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The Thermo-lignum Pest Control Treatment

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Abstract
The commercially available Thermo Lignum© process of pest control uses high temperatures combined with controlled relative humidity to provide a safe and practical option for large-scale pest control treatments. It has previously been tested on a range of collection material from the Natural History Museum. Preliminary investigations have now been carried out with respect to possible effects on D.N.A. on selected entomological specimens. These have shown that, within the test parameters, there is no known detrimental effect on these specimens as a result of this procedure. Further research is required on a wider range of material to establish the potential scope for the treatment for Natural History collections.

1. Introduction

Thermo Lignum© is a pest eradication process that controls relative humidity within a large capacity chamber throughout a heating-cooling cycle that includes three hours at a maximum core temperature of approximately 52°C, guaranteeing 100% pest mortality.

Previously published research (Ackery P.R., Pinniger, D Doyle, A., and Roux, K 2005)**,** indicates that the Thermo Lignum© process can provide a suitable and safe pest-control method in a variety of museum standard, lidded entomological drawers. By applying certain protocols and controls to transportation, packaging, placement and spacing of drawers within the chamber as well as appropriate chamber environmental levels, the treatment did not create extreme humidity changes which could potentially damage specimens and storage materials.

The next phase of the research was to identify whether this technique would have detrimental effects to D.N.A. to prevent or interfere with current and future molecular research as well as other physical or chemical effects. A research paper was published from which this article is derived (Ackery. P, Testa. J.M., Ready.P.D. Doyle.A.M., Pinniger. D.P. 2004).

2. Procedure

Selected entomological test specimens comprised;recently caught noctuid moths, 10-year old sphingid moths and 20-year old nymphalid butterflies (Danainae. All of these had a known history and have remained untreated by historical or contemporary pest control techniques (i.e. fumigants etc). (See table 1) This enabled us to test empirically whether D.N.A. could be extracted and amplified from the treated specimens and to establish that the resultant sequences were lepidopteran DNA.

2.1 The treatment cycle

Undergoing established Thermo Lignum© processes, the selected entomological specimens were subjected to three hours at 52°C. Imposed controls on relative humidity reflected the requirements of other non-entomological items included in the test run (Thermo lignum© is a commercial business and has client's time booked), peaking at 57% Rh compared to an average collections storage level of 47% Rh around the period of the test run (12.6.2002).

2.2 Specimens from which DNA was amplified

D.N.A. fragments of the correct size-range (300-400 base pairs) were successfully amplified by polymerised chain reaction (P.C.R.) from most samples although this was not as successful for the control samples of *Danaus affinis* as it was for the test samples of the same species or the control and test samples of the other two species. 4/8 of the *Danaus* controls amplified, but the smaller quantities of PCR products obtained from them indicated that less amplifiable DNA had been successfully extracted than from all the other samples.

An interesting *Danaus* result showed that this particular Thermo Lignum© operational cycle might have actually enhanced the efficiency of DNA extraction from old specimens, probably by some form of rehydration. (Ackery. P, Testa. J.M., Ready.P.D. Doyle.A.M., Pinniger. D.P. 2004). This result needs to be re-examined and re-tested to confirm that this is repeatable and is as a direct consequence of the Thermo-lignum© process. (It was however confirmed that there were no contaminants of human or other origins).

3.0 Other ancillary effects upon materials; storage and packaging materials and other specimens
In 1999, with the co-operation of Thermo Lignum©, a wide selection of natural history specimens and associated collections management products such as packaging materials, adhesives, resins and inks were tested along with controls. As was expected, there was no apparent detrimental affect to the packaging materials and inks and there does not appear to be any detriment effect on any of the adhesives (the melting point of these adhesives is higher than the temperature of the Thermo Lignum© chamber although adhesives are subject to chemical change over time).

The only visibly noticed effect was of greasy marks on specimens of oily fish. However, similar problems which were anticipated with some moth groups that have high grease content, particularly castniids, cossids and noctuids, did not occur. Although some verdigris clearly became detached in transit which shows that transportation issues need to be addressed if a treatment 'run' does not happen 'on site'.

(Verdigris forms on brass entomological pins when copper in the brass pin reacts with body fats and acids resulting in the characteristic and all to familiar greenish greasy deposit).

4. Conclusions
From the results of these basic investigations, the aim is to extend these preliminary results with different batches of the same species and other insects from different orders. Those specimens which were used in this study will need re-analyzing in the near future to investigate any longer- term detrimental effects of the Thermo Lignum© treatment as well as identifying any other form of investigative process that may be suitably employed to detect any form of damage. In addition, the suggestion of a possible relationship between re-hydration and enhanced efficiency of DNA extraction needs to be investigated further as does further work on inherently 'greasy' specimens and verdigris.

Finally, as understanding of historical conservation techniques become better understood and researched; specifically, previous treatments with chemicals, Thermo lignum© should be investigated as a possible method for removing unwanted and hazardous pesticides in a safe and controlled manner.

5. Acknowledgments

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6. References

1. Ackery, P.R., Pinniger, D Doyle, A., and Roux, K.. Heat treatment of entomological drawers using the thermo lignum heat process. Collections Forum, 19 (1-2) (2005), pp 15-22

2. Ackery. P, Testa. J.M., Ready.P.D. Doyle.A.M., Pinniger. D.P. 2004, effects of high temperature pest eradication on DNA in entomological collections. *Studies in Conservation* 49 (2004) pp 35-40

Table 1. Lepidoptera specimens analysed

Species	**Specimen age**	**Comments**
Danaus affinis	20 years old	Pinned specimens from the collection
Clanis bilineata	10 years old	Dried and stored in packets
Agrotis exclamationis	August 2002	Collected from the Museum Wildlife garden