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Effect of *Solanum surattense* seed on the oxidative potential of cauda epididymal spermatozoa

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ABSTRACT

Objective: To evaluate the effect of aqueous seed extract of *Solanum surattense* (*S. surattense*) on the oxidative potential of cauda epididymal spermatozoa. **Methods:** *S. surattense* seed extract was orally administered at the dosage of 10 mg/kg b.w. for 15 days, after which aspartate transferase (AST), alanine transferase (ALT), glutamate dehydrogenase (GDH), citric acid and iso-citrate dehydrogenase (ICDH) were assayed. **Results:** The activity levels of the enzymes AST and ALT, which are considered to be the androgenicity in the sperm suspension, were depleted in the extract fed rats. The activity level of the enzyme ICDH, was reduced significantly in the treated group ($P<0.001$). **Conclusions:** It can be concluded that the oral administration of the aqueous seed extract of *S. surattense* can deplete the oxidative stress of cauda epididymal spermatozoa in albino rats.

1. Introduction

Control of population growth is very important in populated countries. Population control is an issue of global and national public health concern. Current methods of contraception result in an unacceptable rate of unwanted pregnancies with side effects. Thus there is a need to replace these methods by safe and effective agents such as plant based contraceptive agents. Many plants extracts have been used as antifertility agents in folklore and traditional medicines without producing apparent toxic effects[1,2]. Approximately 50% of all pregnancies are unintended at conception; 50% of those occur in the 94% of sexually active couples who report using some methods of contraception[3]. The only male-specific contraceptive methods currently available are withdrawal, condoms, and vasectomy. Concerns regarding side effects and inconvenience of these existing methods prevent their universal acceptance[4,5]. The development of additional male methods of fertility control can provide tremendous social and public health benefits. There is global availability of several medicinal plants associated with antifertility properties[6,7]. Herbs have been used for centuries to treat illness and improve health and account for approximately 80% of medical treatments in the developing world[8]. Many plants have been known to possess antifertility activity, but limited attempts have been made to scientifically evaluate these claims[9]. In spite of considerable development in contraceptive technology, searching for male antifertility agents continues to be a potential area of investigation. *Solanum surattense* (*S. surattense*) belongs to the family of Solanaceae. It is a commonly growing perennial herbaceous weed. It is commonly known as Indian night shade or yellow berried night shade and has been used traditionally for curing various ailments such as fever, cough, asthma and diabetes in south Indian traditional medicines[10]. The antidiabetic potential of the fruit was studied in diabetic rats[11,12]. The ethanol and methanol extracts of *S. surattense* showed strong antibacterial activity against *Pseudomonas aeruginosa*[13], wound healing activity[14], physicochemical activity[15] and antioxidant potential[16]. The present study was carried out to evaluate the effect of folklore medicinally valued plant *S. surattense* seed extract on the oxidative potential of the cauda epididymal spermatozoa in male albino rats.

2. Materials and methods

2.1. Collection of plant material

The seeds of *S. surattense* (Family: Solanaceae) were freshly collected in and around Vellore district, Tamilnadu,

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India. The seeds were cleaned and shade dried at room temperature and authenticated. A voucher specimen (No: VCV/06/2010) was kept at the Department of Botany, Voorhees College, Vellore-632 001, Tamilnadu, India.

2.2. Preparation of seed extract

100 g of powdered seed of the plant was taken and mixed with 500 mL of distilled water and magnetically stirred in a container overnight at room temperature. The residue was removed by filtration and the aqueous extracts were concentrated under vacuum to get solid yield of 10%. The seed extract was administered to animals in aqueous solution.

2.3. Animals

Wistar strain male albino rats (160-180 g) were obtained from Tamilnadu Veterinary and Animal Science University, Chennai, India. The animals were acclimatized to the laboratory conditions, fed with standard pellet diet supplied by Hindustan Lever Ltd., Bangalore, India and had free access to water. The experiments were designed and conducted in accordance with guidelines of Institutional Animal Ethics Committee.

2.4. Experimental protocol

The daily dose of the seed extract was freshly dissolved in 0.5 mL of distilled water and orally administered to each experimental animal every morning for 15 days.

The rats were divided into two groups, *i.e.* group I: control rats received 0.5 mL/day of distilled water; group II: rats treated with *S. surattense* aqueous seed extract at the dosage of 10 mg/kg bw.

2.5. Preparation of spermatozoa suspension

Animals were sacrificed by cervical dislocation. The cauda epididymus was cutout and taken in a medium of physiological saline. The tissue was minced gently so as to release the spermatozoa in the physiological saline. Tubes were incubated at 37 ℃ for 1 hour with periodic shaking. A known volume of sperm suspension was taken to estimate the activity levels of the marker enzymes indicating the oxidative potential of the spermatozoa in the suspension.

2.6. Biochemical estimations

Aspartate transaminase (AST) and alanine transaminase (ALT) activity levels were assayed by the method of Reitman *et al*[17]. The activity levels of glutamate dehydrogenase (GDH) were estimated by the method of Lee and Lardy[18]. The level of citric acid was estimated by the method of Rajagopal[19]. The activity level of iso-citrate dehydrogenase (ICDH) in sperm suspension was estimated by the method of Cardobe *et al*[20].

2.7. Statistical analysis

The results were expressed as mean±standard deviation. Statistical analysis was carried out by using one way ANOVA as in standard statistical software package of social science (SPSS) version 12.

3. Results

The activity levels of marker enzymes of the oxidative metabolism such as ALT, AST, GDH, ICDH and citric acid levels were estimated in the cauda epididymal sperm suspension and significant depletion in the activity levels in the animals treated with aqueous seed extract was recorded (Table 1).

Table 1
Activity levels of marker enzymes of oxidative metabolism (Mean±SD).

Components	Group I	Group II
AST (μ mole of sodium pyruvate formed/mL of sperm suspension per hour)	1.810±0.130	1.520±0.130*
ALT (-Ibid-)	0.953±0.090	0.620±0.610*
GDH (-Ibid-)	0.212±0.200	0.161±0.011*
Citric acid (mg/g dry weight)	2.950±0.250	1.060±0.100*
ICDH (μ mole of formazan formed/mL of sperm suspension/hour)	0.859±0.820	0.569±0.530*

*P<0.001 as compared with the control.

4. Discussion

Sperm metabolism derives energy through oxidative metabolism involving tri-carboxylic acid (TCA) cycle. The activity levels of the enzymes ALT and AST were decreased in the seed extract fed rats indicating the deranged oxidative potential of the spermatozoa. The activity levels of ALT and AST have been considered as the markers of the androgenicity in sperm suspension[21,22]. The significant depletion in the activity level of GDH in the treated animals indicates the decreased efficiency of the TCA cycle. The GDH forms the important marker enzyme towards the mobilization of several amino acids into TCA cycle[23-25]. The citric acid content in the sperm suspension of the seed extract fed rats revealed a significant decrement indicating the reduced oxidative metabolism. Citric acid level in the sperm suspension forms the index towards the level of oxidative metabolism of the spermatozoa as well as the reproductive tissue[26-37]. The activity level of the enzyme iso-citrate dehydrogenase recorded significant depletion in the extract fed rats when compared with that of the control indicating the deranged oxidative potential in the sperm suspension. ICDH is a specific marker for the mitochondrial density[38]. The sperm motility showed a drastic depletion in the extract fed rats.

The seed extract of the plant *S. surettence* which was fed to the male albino rats showed a decreased oxidative potential in the cauda epidimymal spermatozoa indicating the antifertility effect. Therefore, there is a possibility to develop a probable antifertility agent from the seed of *S. surettence*.

Conflict of interest statement

We declare that we have no conflict of interest.

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