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 hand, the tuber extract had no significant effect on the sperm profile of the animals. Therefore, the consumption of the leaf of the plant should be regulated in view of its side effects as observed in this study.

Keywords: *Ipomoea batatas*, sperm quality, sperm count, sperm head abnormality.

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 convolvulaceae with nearly 1650 predominately tropical species. The genus Ipomoea has approximately 500 - 600 species and makes up the largest number of species within the convolvulaceae family. 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 secondary metabolites which possess several actions including antioxidant, antimutagenic, anti - inflammatory, anti-carcinogenic and antifertility properties.

MATERIALS AND METHODS

Collection and preparation of plant material

The leaves of *Ipomoea batatas* were collected from the botanical garden of the 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 of Calabar 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 601 electronic weighing balance. The epididymes were processed for epididymal sperm motility, viability, count and sperm head abnormality, semen pH and sperm motility: Immediately after dissection, a puncture was made in the epididymis with a sterile pin.

The semen smeared on the pin was rubbed on a pH paper of range 4.0-10.0. The colour change corresponds to the pH and was read from the paper. Two drops of sperm

suspension was put 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 to Ekaluo *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 (ANOVA) test while differences in means were separated using Least Significant Difference (LSD) test.

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}, respectively indicating 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%, respectively indicating a dose – dependent toxic effect. Meanwhile, rats treated with the tuber extract recorded 66.20, 63.80 and 62.20% for 200, 400 and 600mg/kg, respectively. The results also indicated a significant decrease in the percentage of viable sperm cells in the leaf extract treated animals (63.74, 52.68, and 50.03%, respectively for groups 200, 400 and 600mg/kgBW) when compared to the control being 78.60% (Table 1). Meanwhile,

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 abnormality while animals treated with the tuber extract had statistically similar percentage of sperm head abnormality to the control group (2.40, 2.80 and 2.90% for 200, 400 and 600mg/kgBW).

Table 1:

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

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

Values are presented as mean ± SEM. Values across the table with similar superscripts are not significantly different at 5% based on ANOVA.

Discussion

Results obtained revealed that the leaves extract of *Ipomoea batatas* adversely affected the sperm profile of the treated animals in a dose – dependent manner which is agrees with the findings of Udoh *et al*. [11] while the tuber extract had no significant impact on the sperm profile of the rats which is in agreement with Adiebo [12]. 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*. [15] 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 [16, 17]. 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 [18, 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 (*Ipomoea batatas*) 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.

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