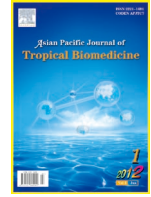




Contents lists available at ScienceDirect

Asian Pacific Journal of Tropical Biomedicine

journal homepage: www.elsevier.com/locate/apjtb



Document heading doi:10.1016/S2221-1691(11)60183-4 © 2012 by the Asian Pacific Journal of Tropical Biomedicine. All rights reserved.

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

Thirumalai T, David E*, Viviyan Therasa S, Elumalai EK

Post Graduate and Research Department of Zoology, Voorhees College, Physiology Wing, Vellore-632 001, Tamilnadu, India

ARTICLE INFO

Article history:

Received 5 June 2011

Received in revised form 27 June 2011

Accepted 3 July 2011

Available online 28 January 2012

Keywords:

Sperm

Solanum surattense

Contraception

Antifertility

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,

*Corresponding author: Dr. Ernest David, Professor and Head, Department of Zoology, Physiology Wing, Voorhees College Vellore-632001 (T.N.), India.

Tel: +91-416 2225965, +91-9345300236

E-mail: ernestdavid2009@gmail.com

Foundation Project: Supported by Postgraduate Department of Zoology, Voorhees College.

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 °C 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 epididymal 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.

Acknowledgements

Authors are thankful to Voorhees College, Vellore, Tamilnadu for providing laboratory facilities to carry out this study.

References

- [1] Singh A, Singh SK. Evaluation of antifertility potential of Brahmī in male mouse. *Contraception* 2009; **79**(1): 71–79.
- [2] Sharma JD, Sharma L, Yadav P. Antifertility efficacy of *Piper betle* Linn. (Petiole) on female albino rats. *Asian J Exp Sci* 2007; **21**(1): 145–150.
- [3] Gaudineau A, Ehlinger V, Gabhainn SN, Vayssiere C, Arnaud C, Godeau E. Use of emergency contraceptive pill by 15–year–old girls: results from the international health behaviour in school–aged children (HBSC) study. *BJOG* 2010; **117**(10): 1197–1204.
- [4] Ramarao S, Sitruk–Ware R, Townsend JW. New vistas in contraceptive technology. *Gen Dev* 2008; **16**(2): 327–344.
- [5] Solomon H, Yount KM, Mbizvo MT. A shot of his own: the acceptability of a male hormonal contraceptive in Indonesia. *Cult Health Sex* 2007; **9**(1): 1–14.
- [6] Paul S, Kang SC. *In vitro* determination of the contraceptive spermicidal activity of essential oil of *Trachyspermum ammi* (L.) Sprague ex Turill fruits. *N Biotechnol* 2011.
- [7] Gupta RS, Sharma R. A review on medicinal plants exhibiting antifertility activity in males. *Nat Prod Radiance* 2006; **5**(5): 389–410.
- [8] Bent S, Ko R. Commonly used herbal medicines in the United States: a review. *Am J Med* 2004; **116**: 478–485.
- [9] Shibeshi W, Makonnen E, Zerihun L, Debella A. Effect of *Achyranthes aspera* L. on fetal abortion, uterine and pituitary weights, serum lipids and hormones. *Afr Health Sci* 2006; **6**(2): 108–112.
- [10] Parmar S, Gangwal A, Sheth N. *Solanum xanthocarpum* (yellow berried night shade): a review. *Der Pharm Lett* 2010; **2**(4): 373–383.
- [11] Gupta S, Mal M, Bhattacharya P. Evaluation of hyperglycemia potential of *Solanum xanthocarpum* fruit in normal and streptozotocin induced diabetic rats. *Eur Bull Drug Res* 2005; **13**(51): 55.
- [12] Kar DM, Maharana L, Pattnaik S, Dash GK. Studies on hypoglycaemic activity of *Solanum xanthocarpum* fruit extract in rats. *J Ethnopharmacol* 2006; **108**(2): 251–256.
- [13] Ghani MS, Farooq MU, Khan MTJ. Phytochemical investigations and evaluation of antibacterial and irritant potential of different extracts of whole plant of *Solanum xanthocarpum* Schrad and Wendl. *J Chin Chem Soc* 2010; **57**: 1257–1262.
- [14] Kumar N, Prakash D, Kumar P. Wound healing activity of *Solanum xanthocarpum* Schrad. & Wendl. fruits. *Indian J Nat Prod Resour* 2010; **1**(4): 470–475.
- [15] Meena AK, Rao MM, Kandale A, Sharma K, Singh U, Yadav A. Evaluation of physicochemical and standardisation parameters of *Solanum xanthocarpum* Schrad. & Wendl. *Int J Chem Anal Sci* 2010; **1**(3): 47–49.
- [16] Priyadarsini R, Tamilarasi K, Karunambigai A, Gayathri DS. Antioxidant potential of the leaves and roots of *Solanum surattense*. *Plant Arch* 2010; **10**(2): 815–818.
- [17] Reitman S, Frankel S. A colorimetric method for the determination of glutamic oxaloacetic and glutamic pyruvic transaminases. *Am J Clin Pathol* 1957; **28**: 56–58.
- [18] Lee YL, Lardy HA. Influence of thyroid hormones on L–glycophosphate dehydrogenase and other dehydrogenase in various organs of rat. *J Biol Chem* 1965; **240**: 1427–1432.
- [19] Rajagopal G. A simple colorimetric procedure for estimation of citric acid cycle. *Indian J Exp Biol* 1984; **22**(7): 391–392.
- [20] Cardobe M, Pintos L, Becon MT. Different activities malate and isocitrate NAD(P) dependant dehydrogenases are involved in the induction of capacitation and acrosome reaction in cryopreserved spermatozoa. *Andrologia* 2005; **37**(1): 40–46.
- [21] El–Kashoury AA, Salama AF, Selim AI, Mohamed RA. Animal model study of reproductive toxicity of the chronic exposure of dicofol. *Life Sci J* 2009; **3**(6): 1–18.
- [22] Sahar A, El–Magd A, Sabik MEL, Shoukry A. Pyrethroid toxic effects on some hormonal profile and biochemical markers among workers in pyrethroid insecticides company. *Life Sci J* 2011; **8**(1): 311–322.
- [23] Devaraju T, Sujatha K, Madhava Rao S, Jayantha Rao K. Impact of sodium arsenate on selected enzymes and hispathological studies in albino mice. *Int J Pharmacol Biol Sci* 2010; **1**(3): 1–7.
- [24] Masclaux–Daubresse C, Daniel–Vedele F, Dechorgnat J, Chardon F, Gaufichon L, Suzuki A. Nitrogen uptake, assimilation and remobilization in plants: challenges for sustainable and productive agriculture. *Ann Bot* 2010; **105**: 1141–1157.
- [25] Martinelli T, Whittaker A, Bochicchio A, Vazzana C, Suzuki A, Masclaux–Daubresse C. Amino acid pattern and glutamate metabolism during dehydration stress in the ‘resurrection’ plant *Sporobolus stapfianus*: a comparison between desiccation–sensitive and desiccation–tolerant leaves. *J Exp Bot* 2007; **58**: 3037–3046.
- [26] Makker K, Agarwal A, Sharma R. Oxidative stress & male infertility. *Indian J Med Res* 2009; **129**: 357–367.
- [27] Erukainure OL, Ajiboye JA, Adejobi RO, Okafor OY, Adenekan SO. Protective effect of pineapple (*Ananas cosmosus*) peel extract on alcohol–induced oxidative stress in brain tissues of male albino rats. *Asian Pac J Trop Dis* 2011; **1**(1): 5–9.
- [28] Thirumalai T, Therasa SV, Elumalai EK, David E. Intense and exhaustive exercise induce oxidative stress in skeletal muscle. *Asian Pac J Trop Dis* 2011; **1**(1): 63–66.
- [29] Nanda J, Adak DK, Bharati P. Contraceptive practices among adolescent married women in Tamil Nadu, India. *Asian Pac J Trop Dis* 2011; **1**(2): 137–141.
- [30] Chhabra S, Goyal D, Kakani A. Need for relooking into management of eclampsia. *Asian Pac J Trop Dis* 2011; **1**(3): 241–244.
- [31] Chaves RG, Lamounier JA, César CC. Association between duration of breastfeeding and drug therapy. *Asian Pac J Trop Dis* 2011; **1**(3): 216–221.
- [32] Makkun S, Prueksadee J, Chayakulkheeree J, Boonjunwetwat D. The accuracy of ultrasound guided 14–gauge core needle breast biopsy: correlation with surgical excision or long term follow–up. *Asian Pac J Trop Dis* 2011; **1**(3): 222–226.
- [33] Osonuga IO, Osonuga OA, Onadeko AA, Osonuga A, Osonuga AA. Hematological profile of pregnant women in southwest of Nigeria. *Asian Pac J Trop Dis* 2011; **1**(3): 232–234.
- [34] Raghavendra KP, Wilma Delphine Silvia CR. Evaluation of preanalytical stability of the sample for complete blood count. *Asian Pac J Trop Dis* 2011; **1**(3): 239–240.
- [35] Altaif KI. Prevalence of intestinal parasitic infestation in Ma’an governorate, Jordan. *Asian Pac J Trop Dis* 2011; **1**(2): 110–112.
- [36] Jeevangi SR, Patil RB, Awanti SM, Manjunath S, Patil B, Devi K. Drug utilization study in a burn care unit of a tertiary care hospital. *Asian Pac J Trop Dis* 2011; **1**(1): 41–46.
- [37] Mandal CR, Adak DK, Biswas S, Bharati P. A study on BMI among the Bhotia of Uttaranchal, India. *Asian Pac J Trop Dis* 2011; **1**(1): 55–58.
- [38] Ganesan B, Rajesh R, Anandan R, Dhandapani N. Biochemical studies on the protective effect of betaine on mitochondrial function in experimentally induced myocardial infarction in rats. *J Health Sci* 2007; **53**(6): 671–681.