



## COLOURLESS NATURAL ANTIMOTH AGENTS FOR WOOLLENS

Ajay Kumar\*, P.K. Pareek, D.B. Shakyawar<sup>1</sup> and V.V. Kadam

Division of Textile Manufacture and Textile Chemistry

ICAR-Central Sheep and Wool Research Institute, Avikanagar- 304 501, Rajasthan

<sup>1</sup>Uttar Pradesh Textile Technology Institute, Kanpur- 208 001, Uttar Pradesh

\*E-mail address: kumarajay817@gmail.com

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### ABSTRACT

Woollen products are quickly infested with moth under favourable conditions. Some of the natural dyes have antimoth efficacy, but they reproduce limited colour shades. To identify a colourless natural source for antimoth properties, *Datura stramonium* L. (*Datura*) was taken. On a weight basis, 43.56% colourless extract yield of datura seeds was obtained. The woollen fabric was treated with extract to study antimoth efficacy by standard method and compared with synthetic antimoth agent 'Eulon'. The antimoth efficacy was found to be poor in datura seed extract alone as well as with alum and ferrous sulphate. Treatment of the seed extract with stannous chloride showed excellent antimoth efficacy (0.19%), equivalent to commercial antimoth agent "Eulon" (0.17%). The natural antimoth extract obtained from datura seeds avert moth attack on woollen fabrics and can be used for industrial application.

**Keywords:** *Datura stramonium* L., Eulon, Natural antimoth agent, Organotin, Wool

Wool and specialty hair fibres are widely used for producing carpets, blankets, *namdhas*, shawls and knit wears. Woollen products possess unique properties like warmness, softness, flame resistance etc., but are prone to attack of moth due to its protein content (Cox and Pinniger, 2007). Wool moth is an insect and its larvae eat the protein present in wool. Chemical antimoth agents are readily added during the process of dyeing and finishing process for preventing moth attack on wool products. Ideal antimoth agents should be ecofriendly and effective through the lifetime of the wool textiles (Wei, 2011). *Datura stramonium* L. (*Datura*) is a herbaceous species belonging to the family *Solanaceae* and distributed throughout temperate and tropical regions. It contains tropane alkaloids such as scopolamine, hyoscyamine, and atropine, primarily in their seeds and flowers (Michalodimitrakis and Koutselinis, 1984). A study was taken to identify a natural colourless

antimoth agent for woollen using datura seed extract.

### MATERIALS AND METHODS

*Datura* seeds were collected from ICAR-Central Sheep and Wool Research Institute, Avikanagar and dried on a wooden platform. Pure wool fabric was mildly scoured with a nonionic detergent (@ 0.5 g /litre) at 50°C for 30 min, washed with warm water, rinsed with cold water and dried at ambient temperatures.  $Al_2(SO_4)_3$  (alum),  $SnCl_2$  (tin chloride) and  $FeSO_4$  (Ferrous sulphate) were used as mordants. Pulverized datura seeds (100 g) were soaked in water (5 litre) overnight. The seed solution was boiled at 100°C for 60 min for extraction. The woollen fabric was treated with 10% extract at 100°C with 1:40 material to liquor ratio at pH 5-6 in the presence of 0.5 g/litre acetic acid solution for one hour in a water bath and meta-mordanting was done with 3% mordant (Kumar et al., 2015).

The treated and untreated (control) woollen fabric samples were kept in petri dishes by adding 10 adult live carpet beetle moths (*Anthrenus verbasci*) for testing (Kato et al., 2004). Petri dishes were kept in incubator at 33°C and 60% relative humidity for 30 days. The antimoth properties were assessed based on weight loss in the fabric due to moth attack, visual examination of fabric for damage and the number of moths alive after the test. Simultaneously, a synthetic antimoth chemical 'Eulon' treated wool fabric was also kept in similar conditions to compare the results. Durability of treatment is the resistance to change in any of its characteristics of treated fabrics. Fabric

samples were washed as per AATCC Test method 190 - Colorfastness to Home Laundering in Landrometer with 0.1% non-ionic detergent and sodium carbonate for washing test and dry clean on commercial dry cleaning unit.

## RESULTS AND DISCUSSION

On weight basis, the yield of colourless extract from *D. stramonium* seed was 43.56%. In control sample, wool moth attack and damage the woollen products (Plate 1) compared treated samples.

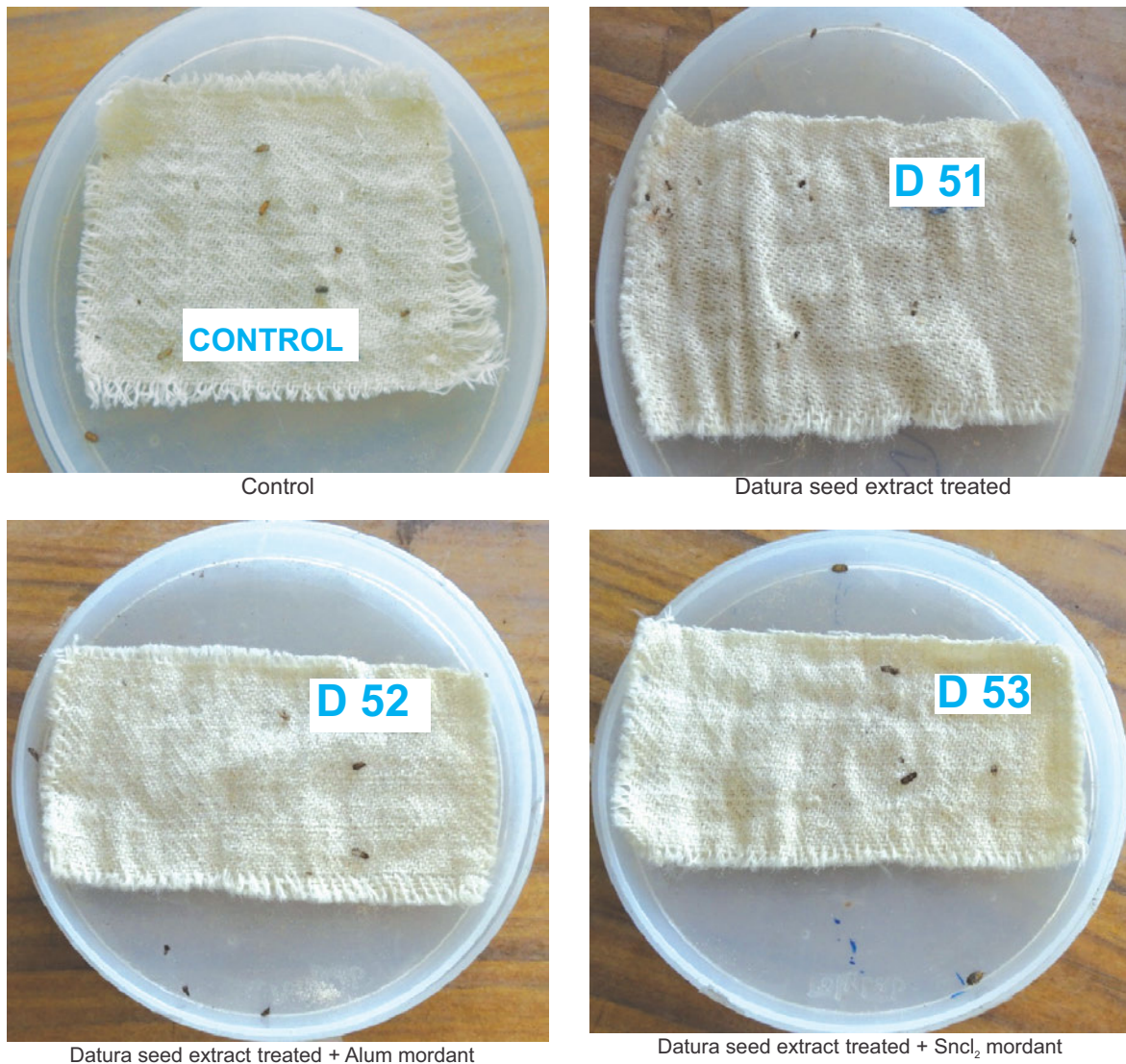


Plate 1. Wool fabrics and moth larvae 4 weeks on feeding tests

The treatment of woollen fabric with datura seed extract alone caused serious damage to fabric, i.e. 3.2% weight loss of fabric which exceeded the limit of 2.00% (Shakyawar et al., 2015) but with only 30% of live moths, it established the lethal effect for wool moth (Fig. 1). The fabric treatment along with meta-mordanting with  $Al_2(SO_4)_3$  showed lower fabric weight loss (1.95%) but with 50% of live moths. Meta mordant of  $SnCl_2$  along with datura seed extracts showed an excellent antimoth property i.e. fabric weight loss of only 0.19% with none of the moth alive after the incubation period almost equivalent to commercial

antimoth agent 'Eulon' (0.17%). Meta-mordant of  $FeSO_4$  along with treatment of the datura seed extract resulted in serious damage to fabric, i.e. 4.0% weight loss of fabric as well as 60% alive moth after the incubation period.

In the present study, an excellent antimoth property of datura seed extract with  $SnCl_2$  may be attributed to the formation of organotin compound with stannous mordant treated fabrics. Organotin compound disrupts oxidative phosphorylation and blocks the bioenergetics system of a moth (Marcic et al., 2011) leading to death of moth. The formation of organotin compound for

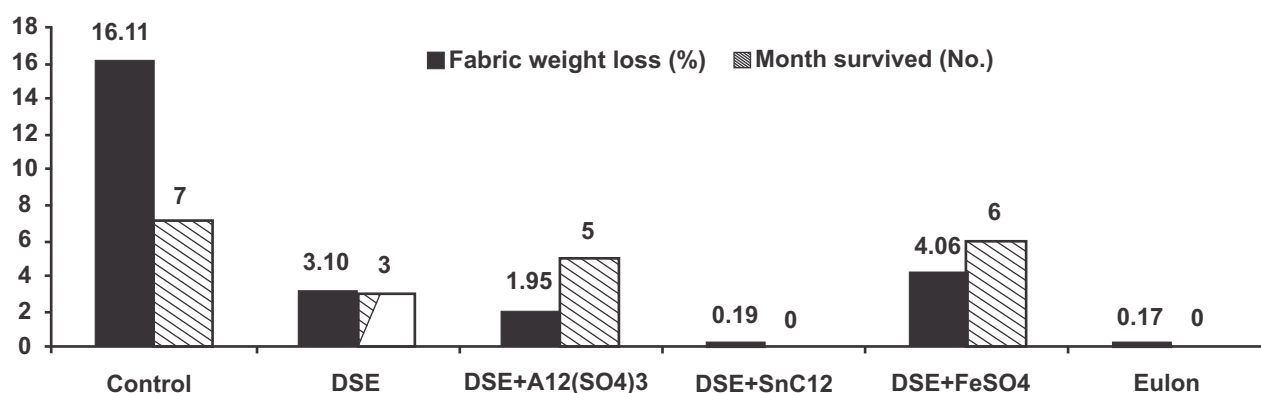


Fig. 1. Antimoth properties of Datura seed extract (DSE) treated woollen fabric

treatment with datura seed extract in combination with stannous mordant was analyzed through Fourier Transform Infrared (FTIR) spectroscopy (Plate 2). A strong peak was observed at  $1160\text{ cm}^{-1}$  in the FTIR spectra suggested the formation of organotin compound (Schumann and Schumann, 1988).

To test the characteristics of treated fabrics for antimoth property after washing and dry cleaning, a set of fabric was washed and dry cleaned separately. The fabric was then incubated to observe the damage caused by the wool moth. It was found that after one washing, the fabric weight loss increased by 13% for datura seed extract alone and treatment with  $Al_2(SO_4)_3$  mordant samples. A slightly higher 19% weight loss was observed for treatment and  $FeSO_4$  mordant

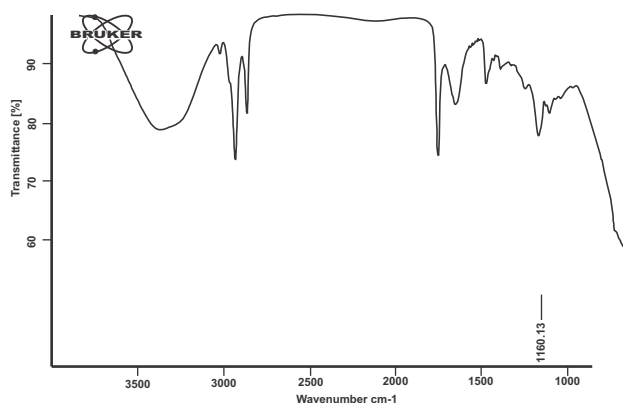


Plate 2. IR Spectra of datura seed extract and tin chloride-treated fabric

samples. The increase in fabric weight loss after washing may be due to decline in the antimoth efficacy of the datura seed extract after washing. Whereas, for fabric organotin compound (datura seed extract

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treatment with SnCl<sub>2</sub> mordant) and commercial antioth treated fabrics showed 5.5 times higher fabric weight loss after the incubation period for washing fabrics, though the fabric weight loss was in the range of 0.26 - 0.86% in absolute value which is well below the limit of 2% (Table 1).

Table 1. Antioth efficacy of datura seeds extract (DSE) treatment on woollen fabrics

Treatment	Weight loss (%)			Moths alive (No.)		
	Unwashed	Washed	Dry cleaned	Unwashed	Washed	Dry cleaned
DSE alone	3.20	3.62	3.38	3	4	4
DSE + Aluminium Sulphate	1.95	2.21	2.03	5	4	5
DSE + Tin Chloride	0.19	1.03	0.20	0	0	0
DSE + Ferrous Sulphate	4.06	4.86	4.11	6	7	6
Commercial antioth	0.17	0.83	0.32	0	0	0
Control	16.11	-	-	7	-	-

Fabric washing reduces the deleterious effect of the datura seed extract which results in increase of number of moths alive after the incubation period. The lethal effect of organotin compound and the commercial antioth agent is maintained even after washing. The reduction of antioth properties after dry cleaning process to the fabric was relatively low compared to washing.

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