 400 and 600mg/kgBW, respectively).

Semen pH and sperm count

Results presented in Table 1 showed that there was no significant effect of the treatments on the semen pH. A significant (P=.05) reduction in the sperm count was observed in the leaf extract treatment groups when compared to the control and animals treated with the tuber extract.. The highest count was observed in the control group ($6.55x10^6$ mL^{-1}) while animals treated with 200, 400 and 600mg/kgBW of leaf extract had 4.03, 3.75 and 2.39 $x10^6$ mL^{-1},respectivelyindicating a dose – dependent decline. No significant difference was observed in rats treated with the tuber extract being 6.20, 6.15 and 5.90 $x10^6$ mL^{-1} in animals treated with 200, 400 and 600mg/kgBW of the tuber extract when compared to the control.

Sperm motility and viability

The motility of the sperm cells reduced in groups of rats treated with the extract of *Ipomoea batatas* while the tuber extract did not significantly affect the sperm motility when compared with the control as presented in Table 1. The control had 70.20% while rats treated with 200, 400, and 600 mg/kgBW of the leaf extract had 60.27, 38.97 and 29.13%,

79.40, 78.20 and 75.40% was obtained for 200, 400 and 600mg/kgBW of the tuber extract, respectively.

Sperm head abnormality

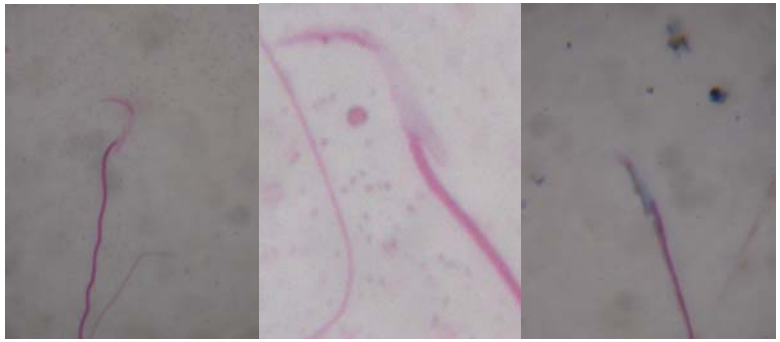
Result obtained on the effect of leaf extract of sweet potato is presented in Table 1. Animals treated with leaf extract had the high percentage of sperm head abnormalities which were 3.00, 3.45 and 3.58% for 200, 400 and 600mg/kgBW, respectively when compared to the control (2.20%) showing a dose – dependent increase in sperm head abnormalities while animals treated with the tuber extract had statistically similar percentage of sperm head abnormalities to the control group (2.40, 2.80 and 2.90% for 200, 400 and 600mg/kgBW). Sperm head abnormalities observed include hook appearing like dunce cap and wrongly situated hook (Plate 1).

Table 1:

Effect of sweet potato (*Ipomoea batatas*) leaf and tuber extracts on male rats

Parameters	Control	200mg/kg		400mg/kg		600mg/kg	
		Leaf	Tuber	Leaf	Tuber	Leaf	Tuber
Weight of testes (g)	1.24^{a}± 0.07	1.13^{a}±0.11	1.26^{a}±0.08	1.18^{a}±0.11	1.08^{a}±0.14	1.19^{a}±0.01	1.08^{a}±0.10
Weight of Epididymis (g)	0.58^{a}±0.07	0.49^{a}±0.68	0.52^{a}±0.04	0.41^{c}±0.03	0.44^{a}±0.02	0.31^{b}±0.03	0.57^{a}±0.02
Sperm count (x10^{6} mL^{-1})	6.55^{a}±073	4.03^{c}±0.63	6.20^{a}±0.86	3.75^{c}±0.38	6.15^{a}±0.78	2.39^{b}±0.35	5.90^{a}±0.89
Sperm motility (%)	70.20^{a}±4.36	60.27^{a}± 0.38	66.20^{a}±1.98	38.97^{c}±3.33	63.80^{a}±1.43	29.13^{b}±1.33	62.20^{a}±0.10
Sperm viability (%)	78.60^{a}±3.23	63.74^{b}±2.24	79.40^{a}±2.40	52.68^{c}±3.32	78.20^{a}±3.19	50.03^{c}±0.89	75.40^{a}±2.78
Sperm head abnormality (%)	2.20^{a}±058	2.90^{a}±0.37	2.40^{a}±0.59	3.45^{b}±0.41	2.80^{a}±0.37	3.58^{b}±0.38	3.00^{a}±0.05
Semen pH	7.12^{a}±0.05	7.20^{a}±0.08	6.64^{a}±0.01	7.24^{a}±0.04	6.82^{a}±0.07	7.24^{a}±0.24	7.02^{a}±0.09

Values are presented as mean ± sem. values across the table with similar superscripts are not significantly different while those with different superscript a, b, c are significantly different at 5% level of significance (P=.05) based on ANOVA.



A **B** **C**

Plate 1: Types of Sperm head seen in the control and treated rats.
(A) Normal sperm head having normal hook. (B and C) Abnormal sperm heads as follow: (B) Wrong angle; wrongly situated hook. (C) Dunce-cap; hook appears like Dunce cap

with the findings of Udoh *et al*. [11] whereas the tuber extract had no significant impact on the sperm profile of the rats which is in agreement with Adienbo and Wodu [15]. The significant reduction in the sperm profile of rats treated with the leaves extract could be attributed to alterations or disruptions of spermatogenic processes and pathways. This assertion is supported by Ikpeme*et al*. [16] who noted that a distortion in fertility of male mammals is correlated to distortions in spermatogenesis. More so, the dose – dependent reduction in the weight of epididymes in the leaf extract treated rats corroborates the significant decrease in the sperm count of the same groups of animals. The reduction in the weight of epididymes might be due to testicular degeneration and toxicity [17, 18]. The leaves extract also significantly reduced sperm viability and motility which are prominent indices of male fertility. This could be as a result of oxidative stress on the testicular tissues and/or distortion in the hormonal milieu which is vital in spermatogenesis in males [19]. Consequently, it is most likely that the tuber extract did not interfere with the process of spermatogenesis in the animals as evident in the sperm profile of animals treated with tuber extract when compared to control group (Table 1).

Also, the leaves extract caused a dose – dependent increase in the percentage of sperm head abnormality in the treated animals when compared with the control and tuber extract groups suggesting induced mutations during spermatogenesis in line observations of Ekaluo*et al*. [14, 20], Glover and Asinder [21],Ekaluo*et al*. [22] Uno *et al*. [23] and Ikpeme [15].

CONCLUSION

The findings of the present study reveal that sweet potato (*Ipomoeabatatas*) leaf extract has a dose – dependent toxic effect on sperm profile of male albino rat models. On the other hand, the tuber extract has no effect on the sperm profile of the mammalian models.

2. Ekaluo UB, Uno UU,Edu NE, Ekpo PB, Etta SE, Volunteer BO. Protective role of onion (*Allium cepa*) on caffeine induced spermatotoxicity in albino rats. Journal of Applied Life Science International, 2016; 4(4): 1-7.
3. Okoli R, Aigbe O, Mensah J. Medicinal plants used for managing some common ailments among the Esua people of Edo state, Nigeria. Pakistan Journal Nutrition, 2007; 6(5):490 - 496.
4. Austin DF, HuamanZA.synopsis of Ipomoea (Convolvulaceae) in the Americas. Taxon, 1996; 45: 3 - 38.
5. Duke J,Wain K. Medicinal plant of the World, Vol. 3 Computer index with more than 85,000 entries. Plant genetics and germplasm Institute. Agriculture Research service, Beltsville, Maryland, 2008; 231-239.
6. Wagner H. The chemistry of resin glycosides of the Convolvulaceae family, in: Bendz G, Santesson Journals (eds.), Medicinal and Natural Sciences, Chemistry in Botanical Classification, Academic Press, New York, 2003; 235 - 240.
7. LudvikB,Pancini G. Efficacy of Ipomoea batatas (Caiapo) on diabetes control in type 2 diabetic subjects treated with diet. Diabetes Care, 2004; 25: 239 - 240.
8. Pereda-Miranda R, Bah M. Biodynamic constituents in the Mexican morning glory: Purgative remedies transcending boundaries: Current Topics in Medicinal Chemistry, 2003; 3: 111 – 131.
9. Luo J, Kong L. Study on flavonoids from leaf of Ipomoea batatas. Nutrition, 2005; 30: 516 - 518.
10. Islam M,Yamakawa O. Anthocyanin composition in sweet potato (*Ipomoeabatatas*L.) leaves. Bioscience, Biotechnology and Biochemistry, 2006; 66: 2483-2486.
11. Udoh F, UdohP,Umoh E. Effect of Ipomoea batatas leaf extract on the thyroid gonadal axis of male Wister rats. Sciences, 2010; 7: 78 – 84.
12. Bjorndahl L, Soderlund I, Kvist U. Evaluation of the one-step eosin-nigrosin staining

14. Ekaluo UB, Ikpeme EV, Udokpoh AE. Sperm head abnormality and mutagenic effects of aspirin, paracetamol and Caffeine containing analgesics in rats. *The Internet Journal of Toxicology*, 2009; 7: 1-9.
15. Adienbo OM, Wodu CO. Fertility enhancing potentials of Ipomoea batatas (Sweet Potato) in Male Albino Wistar Rats. European Journal of Biomedical and Pharmaceutical Sciences, 2015; 2(3):1197-1202.
16. Ikpeme EV, Udensi O, EkaluoUB,Efieneokwu N. Biological response of male wistar rats to crude extracts of *Ficus exasperate* (VAHL). *International Journal of Current Research,* 2010; 7:9-13.
17. Ekaluo UB., Uno UU, Edu NE, Ekpo PB, Etta SE, Daniel IO. Attenuating effect of Trevo dietary supplement on caffeine induced testicular toxicity. Journal of Life Science Research and Discovery, 2015; 2: 25 – 30.
18. Krassas GE, Pontikides N. Male reproductive function in relation with thyroid Alterations. Clin. Endocrinol., 2004; 65(4): 446-452.
19. Ekaluo UB, Ikpeme EV, Uno UU, Umeh SO, Erem FA. Protective role of aqueous guava leaf extract against caffeine induced spermatotoxicity in albino rats. Research Journal of Medicinal Plants. 2016; 10(1): 98 – 105
20. Glover A, Assinder SJ. Acute exposure of adult male rats to dietary phytoestrogens reduces fecundity and alters epididymal steroid hormone receptor expression. JournalofEndocrinology. 2006; 189:565-573.
21. Dorostghoal M, Majd NE, Noorael P. Maternal Caffeine consumption has irreversible effects on reproductive parameters and fertility in male offspring rats. Clinical, Experimental, Reproduction and Medicine.2012; 39: 144-152.
22. Ekaluo UB, Ikpeme EV, Uno UU, Umeh SO, Erem FA. Protective role of aqueous guava leaf extract against caffeine induced spermatotoxicity in albino rats. Research Journal of Medicinal Plants. 2016; 10(1): 98 – 105
23. Uno UU, Ogbe HO, Okolo CM, Ekaluo UB,Akwa BU. Effect of soursop (*Anunnamuricata* L.) leaf extract on sperm toxicity induced by caffeine in albino rats.