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RESEARCH ARTICLE

EFFECT OF *MUCUNA PRURIENS* SEED EXTRACT ON BEHAVIOUR AND FITNESS OF
DROSOPHILA MELANOGASTER

¹Suchitra, G., ²Palaksha and ^{*3}Shakunthala, V.

¹Department of Zoology, JLB Road, Mysore-570005, Karnataka, India

^{2,3}Department of Studies in Zoology, University of Mysore, Manasagangotri, Mysore-570006, Karnataka, India

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ABSTRACT

The fruit fly *Drosophila* has been extensively important organism not only for genetic, molecular, developmental studies but for also medicinal science, because of similiarity in pharmacological and physiological properties common to humans. The seed of *Mucuna pruriens* suggested in the treatment of gonorrhoea, general debility and many studies have showed that it possess a wide range of pharmacologic activities such as antimicrobial, anti- protozoal, anti-inflammatory, neuroprotective, antidiabetic and antioxidant and aphrodisiac property etc. Thus the present study is focused on the aphrodisiac property of the *Mucuna pruriens* seed on courtship behaviour and fitness of *D. melanogaster*. To examine this, *D. melanogaster* flies were treated with aqueous extracts of *Mucuna pruriens* seeds by adult feeding method along with control. Mating latency and copulation duration was observed and the same flies were used to check their egg laying ability and fertility. The results revealed that there is decrease in the mating latency and increase in copulation duration compared to control. Flies have showed increased fecundity and fertility compared to untreated flies. There is 10-15% increase in reproductive ability of the flies.

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INTRODUCTION

Ayurveda literally 'science of life' is based on twin principles of wholeness and balance. Ayurveda is the most ancient medicinal system and it is 5,000 years old Indian method of healing that includes diet, natural therapies. The current aim of Ayurvedic medicine is to identify a plant with antidoshas and understand the medicinal properties using several new techniques available such as Panchakarma, Rasayana, Bhasmas and Aphrodisiacs. Our current interest of study is to analyze the Aphrodisiac property of *Mucuna pruriens* on behavior and fitness of *Drosophila melanogaster*. Aphrodisiac are substances that stimulate or increases sexual desire and performance. According to Sushruta, sexuality and reproduction are so vital in Ayurveda that an entire discipline, known vajikarana, is dedicated to enhancing fertility and rejuvenation of sexual and reproductive energy. Vajikarana therapy improves the function of reproductive organs and vitalizes reproductive tissues, increasing semen count and strengthening their motility and making the eggs more viable for conception. This not only enhances the quality and longevity of individual life, but also the health and vitality of offspring. Infertility is one of the most serious social problems facing advanced nation, although it is generally not well

recognized that number of infertile couples is rising in these countries. Studies on *Mucuna pruriens* improves semen quality in infertile men suffering from physiological stress (Shukla et al., 2010). It is proved to possess an antioxidant property that helps to restore the antioxidant defense system of semen. It is also very effective nervine tonic and mild aphrodisiac. *Mucuna pruriens* which has Aphrodisiac activity. There are numerous reports of Aphrodisiac activity attributed to plants (Adimoelja, 2000; Amin et al., 1996; Aversa and Fabbri, 2001). *Mucuna pruriens* is an annual climbing legume indigenous to tropical regions especially Africa, India and West Indies. In India it is found in the foothills of Himalayas, the plains of west Bengal, Madhya Pradesh and Karnataka. It also grows throughout Southern and South East Asian regions (Dukes, 2003). It grows widely in India and cultivated as fodder crop. The plant is commonly called as cowitch, velvet bean, cowage, kapikachu and naikarnanam. It's constituent of more than 200 indigenous formulations. It contains L-dopa as major constituent in seeds (Bell and Janzen, 1971), epoxy fatty acids such as cis 12, 13-epoxyactodec-trans-9-cis-acid, cis-12,13-epoxyoctadec-trans-9 enoic acid (Misra and Wagner, 2006). It contains active constituent alkaloids such as mucanine pruridine tannic acid resin lecithin and L-dopa Seed powder contains high concentration of levodopa, it is a direct precursor of neurotransmitter called dopamine. Its trichomes covering shells are used as Vermifuge (Vasudev Rao and Shanpru, 1981). In Ayurvedic system of medicine, the seeds of this plant are prescribed for the treatment of gonorrhoea,

*Corresponding author: Shakunthala, V.

Department of Studies in Zoology, University of Mysore,
Manasagangotri, Mysore-570006, Karnataka, India

general debility and Parkinson's disease (Katzenschlager et al., 2004; Kirtikar and Basu, 1988). *Mucuna pruriens* possess a wide range of Pharmacologic activities such as antimicrobial activity (Rajeshwar et al., 2005), anti-protozoal activity (Ekanem et al., 2004) anti-inflammatory activity (Hishikar et al., 1981), neuroprotective activity (Manyam et al., 2004) anti diabetic (Rathi et al., 2002), antioxidant activity (Tripathi and Upadhyay, 2002). Antifungal and Anthelmintic activity (Abedulla khan et al., 2008). Ayurvedic Indian medicine system for various nervous defenses including today's Parkinsonism. Its different preparation (from the seeds) are used for the management of several free radical mediated disease such as aging, rheumatoid arthritis, diabetics, atherosclerosis, male infertility and nervous disorder (Vaidya et al., 2007). However effect of this drug on normal reproductive activity enhancement of reproductive ability has not been scientifically validated. Though it is already used as medicine for infertility treatment; however how exactly it is improving the quality of sperm and fertility of sperm is not validated. The present study is carried out with an objective to explore the potential of *Mucuna pruriens* seed extract on courtship behavior and fitness of *D.melanogaster*

MATERIALS AND METHODS

Drosophila melanogaster were obtained from *Drosophila* stock center university of Mysore, Manasagangotri, Mysore. The isogenic culture of these flies was maintained under standard wheat cream agar media (Hegde and Krishnamurthy, 1979; Guruprasad et al., 2008). *Mucuna pruriens* seeds were collected from local panchasara store Mysore, Karnataka. Then the seeds were shade dried and milled into coarse powdered by mechanical grinder. The coarse powder plant material was extracted with water by decoction using round bottom flask. The water was evaporated into semisolid mass. The semisolid mass were dried and stored for future and the aqueous extract of *Mucuna pruriens* were used for further studies (Dhingra and Sharma, 2006).

Drosophila melanogaster (Organ K strain) stocks were used for the present experiment. Then flies were maintained at $22\pm 1^{\circ}\text{C}$ and 75% relative humidity in 30 ml culture bottles containing wheat cream agar medium. For treated groups or experimental groups two concentration were taken viz, 2.0mg/100ml (0.02mg/ml) and 2.5mg/100ml (0.025mg/ml) mixed in wheat cream agar medium mentioned as T1 and T2 respectively. In order to fix the concentrations of seed extract of *Mucuna pruriens* LC 50 was determined using log dose probit method. The lethal concentration for this test is 3.0mg/100ml (0.03mg/ml). The sub lethal (Effective concentration) concentration is T1 and T2 as mentioned above. Bachelor male and virgin female were collected in the early morning and aged for 3 days and the flies were starved for 8 hours and fed for 40 hours. Sexual behavior was studied in the morning hours between 6.15-7.15 AM. 20 flies of both sexes were used to study Courtship activities (Spieth et al., 1983). Mating Latency (ML) defined as time between the introduction of males and females into mating chamber and initiation of copulation of each pair and Copulation Duration (CD) defined as time between initiation and termination of copulation of each pair. The terminologies were used as per the description

of (Hegde and Krishnamurthy, 1979). Mating latency (ML) and Copulation Duration (CD) were observed. For this observation bachelor male and virgin female were introduced into Elens-Wattiaux mating chamber (5x5cm circular glass chamber with a lid to facilitate easy observation Mating Latency (ML) and copulation duration (CD) the same flies were used to study the reproductive fitness parameter such as fecundity and fertility. For fecundity test mated females were transferred to vials containing fresh wheat cream agar media and the number of eggs laid during the following ten days was scored using stereomicroscope for both control and T1 and T2 groups. The number of individual (progeny) emerged from the single mated female was counted. Ten successive changes were made and the total number of flies emerged from each vial both in control and T1 and T2 groups were counted. One way analysis of variance (ANOVA) was applied using SPSS 10.5 software.

RESULTS

The effect of *Mucuna pruriens* on courtship behavior and fitness of *Drosophila melanogaster* i.e. the Mating Latency and Copulation Duration of *Drosophila melanogaster* depicted in the figure 1, 2 and Table 1.

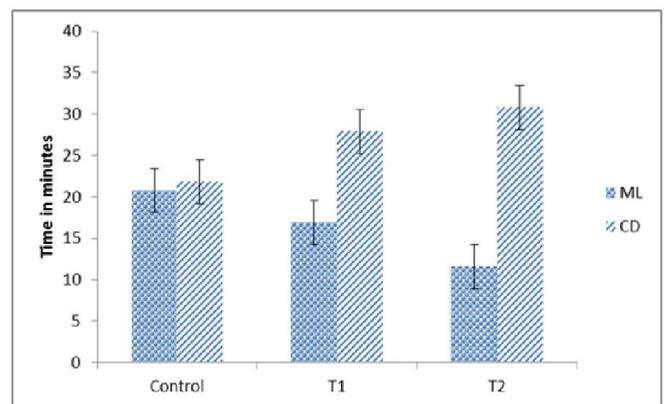


Fig. 1. Shows that Copulation Duration and Mating Latency of *Drosophila melanogaster* in control and *Mucuna pruriens* seed extract T1 and T2 groups .ML; Mating latency and CD; Copulation duration

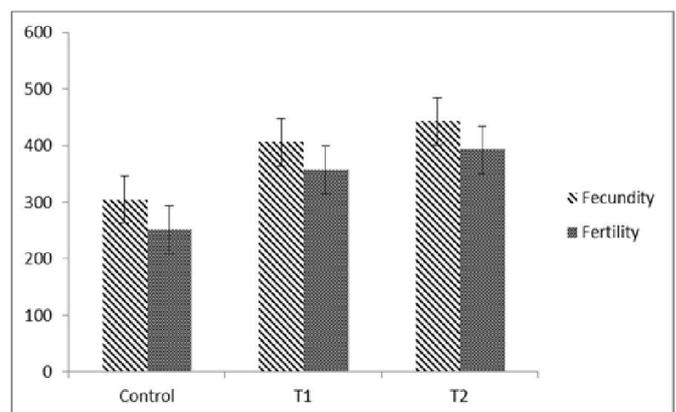


Fig. 2. Shows fecundity and fertility of *Drosophila melanogaster* in control and *Mucuna pruriens* seed extract treated groups

Table 1. Shows that Mean±SE of copulation duration, fecundity and fertility of *Drosophila melanogaster* in control and treated groups

Fecundity	Mean±SE	F	Sig
Control	304±25.05		
Copulation duration	Mean±S	F	Sig
Control	21.8±0.3		
Treated 1	27.9±1.2	16.900	.000s
Treated 2	30.8±0.8		
Treated 1	404±22.99	12.704	.000
Treated 2	442±7.45		
Fertility	Mean±SE	F	Sig
Control	254.4±25.05		
Treated 1	356.9±22.87	12.834	0.00
Treated 2	393.7±8.190		

Mating Latency of *Drosophila melanogaster* was more in control and less in T1 and T 2 groups (i.e. 2.0 and 2.5 concentration). Copulation duration was more in T2 groups than T1 and control. Statistical analysis revealed that there is significant difference among control and treated groups ($F=25.2$, $P<0.05$). Number of eggs laid were increased in T1 and T2 when compare to control (Fig 2). Statistical analysis revealed that there is a significant difference in fecundity between control and treated groups ($F=12.70$, $P<0.05$). Number of offspring produced from the single mated female was increased in T1 and T2 groups when compared to control group ($F=12.84$ $p<0.05$). Statistical analysis revealed that there is a significant difference in fertility between control and treated groups.

DISCUSSION

Drosophila melanogaster is one of the most intensively used animal models in biological research, particularly in genetics and developmental biology. The fruit fly *Drosophila* is one which stands very close to man in having 60% similarity. The recent genome projects have brought to light that about 13600 human genes have homologs to *D. melanogaster* (Spiess, 1970). It has large number of induced and spontaneous mutations with a few chromosomes in a small genome. In the last decades numerous researches have focused their attention on understanding many aspects of neurodegenerative diseases, cancers, reverse genetics, forward genetics and so on. Fruit flies have a life cycle that is very different from that of mammals, yet developmental and cellular pathways are conserved. Many Ayurvedic researches have been done using *Drosophila* as model organism in screening psycho stimulant plant materials. Screening of plant materials as CNS stimulant and depressant uses *Drosophila* as model organism. Mating behavior of *Drosophila melanogaster* includes series of courtship elements, which consists of various behavioral displays followed by an interchange of different sensory stimuli, courtship latency and copulation duration is an important component of fitness.

It is correlated with different components like fecundity and fertility. In *Drosophila*, successful mating depends on male activity and female receptivity. Courtship latency is one of the parameter, which indicates vigor of male. It represents the time between introduction of male and female flies into observation chamber and initiation of courtship. A male with high vigor reacts quickly in the presence of female while a male with less

vigor, reacts slowly. (Eastwood and Burnet, 1977; Markow, 1998). In the present experiment mating latency and copulation duration is affected by the treatment of *Mucuna pruriens* seed extract. Mating latency was shorter in treated flies of *D.melanogaster*. Decrease in mating latency means increase in the vigor of male, the present study revealed that seed extract has increased the copulation duration in *Drosophila*. *Mucuna pruriens* have effect on mating latency in treated groups of *D.melanogaster*. This agrees with the observations which show the genetic determination of certain components of sexual behaviour in *Drosophila* (Pankaj *et al.*, 2011; Guruprasad *et al.*, 2011) and a male with high vigor reacts quickly in the presence of female whereas male with less vigor react slowly (Eastwood and Burnet, 1977; Markow, 1998).

Courtship is a pre requisite for copulation in *D.melanogaster*. Copulation duration is the time between initiations of copulation to termination of copulation of each pair, it is a quite natural that copulation is severely affected when courtship is affected. The reason is obvious that *Mucuna pruriens* seed extract affect behavior, thus affecting copulation duration (Markow, 1998) demonstrated that *Embllica officinalis* enhances the copulation duration and increased the fitness of *Drosophila*. According to Guru Prasad *et al* (2011) longer duration of copulation permits the transfer of more number of sperms by male to female (Pankaj *et al.*, 2011). Therefore extension of copulation duration enhances the fitness of male. It can also enhance the fitness of female because the sperms received by a female can fertilize more number of eggs. Therefore, it is unlikely that longer copulation duration could enhance the fitness, as the female have high receptivity and males have high vigor.

Fecundity is one of the fitness parameter that is used to assess the fitness in the different species of *Drosophila*. It is the most obvious trait that influences the reproductive value of female by her genotype, body size, age and her mate as well as the effects of environmental factors. Estimation of fecundity is important in routine Ayurvedic research of various drugs. This gives an insight into the extent of effect on physiological factors, which is expressed in the terms of egg and offspring production. Fast mating males in *D.melanogaster* perform large number of copulations and produce more offspring than the slow. First mating will provide the female with an advantage of receiving the largest number of sperms since the male deposits the largest number of sperms in the first male and there is a positive correlation between fast mating. In the present results observed that there is a significant increase in the number of eggs laid in both the test groups when compared to control. This study indicates that in test groups increased fecundity may be accounted for the fact that the flies are under the influence of seed extract. Similar results were obtained by Vasudev *et al*. Some plants in the life of garos of organism's fertility are a quantitative trait determined by environmental and genetic components (Spieth and Ringo, 1983). *Mucuna pruriens* seed extract has increased fertility when compared to control group of *Drosophila*, Several workers have made studies on the effect of different chemicals will alter the fertility in *Drosophila* (Pankaj *et al.*, 2011; Guru Prasad *et al.*, 2011; Clara, and Luckiribili, 1985; Graves, 1993).

Conclusion

Numbers of herbs have been used in one form or other for improving the sexual performance. It would be apt to state that utilization of herbal medicine and safer herbal products for improving sexual dynamics could serve the purpose for providing ameliorative effects of sexual dysfunction. The present study has showed that *Mucuna pruriens* has aphrodisiac property which has enhanced fecundity and fertility of *D.melanogaster*.

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REFERENCES

- Abedulla khan, K., Anupama koneru, Pavan kumar, K., Satyanarayana, S., Eshwar kumar, and Sreedevi, K. 2008. Antifungal and Anthelmintic activity of extracts of *Mucuna pruriens* seed. *Pharmacologyonline.*, 2:776-780.
- Adimoelja, A. 2000. Phytochemicals and the breakthrough of traditional herbs in the management of sexual dysfunction. *International J. Androl.*, 23: 82-84.
- Amin, K. M. Y., Khan, M. N., Rehman, S. Z. and Khan, N. A. 1996. Sexual function improving effect of *Mucuna pruriens* in sexually normal rats., *Fitoterapia.*, 67: 58-68.
- Aversa, A. and Fabbri, A. 2001. New oral agents for erectile dysfunction: what is changing in our practice ? *Asian J. Androl.*, 3:175-179.
- Bell, E. A. and Janzen, D. H. 1971. Medical and ecological considerations of L-Dopa and 5-HT in seeds. *Nature.*, 229:7-13.
- Clara, M. U. and Luckiribili, L. S. 1985. The effects of gene-environment interaction on the expression of longevity. *Heredity.*, 55:19-26.
- Dhingra, D. and Sharma, A. 2006. Antidepressant-like activity of *Glycyrrhiza glabra* L. in mouse models of immobility tests. *Progress in Neuro-Psychopharmacology & Biological Psychiatry.*, 30: 449-454.
- Dukes, J. A. 2003. Legume species. Handbook of Legumes of world economic importance. *Jodhpur Scientific Publishers.*, 170- 173.
- Eastwood, L. and Burnet, B. 1977. Courtship latency in male *D. malenogaster*. *Behav Genet.*, 7: 359-372.
- Ekanem, A. P., Objekezie, A., Kloas, W. and Knopf, K. 2004. Effects of crude extracts of *Mucuna pruriens* (Fabaceae) and *Carica papaya* (Caricaceae) against the protozoan fish parasite *Ichthyophthirius multifiliis*. *Parasitol Res.*, 92(5): 361-369.
- Graves, J. L. 1993. The cost of reproduction and dietary restriction: Parallels between insects and mammals. *Growth day ageing.*, 57:233-249.
- Guru Prasad, B. R., Hegde S. N. and Krishna, M. S. 2011. The effect of *Emblica officinalis* diet on lifespan, sexual behavior, and fitness characters in *Drosophila melanogaster*. *AYU.*, 32:279-284.
- Guruprasad, B.R., Hegde, S.N. and Krishna, M.S. 2008. Positive relation between male size and remating success in some population of *Drosophila bipectinata*. *Zool. Studies.*, 47:651-659.
- Hegde, S.N. and Krishnamurthy, N.B. 1979. Studies on mating behavior in the *Drosophila bipectinata* complex. *Aust. J. Zool.*, 27: 421-431.
- Hishikar, R., Shastry, S., Shinde, S. and Gupta, S. S. 1981. Preliminary phytochemical and anti-inflammatory activity of seeds of *Mucuna pruriens*. *Ind. J. Pharmacol.*, 13(1): 97-98.
- Katzenschlager, R., Evans, A., Manson, A., Patsalos, P.N., Ratnaraj, N. and Watt, H. 2004. *Mucuna pruriens* in Parkinson's disease; a double blind clinical and pharmacological study. *J. Neurol. Neurosurg. Psychiatry.*, 75(12): 1672-1677.
- Kirtikar, K. R. and Basu, B. D. 1988. Indian medicinal plants. In; Blatter E, Caius JF, Mhaskar KS, editors. 3rd ed. Dehra Dun, International Book Distributor. 1126-1127.
- Manyam, B. V., Dhanasekaran, M. and Hare, T. A. 2004. Neuroprotective effects of the antiparkinson drug *Mucuna pruriens*. *Phytother. Res. Sep.*, 18(9):706-712.
- Markow, T. A. 1998. Reproductive behavior of *Drosophila melanogaster* and *Drosophila nigra spiracula* in the field and in the laboratory. *Comp. Pshycol.*, 102:169-173.
- Misra, L. and Wagner, H. 2006. Lipid derivatives from *Mucuna pruriens* seeds. *Ind. J. Chem. Sec B.*, 45(3):801-804.
- Pankaj, P., Guru Prasad, B. R., Anjaneya Murthy, N. and Hedge, S.N. 2011. The effect of *Emblica officinalis* diet on lifespan, sexual behavior, and fitness characters in *Drosophila melanogaster*. *International J. Research in Ayurveda.*, 32(2): 279-284.
- Rajeshwar, Y., Gupta, M. and Mazumder, U. K. 2005. In vitro lipid peroxidation and antimicrobial activity of *M. Pruriens* seeds. *Iranian J. Pharmacol. Ther.*, 4(1): 32-35
- Rathi, S. S., Grover, J. K. and Vats, V. 2002. The effect of *Momardica charantia* and *Mucuna pruriens* in experimental diabetes and their effect on key metabolic enzymes involved in carbohydrate metabolism. *Phytother. Res.*, 16(8):774-777.
- Shukla, K. K., Mahdi, A. A., Ahmad, M. K., Jaiswar, S. P., Shankar, S. N. and Tiwari, S. C. 2010. *Mucuna pruriens* Reduces stress and improves the quality of semen in infertile men. *Evid Based Complement Alternat Med.*, 7(1):137-144.
- Spiess, E. B. 1970. Mating propensity and its genetic basis in *Drosophila* In; Hecht MT, Streere WC, editors , In essay in evolution and genetics in honour of the Dobzhansky, New York; Appleton-century -Crafts, pp 315-379.
- Spieth, H.T. and Ringo, J.M. 1983. In: M. Ashburner, H.L. Carsony, J.N. Thompson. Jr, editors, *In The genetics and biology of Drosophila. 3c, London; academic press; Chowkambha.* 6th edition. vol.1, Varanasi, india; pp 223.
- Tripathi, Y. B. and Upadhyay, A. K. 2002. Antioxidant property of *Mucuna pruriens* L. *Curr Sci.* 80(11): 1378- 1386.
- Vaidya, A. B., Rajagopalan, T. B., Mankodi, N. A., Antarkar, D.S., Tathed, P.S. and Purohit, A.V. 1978. Treatment of Parkinson's disease with the cowhage plant-*Mucuna pruriens*. *Neurol. India.*, 26(4):171-176.
- Vasudev Rao, M. K. and Shanpru, R. 1981. Some plants in the life of Garos of Meghalaya. In: Jain SK editor. Glimpses of Indian ethnobotany. New Delhi: *Oxford and LBH Publishing co.*, 153-60.
