

Synthesis of Moth Resist Dyes for Wool

Dr. C. W. Acharya & Girish Kherdekar

Wool Research Association, Thane

Abstract

The damage to the woolen textiles by moth larvae throughout the world is estimated to cost millions of dollars every year. Without effective moth proofing this damage would increase enormously and place wool at a disadvantage as a high quality textile fibre. Considering these facts, it becomes interesting to combine insecticidal & colouring component to produce new molecules to achieve moth proofing & dyeing in single step. During dyeing, such kind of dye being chemically reacting with the wool fibre is expected to provide cost saving and better fastness properties through single bath application. Substituted benzyl 2-methyl – 2 phenyl propyl ethers, substituted benzyl phenyl ethyl ethers and substituted dibenzyl ethers are reported to have potential insect resist properties. The present paper describes the incorporation of these features in the final dye product which are expected to provide moth resist / repellent properties. We have synthesized substituted benzyl propyl ethers with a nitro substituent on the benzyl moiety, which has been reduced to an amino compound. This amino compound is diazotized and coupled with the regular coupling intermediates like H-acid to obtain the corresponding mono azo and diazo compounds which are highly coloured red dyes. Total seven dyes have been prepared and studied for wool dyeing. The synthesized dyes show good moth resist properties and fastness towards washing and light when compared with commercial dyes.

Keywords: moth, combine, insecticidal & colouring component

1. Introduction

Presently Organochlorine, organophosphorous, carbamate and synthetic pyrethroid insecticides are the main potential insecticides which are available for moth proofing use. The organochlorine being susceptible for the penetration into the human body causing serious deleterious effects in terms of dermal toxicity and also due to low biodegradability is discarded. The organophosphorous and carbamate insecticides because of their nonstability against moisture and light cannot provide lasting protection to the wool substrate and were not considered promising for the purpose of insect proofing of wool. Synthetic pyrethroid permethrin which is at present widely used for moth proofing of wool is (3-phenoxyphenyl) methyl 3-(2,2-

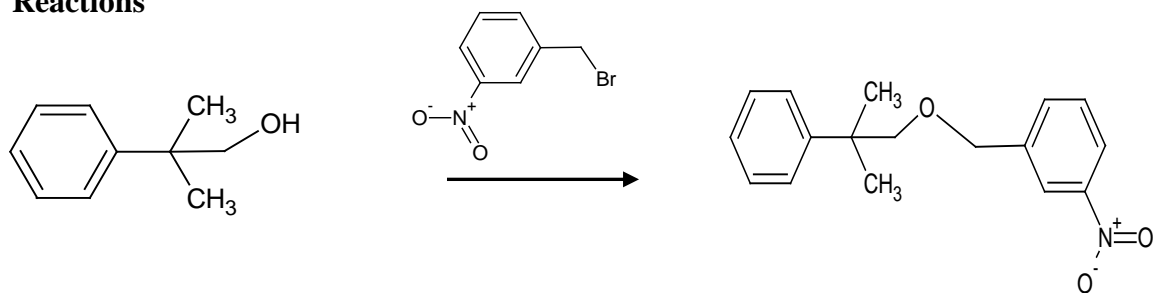
dichloroethenyl) -2,2-dimethyl-cyclopropanecarboxylate mixture of trans and cis isomers in the ratio of 70:30. There has been trend in recent years towards development of compounds that are environmentally less hazardous. Presently moth proofing is carried out along with dyeing with various moth proofing agents, the method of application is done generally by exhaust and also by pad batch technique.

The present synthesis work is a basic research towards development of new molecules incorporating the structural features of toxic and colour imparting groups to have dyeing and moth proofing effect simultaneously in the same bath, keeping in view the cost of application and undesirable deleterious effects. MTI-500 a new generation pyrethroid class of product which is 3-phenoxy benzyl 2-methyl-2-(4 ethoxy phenyl) propyl ether having high toxicity towards insects with low mammal toxicity has been recently reported. Japanese chemist at Sumitomo was able to synthesise new insecticidal esters by replacement of cyclopropanecarboxylic acid by structurally similar α (1-methylethyl) benzene acetic acid.

These esters have broad spectrum activity similar to that of pyrethroids and owing to their stability is also suitable use in agriculture. New generation insecticide MTI-500 does not contain any chlorine or halogen atom. Its common name is 'ethofenox' and is also called as C H O compound because it is composed of only Carbon, Hydrogen and Oxygen. Its chemical name is 2-(4-ethoxyphenyl)-2-methylpropyl-3-phenoxybenzyl ether. It is a broad spectrum insecticide effective against a number of insect pests but has very low toxicity towards mammals or plants.

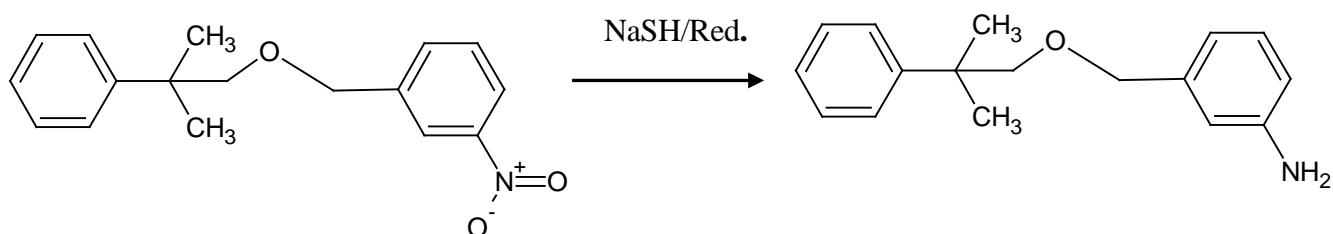
We have selected the structural features of ethofenox molecule for its incorporation in the synthesis of the new class of dyes. The paper describes the synthesis of monoazo and diazo dyes containing dibenzyl, benzylphenylethyl and (2 phenyl-2 methyl propyloxy-benzyl) as insecticidal groups.

Reactions



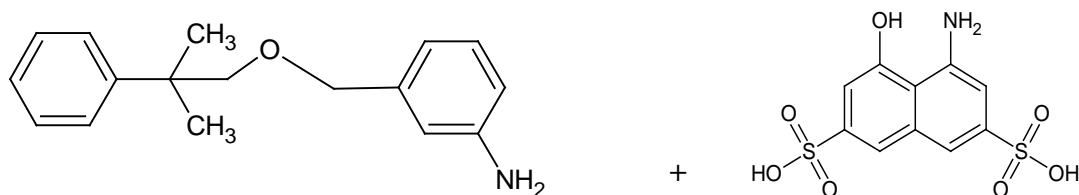
2-Methyl, 2-phenyl propanol

2-Methyl, 2-phenyl propyl 3-nitro benzyl ether

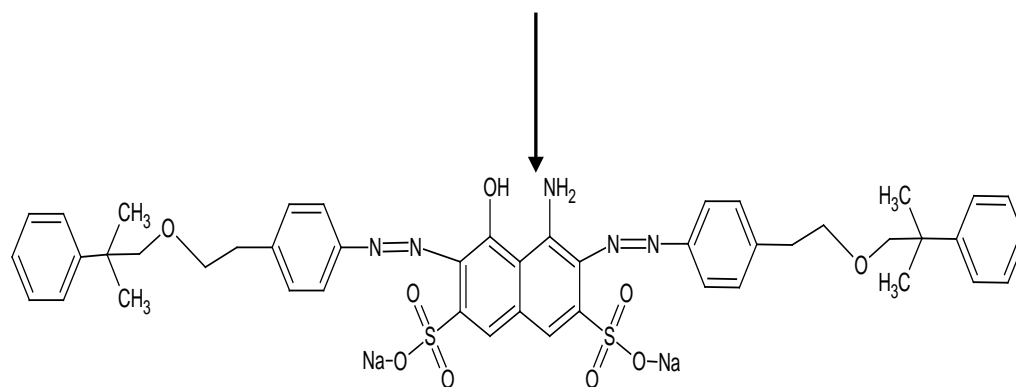


2-Methyl, 2-phenyl propyl 3-amino benzyl

ether



2-Methyl, 2-phenyl propyl 3-amino benzyl ether



2-7 diazo (2 phenyl-2 methyl propoxy-benzyl) 3-6 disulpho-1, amino, 8 hydroxy Naphthalene

2. Experimental

UV spectra are taken on GBC UV Vis 918 spectrophotometer. IR spectra are taken on Perkin Elmar spectrophotometer. Mass spectra are taken on GCMS MD800 instrument.

2.1 Preparation of 3-nitrobenzyl 2-methyl-2-phenylpropyl ether

2-Methyl-2-phenylpropanol (1.65 g, 0.011 mole), 3-nitrobenzyl bromide (2.15 g, 0.01 mole), tetrabutyl ammonium bromide(TBAB) (0.35 g, 0.001mole) and aq. NaOH (15g, 50% w/w) were taken in toluene(20 ml) and vigorously stirred at room temp, for 1 hr and then at 80 °C. for 3 hrs. The reaction mixture when purified by column chromatography yielded 3-nitrobenzyl 2-methyl -2-phenyl propyl ether, B.P. 250-252°C/1 mm, yield 1.89 g, (66.4%).

UV (MeOH) nm: 206.1 (log ϵ , 4.2575), 262.4 (log ϵ , 4.5084);

IR (neat) cm⁻¹: 3060 (CH str of Ph), 2950, 2850 (CH₂), 1580, 1340 (NO₂), 1490, 1445(CH₂), 1250 (C-O-C Aryl), 1110 (C-O-C aliphatic), 850, 760 & 700 (substituted benzene)

Mass spectrum : M⁺ 285 and_fragments ions at m/z 255 (C₆H₅ - C(CH₃)₂- CH₂-O-CH₂-C₆H₄-O)⁺ 136 (NO₂- C₆H₄CH₂)⁺, 119 (C₆H₅ - C⁺(CH₃)₂), 91 (C₆H₅CH₂)⁺ and 77 (C₆ H₅)⁺.

2.2 Preparation of 3-nitrobenzyl phenylethyl ether

3-Nitrobenzyl phenylethyl ether was prepared by condensing 2-phenylethanol (1.22 g, 0.01 mole), with 3 -nitrobenzyl bromide (2.12 g, 0.01 mole),in presence of tetrabutyl ammonium bromide(TBAB) (0.35 g, 0.001mole) in aq. NaOH (15g, 50% w/w.) in toluene(20 ml) as described in the preparation of benzyl phenylethyl ether. The ether was purified by distillation under reduced pressure, The yield of pure 3-nitrobenzyl phenylethyl ether was 2.14 g, (81%), boiling at 235-240⁰C, /10 mm)

UV (MeOH) nm: 204.8 (log ϵ , 4.3047), 262.4 (log ϵ , 3.8460),

IR (neat) cm⁻¹: 2950, 2850 (-CH str of CH₂), 1530 and 1350(NO₂ in phenyl) , 1100(C-O-C of ether), 800 and 730 (meta substituted phenyl), 700 and 690(mono substituted phenyl).

Mass spectrum: M⁺ 257 and fragments ions at m/z 136 (NO₂ C₆H₄CH₂)⁺ , 105 (C₆H₅CH₂ CH₂)⁺, 91 (C₆H₅-CH₂)⁺.

2.3 Preparation of benzyl 3-nitrobenzyl ether

Benzyl 3-nitrobenzyl ether was prepared by condensing benzyl alcohol (1.08 g, 0.01 mole), with 3-nitrobenzyl bromide (2.16 g, 0.01 mole) in presence of tetrabutyl ammonium bromide (TBAB) (0.35 g, 0.001 mole) in aq. NaOH (15g, 50% w/w.) in toluene (20 ml) as described in the preparation of benzyl phenylethyl ether. The ether was purified by column chromatography to yield pure benzyl 3-nitrobenzyl ether 1.94 g, (80%), boiling at 210-15⁰C /10mm).

UV (MeOH) nm: 206.1 (log ϵ , 4.2741), 262.4 (log ϵ , 3.7783),

IR (neat) cm⁻¹: 3100, 2970 (CH of phenyl), 2900, 2873(-CH str of CH₂), 1515 and 1367(NO₂ in phenyl), 1155, 1032(C-O-C of ether), 781 and 698 (meta substituted phenyl).

Mass spectrum: It does not show molecular ion peak. However, on reduction with sodium polysulphide it gave the corresponding amine, which gives the molecular ion peak at 213.

2.4 Reduction of benzyl 3-nitrobenzyl ether

In a 50 ml round-bottomed flask benzyl 3-nitrobenzyl ether (0.5g, 0.00205 mole) and water 5 ml. was heated under reflux and added Na₂S 9H₂O (1.8g.) and sulphur(0.5 g.) dissolved in water (5 ml) in portions over 10 mins. The reaction mixture was refluxed for 24 hrs. The reaction mixture was extracted with ether (3x25ml). The ether layer was extracted with hydrochloric acid (1:1) 15 ml (5 x 3) to remove the reduced ether (amine). The hydrochloric acid extract was shaken with ether (25 ml). The hydrochloric acid layer was removed and cooled to 0^oC. by ice bath and carefully neutralized with liquor ammonia taking care the temperature did not exceed 20 ^oC. The amine precipitated out in alkaline medium. The precipitated amine was re-extracted with ether (3x25ml), washed with water. The ether layer was dried with anhydrous sodium sulphate and the ether was distilled on water bath. The traces of moisture were removed at 60⁰C. under vacuum for two hrs. This reduced compound benzyl 3-aminobenzyl ether was used for the preparation of dyes.

Mass spectrum: Does not show M⁺ and fragment Ions at m/z 107(C₆H₅-CH₂-O)⁺, 106(H₂N-C₆H₄-CH₂)⁺, 91(C₆H₅CH₂)⁺, 77(C₆H₅)⁺, 65(C₅H₅)⁺

2.5 Reduction of 2-Methyl -2- phenylpropyl 3-nitrobenzyl ether (Preparation of 3- amino benzyl 2-methyl-2- phenylpropyl ether)

Sodium sulphide (1.70 g, 0.007 moles) was dissolved in water (4.7ml) in sonicator. Sodium carbonate (0.8 g, 0.0095 moles) was added slowly while sonicating. The mixture was cooled to

20⁰C and Methanol (6.7ml) added the precipitated sodium carbonate was filtered at the pump. The residual filter paper was washed with Methanol (3 ml). The filtrate (sodium hydrogen sulphide solution) was used for reduction purpose.

In a 50ml round-bottomed flask, 2-Methyl -2- phenylpropyl 3-nitrobenzyl ether (1g, 0.0035 moles) was dissolved in methanol (5 ml). The sodium hydrogen sulfide solution prepared above was added to the round bottomed flask. The mixture was reflux on a heating mantle for 2 hrs. The methanol (12ml) was distilled out. The reaction mixture was brought to room temperature, diluted with (24 ml) water and extracted with Diethyl ether (3 X 25ml). The ether layer washed with water (25ml) and dried with sodium sulphate. The ether was distilled off on a water bath the traces of moisture in the reduced compound were removed on 100⁰C. Crude yield of the reduced compound was 0.7 g.

Mass Spectrum (EI): M⁺ 255 and fragment Ions at m/z 119(C₆H₅-C(CH₃)₂)⁺, 106(H₂N-C₆H₄-CH₂)⁺, 91(C₆H₅CH₂)⁺, 77(C₆H₅)⁺, 65(C₅H₅)⁺

2.6 Reduction of Benzylphenylethyl 3-nitrobenzyl ether (Preparation of 3- amino benzyl phenylethyl benzyl ether)

In a 50ml round-bottomed flask, Benzylphenylethyl 3-nitrobenzyl ether (0.5g, 0.0035 moles) was dissolved in methanol (5 ml). The sodium hydrogen sulfide solution prepared as described earlier was added to the round bottomed flask. The mixture was reflux on a heating mantle for 2 hrs. The methanol (12ml) was distilled out. The reaction mixture was brought to room temperature, diluted with (24 ml) water and extracted with Diethyl ether (3 X 25ml). The ether layer washed with water (25ml) and dried with sodium sulphate. The ether was distilled off on a water bath the traces of moisture in the reduced compound were removed on 100⁰C. Crude yield of the reduced compound was 0.7g.

Mass Spectrum (EI): M⁺ 227 and fragment Ions at m/z 105(C₆H₅-(CH₂)₂)⁺, 91(C₆H₅CH₂)⁺, 77(C₆H₅)⁺, 65(C₅H₅)⁺

3. Preparation of Dyes

3.1 Preparation of Acid dye from 3-aminobenzyl benzyl ether

In a 50ml round-bottomed flask, the above amine compound (0.213g, 0.001 mole) was taken and dilute hydrochloric acid (1.5 ml, 0.04 mole) added. Then flask is cooled to 0⁰C and 1.5 ml water added to it. Maintaining the temperature to 0⁰C, 0.1N sodium nitrite solution was added

from burette slowly till the starch iodide paper changes to violet colour. This confirms the formation of the dizonium salt. Now H-Acid (0.39g, 0.0005mole) is added slowly in portions with continuously stirring. After half an hour the pH of the solution was made alkaline to pH 7.5 to 8 by addition of sodium hydroxide. Further it was brought to pH 10 by addition of sodium carbonate (1N).The solution becomes dark pink, indicating the formation of the diazo colored compound (dye). The solution was salted out by the addition of sodium chloride, vigorously stirred and filtered at pump to obtain the precipitated dye. (Yield 0.42g (70 %)).

3.2 Preparation of Acid dye from 3- amino benzyl 2-methyl-2- phenylpropyl ether

In a 50ml round-bottomed flask, the above amine compound (0.255g, 0.001 mole) was taken and dilute hydrochloric acid (1.5 ml, 0.04 mole) added. Then flask is cooled to 0⁰C and 1.5 ml water added to it. Maintaining the temperature to 0⁰C, 0.1N sodium nitrite solution was added from burette slowly till the starch iodide paper changes to violet colour. This confirms the formation of the dizonium salt. Now H-Acid (0.39g, 0.0005mole) is added slowly in portions with continuously stirring. After half an hour the pH of the solution was made alkaline to pH 7.5 to 8 by addition of sodium hydroxide. Further it was brought to pH 10 by addition of sodium carbonate (1 N).The solution becomes red, indicating the formation of the diazo colored compound (dye). The solution was salted out by the addition of sodium chloride, vigorously stirred and filtered at pump to obtain the precipitated dye. (Yield 0.4g (68 %)).

3.3 Preparation of Acid dye from 3- amino benzyl phenylethyl benzyl ether

In a 50ml round-bottomed flask, the above amine compound (0.227g, 0.001 mole) was taken and dilute hydrochloric acid (1.5 ml, 0.04 mole) added. Then flask is cooled to 0⁰C and 1.5 ml water added to it. Maintaining the temperature to 0⁰C, 0.1N sodium nitrite solution was added from burette slowly till the starch iodide paper changes to violet colour. This confirms the formation of the dizonium salt. Now J-Acid (0.18g, 0.0005mole) is added slowly in portions with continuously stirring. After half an hour the pH of the solution was made alkaline to pH 7.5 to 8 by addition of sodium hydroxide. Further it was brought to pH 10 by addition of sodium carbonate (1 N).The solution becomes dark pink, indicating the formation of the diazo colored compound (dye). The solution was salted out by the addition of sodium chloride, vigorously stirred and filtered at pump to obtain the precipitated dye. (Yield 0.32g (65 %)).

4. Moth proofing activity

4.1 Materials & methods

Test fabric:

A soap scoured twill weave fabric 225 g./m² made from 64s quality wool was used as test fabric for moth proofing tests and also as standard control (negative control) fabric to determine the voracity of insect larval feeding. Similarly, fabric treated with 0.1% permethrin was also employed during tests as positive control.

Test compounds:

Synthesised dyes containing substituted benzyloxy 2-methyl-2-phenylpropyl diazo compounds, substituted benzyloxy benzyl diazo compounds and substituted benzyloxy phenylethyl diazo compounds were tested for their moth proofing efficiency.

4.2 Dyeing of the fabric using synthesized dyes

Twill weave fabric (225 g. /m²) was dyed with the above synthesized dyes at the percent shade of 0.25, 1.00 & 2.00, using Lyogen SMKI 1% as a leveling agent, Ammonium sulphate 4% as buffer on the weight of material and Sulphuric acid to adjust pH to 4.5 at boil for 45 mins. The wetting was carried out at 50 °C for 15 mins. After wetting, the temperature was raised with 2^oC rise per min. to boil. After dyeing, soaping was carried out with 1 gram per liter Lissapol at boil for 20 min. Similarly dyeings were carried out using the above fabric with Lanasyn Yellow 2GLNI and Navimill Brilliant Red 3BN from (Clariant India) with 0.25, 1, 2 % shade for the comparison of the feeding damage with the fabrics treated with synthesized dyes. The dyed samples were air dried for 4 days at room temperature before conducting tests. Sample specification is shown in the table1 below,

Table 1 Sample Specification

Sample No.	Description
1	Lanasyn Yellow 2GLNI
2	Navimill Brilliant Red 3BN
3	substituted benzyloxy 2-methyl-2-phenylpropyl diazo compound
4	substituted benzyloxy 2-methyl-2-phenylpropyl diazo compound
5	substituted benzyloxy benzyl diazo compound
6	Untreated
7	Treated with 1% Permethrin

4.3 Washing Fastness Test method- BS EN ISO 105- C10-B (2) 2007

The fastness to washing was tested according to ISO wash fastness method C10-B (2). The treatment was using 5 gm/L soap solution at 50°C for 45 minutes. Material to liquor ratio was maintained as 1:50. After treatment the samples were rinsed, dried and the rating was given to change in colour and staining.

Table 2 Result of washing fastness with respect to staining on cotton and wool and effect on shade

Sample No.	Staining on Cotton	Staining on Wool	Effect on shade
1	4-5	4-5	4
2	4-5	4-5	4-5
3	3-4	3-4	3-4
4	3-4	3-4	3-4
5	3-4	3-4	3-4

4.4 Light Fastness – BS EN ISO 105- BO2 1999

The light fastness of the dyed samples was tested with colour fastness to artificial light: Xenon arc fading lamp test and the results are as follows,

Sample nos. 1 & 2 showed rating of 4-5.

Sample nos. 3, 4 & 5 showed rating of 3.

4.5 Biological assay

Biological assays were done with the larvae of *Anthrenus Flavipies* (Le Conte) according to visual observation of the extent of damage and weight loss of the test fabric and the larval condition of the test larvae as per the procedure described by International Organisations (ISO 3998)

4.5.1 Test procedure

The fabric was cut into circular pieces of 4 cms in diameter, weighed at 65% relative Humidity at 25°C. The untreated fabric as negative control, permethrin 0.1% treated fabric as

positive control and above dyed fabrics at 0.25%, and 2.00 % were taken for studies to determine the feeding damage. The feeding tests were conducted according to test procedure followed by International Organisation for Standardisation (ISO 3998) for evaluation of the resistance of textiles to the larvae of *Anthrenus Flavipies* (Le Conte) wool insect pest (available at Wool Research Association, Thane(West) 400 607)¹¹. Eleven weeks old larvae of *Anthrenus Flavipies* (Le Conte) weighing about 0.8 to 1.2 mg. were used for the test. Thus fabric samples of about 4 cms. diameter of known weights were cut out from fabric and placed in contact with 15 larvae of test insects *Anthrenus Flavipies* (Le Conte) in glass petri dishes (50 mm x 18 mm) with perforated aluminium lid for 14 days in controlled atmosphere of $27 \pm 1^\circ\text{C}$, and $60 \pm 5\%$ relative humidity in a dark cabinet. All the fabrics were assessed for damage by visual observation of the extent of cropping, hole formation and weight loss. The tests were carried out in duplicate. The fabric is considered satisfactorily resistant to larvae of test insect if the duplicate test specimens have no holes and no cropping (surface damage) visible to naked eyes or mean weight loss is less than 15 mg. or 20 mg. in a single test specimen provided in voracity controlled specimens mean weight loss is not less than 35 mg. or 25 mg. in a single specimen and not more than 25% larvae die or pupate during the test period.

Table 3: Moth proofing activity of synthesized dyes on all wool serge fabric

Sample No.	Application of compound in g/100 g of fabric	Mortality 15 days	Feeding loss mg/% loss	Visual Damage	Proofed / Not proofed	Remarks
1	0.25	4	84/28	D	Not Proofed	Fabric structure damaged
	1.0	2	38/18.72	D	Not Proofed	
2	0.25	2	70/23.33	D	Not Proofed	Fabric structure damaged
	1.0	2	30/16.9	D	Not Proofed	
3	0.25	2	66/22	D	Not Proofed	Moderate resistance above 1% on fabric wt.
	1.0	2	26.6/8.9	C	Not Proofed	
4	0.25	3	82/27.33	D	Not Proofed	Moderate resistance above 1% on fabric wt.
	1.0	3	21.1/ 6.79	B	Not Proofed	
5	0.25	4	84/28	D	Not Proofed	Moderate resistance above 1% on fabric wt.
	1.0	4	29.7/9.8	C	Not Proofed	
6	(Negative)	Nil	74.5/26.24	D	Not Proofed	Fabric

	control)					structure damaged
7	(Positive control)	14	Nil / Nil	A	Proofed	No detectable damage

Note: A = no detectable damage, B = yarns or fibers partially severed, C = a few large or several small holes, yarns/fibers severed, D = several large holes. Proofed = no detectable damage; Not proofed = detectable damage.

5. Results & Discussion

Considering the structural features of the molecule of MTI 500 which do not contain any chlorine or halogen atoms was selected in the present work being the basic skeleton for developing new insecticidal sites by changing the substituent and their positions in the structure. Considering the above requirements, we have carried out the synthesis of Benzyl 2-methyl-2-phenylpropyl ether, a potential toxic compound which is expected to possess high insecticidal activity and low mammal toxicity. 2-methyl-2-phenyl propanol was used for producing substituted benzyl-propyl ethers. Substituent like NO₂ group has been introduced to obtain Nitrobenzyl propyl ethers which have been successfully reduced to obtain corresponding amine for use in the preparation of the dye molecule.

Substituted benzyl 2-methyl – 2 phenyl propyl ethers, substituted benzyl phenyl ethyl ethers and substituted dibenzyl ethers has shown potential insect resist properties. They have been tested at the level of 1% of the fabric weight with its physical presence. It has been observed that there is a substantial reduction in the feeding damage and in some cases it imparts moth resist properties to the fabric. Therefore, incorporation of its structural features in the final dye product is expected to provide moth resist / repellent properties. We have synthesized substituted benzyl propyl ethers with a nitro substituent on the benzyl moiety, which on subsequent reduction, diazotisation and coupling with the regular coupling intermediates like H-acid gave the corresponding monoazo and diazo compounds which are highly coloured red dyes. Washing fastness properties of the synthesized dyes were observed to be moderate at 3-4 as against 4-5 of the commercial Clariant dyes. Light fastness properties of the synthesized dyes were observed to be moderate at 3.0 as against 4-5 of the commercial Clariant dyes. Table 3 gives the moth proofing activity of the above products. It can be seen that compound no. 1 and 2 above are the

yellow and red dyed samples at 0.25 and 1% (dyes from Clariant India Ltd.) has a feeding damage of 28.0, 18.72 and 23.33, 16.90 % respectively with a visual destruction of the fabric under test. Sample no. 3 and 4 are dyed at 0.25 and 1% with the synthesized compounds has a feeding damage of 22.0, 8.90 and 27.33, 6.79 % respectively. From these results it is clear that at 0.25 % shade death there is no difference between the commercial dyed samples and samples dyed with synthesized dye. This indicates dye synthesized is not having significant moth resist activity at a level below 0.25 %. However when we compare the feeding damage at the 1% level of dying there is considerable difference on the feeding damage. The synthesized dye at sample no. 3 and 4 show a feeding damage of 8.9% and 6.79% as against the damage exhibited by the commercially dyed samples 1 and 2 at 18.72 and 16.90% showing a good resistance of synthesized dyes against the commercial Clariant dyes. The sample no.5 which is dyed with the synthesized dye also is in line with the above products, the feeding damage at the 0.25% being 28.0% and at 1% being 9.8%. The visual damage when compared with the samples dyed at 1% also indicates lower damage. The sample no.6, a negative control indicates a heavy damage 26.24% shows that the test conditions are appropriate and the results are valid for consideration. The sample no. 7 positive control (treated with 0.1% permethrin) shows no feeding damage with absolutely no visual damage indicating the confirmation of the proper conditions of the performance test. It has been observed that the presence of the toxic component in the dye structure provides insect resist properties, but as observed above the toxic properties are diluted due to a larger molecular structure weight and therefore the efficiency level of the dye molecules, requiring 1% treatment as against original ether compound of 0.5%.

6. Findings and conclusion

Different new dye molecules are synthesized incorporating the insecticidal group. The red dyes so synthesized show good resistance to the moth larvae of *Anthrenus flavipes*. Synthesized dyes show good moth resist properties as compared to wool dyes commercially available in the market. The feeding damage is observed to be lower at 8% as against 23.33% with the commercial dyes. Washing fastness properties of the synthesized dyes were observed to be moderate at 3-4 as against 4-5 of the commercial dyes. Light fastness properties of the synthesized dyes were observed to be moderate at 3.0 as against 4-5 of the commercial dyes.