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TECHNICAL REPORT

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**CHEMICAL AND BIOLOGICAL ANALYSIS
OF
TAN-O-QUIL-QM-TREATED WATERFOWL FEATHERS**

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Haig Markarian and John J. Pratt, Jr.

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Pioneering Research Laboratory
U. S. ARMY NATICK LABORATORIES
Natick, Massachusetts 01760

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FOREWORD

This report concerns the chemical and biological analysis of waterfowl feathers which had been treated with DDT prior to their treatment with the Tan-O-Quil-QM process to enhance bulk of the feathers. The study was conducted in order to resolve the question of the biological effectiveness of Tan-O-Quil-QM treated feathers and to determine the compatibility of the Tan-O-Quil-QM process with feathers treated with DDT. This study was conducted in cooperation with the Clothing and Organic Materials Laboratory of the Natick Laboratories.

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ABSTRACT

Prior to being utilized for military purposes, feathers from Government stockpiles are treated with the Tan-O-Quil-QM process which curls the feather quill. The chemical and biological aspects of the compatibility of this treatment with the DDT applied to the feathers for mothproofing purposes were investigated.

The results show that: (1) Tan-O-Quil-QM-treated feathers are susceptible to attack by black carpet beetle larvae; (2) DDT-treated feathers which were washed prior to treatment with Tan-O-Quil-QM, retained sufficient DDT (0.21%) to protect the feathers from attack by black carpet beetle larvae; (3) there were no chemical, physical or biological effects of the Tan-O-Quil-QM process on DDT.

CHEMICAL AND BIOLOGICAL ANALYSIS OF TAN-O-QUIL-QM-TREATED

WATERFOWL FEATHERS

Introduction

In connection with mothproofing provisions in Proposed Military Specification MIL-F-43097c, Feathers, Waterfowl, Chemically Modified, Tan-O-Quil-QM Process, 8 July 1966, a question arose on the compatibility of DDT with the Tan-O-Quil-QM treatment (1). This treatment consists of the "co-application of chrome tanning and water-repellent compounds to enhance the effective bulk of the feathers and to improve their hygienic properties".

This study was done to determine: (1) whether Tan-O-Quil-QM-treated feathers showed resistance to attack by black carpet beetle larvae and (2) whether the Tan-O-Quil-QM process interfered chemically or biologically with DDT applied to feathers prior to the Tan-O-Quil-QM. Although the type of compounds used in this treatment would not be expected to be toxic to carpet beetles or clothes moths, no data were available to substantiate this. It was also possible that the tanning agent might make the feathers physically more resistant to insect attack.

Since the first batch of feathers, which were obtained from a Government stockpile, were found to contain DDT, observations were made on possible effects of the Tan-O-Quil-QM chemicals on the biological effectiveness of DDT.

Materials and Methods

Feathers: Feathers with the following treatments and from the indicated sources were used:

1. From Government Stockpile,

<u>Sample No.</u>	<u>Type and Treatment</u>
AT 805 U	Goose - Untreated
AT 805 T	Goose - Tan-O-Quil-QM-treated
AT 806 U	Goose - Untreated

<u>Sample No.</u>	<u>Type and Treatment</u>
AT 806 T	Goose - Tan-O-Quil-QM treated
AT 807 J	Duck and Goose - Untreated
AT 807 T	Duck and Goose - Tan-O-Quil-QM treated

These feathers were reported to have been washed in an aqueous bath containing an anionic detergent and trisodium phosphate before treatment with Tan-O-Quil-QM, presumably to remove some or all of the DDT originally present.

2. From a Commercial Source

<u>Sample No.</u>	<u>Type and Treatment</u>
T-808	Duck, untreated
T-809	Duck, Tan-O-Quil-QM treated

These feathers were reported to be free of DDT, and on analysis were found to be so.

Biological Tests:

AATCC Standard Test Method 24-1956, Insects, Resistance of Textiles to, (2) was used. This specifies larvae of the black carpet beetle (Attagenus piceus) as the test insect, a standard control sample of 6.6 oz. undyed, scoured wool, 4 replicates of each test sample, and recording of results in terms of insect mortality and excrement weight. Visual damage was observed and recorded for additional information.

Chemical Analyses:

The method of Schechter and Haller (3) was used for the determination of DDT on the feathers. This method involves intensive nitration of the cleaned-up extracts from the feathers and the production of the characteristic blue colors of the nitrated products of DDT in benzene and methanolic sodium methylate. Two determinations were made and the results averaged.

Results

Biological results on the Tan-O-Quil-QM-treated, and on the untreated duck and goose feathers from a Government stockpile, are shown in Table I and Figs. 1, 2 and 3.

Table I. Biological Tests of Tan-O-Quil-QM-Treated and Untreated Duck and Goose Feathers from Government Stockpile. U = Untreated, T = Treated

Sample	Mortality*				Visual Damage**				Excreta weight (mg)			
	Replicate				Replicate				Replicate			
	1	2	3	4	1	2	3	4	1	2	3	4
Test Cloth	0	1	2	0	3	3	3	3	13.5	16.5	13.7	13.6
AT 805 U	8	7	6	6	3	3	3	0	1.0	1.5	0.5	0.5
AT 805 T	10	10	10	10	0	0	0	0	1.0	2.0	0.5	1.0
BT 806 U	5	8	8	3	1	0	0	0	1.5	1.0	1.0	1.5
BT 806 T	5	6	7	3	3	0	1	1	1.0	1.0	0.5	0.5
CT 807 U	5	8	5	7	1	0	1	1	1.0	1.5	1.5	1.0
CT 807 T	10	5	10	7	0	0	0	0	1.5	1.5	1.0	0.5

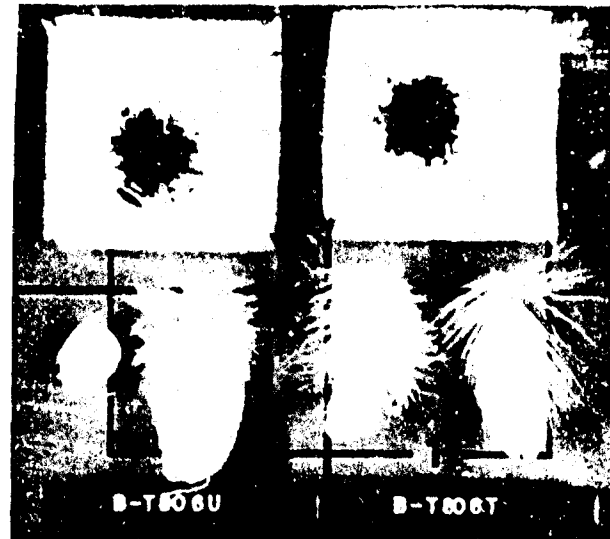
*10 insects per replicate

**Visual damage ratings: 0 = No damage; 1 = slight surface damage; 2 = Extensive surface damage; 3 = holes.

The mortality of insects on all the feather samples was high, the visual damage practically nonexistent (Figs. 1, 2 and 3) and the excreta weight low. The results show that the feathers were resistant to attack by the black carpet beetle larvae. These data indicate that the feathers were treated with an insecticide. It was presumed to be DDT, which may not have been removed completely prior to the Tan-O-Quil-QM treatment. Feathers known to have no DDT treatment were therefore obtained and tested biologically while analyses for DDT were being made on the feathers obtained from Government stockpile. Table II and Fig. 4 show that the feathers without a DDT treatment were susceptible to insect attack and that both Tan-O-Quil-QM-treated and untreated feathers were equally susceptible.

Table II. Biological Tests of Tan-O-Quil-QM-Treated and Untreated Duck Feathers from a Commercial Source. U = Untreated, T = Treated

Sample	Mortality				Visual Damage				Excreta weight (mg)			
	Replicate				Replicate				Replicate			
	1	2	3	4	1	2	3	4	1	2	3	4
Test Cloth	0	0	1	2	3	3	3	3	24.6	28.2	10.5	12.9
T 808 T	3	0	2	0	3	3	3	3	9.1	11.4	7.1	9.3
T 809 U	1	2	0	1	3	3	3	3	8.7	11.0	13.0	5.7



Figs. 1 and 2 - Two samples of DDT-treated goose feathers from Government stockpiles after exposure to black carpet beetle larvae. A-T805T and B-T806T = Tan-O-Quil-QM treated; A-T805U and B-T806U = Untreated. Test cloths at top.



Fig. 3 - DDT-treated duck and goose feathers from Government stockpile after exposure to black carpet beetle larvae. C-T807T = Tan-O-Quil-QM treated; C-T807U = Untreated. Test cloth at top.



Fig. 4 - Duck feathers from commercial source after exposure to black carpet beetle larvae. T-808 = Tan-O-Quil-QM treated; T-809 = Untreated. Test cloth at top.

Table III shows the results of analyzing both batches of feathers for DDT content.

Table III. DDT Content of Tan-O-Quil-QM-Treated and Untreated Duck and Goose Feathers

Sample	Type, Treatment and ^{SOURCE} Service	Percent DDT (wgt./wgt.)
T 808 U	Duck, untreated, commercial	0
T 809 T	Duck, Tan-O-Quil-QM-treated, commercial	0
AT 805 U	Goose, untreated, Gov't stored	0.18
AT 805 T	Goose, Tan-O-Quil-QM-treated Gov't stored	0.25
BT 806 U	Goose, untreated, Gov't stored	0.18
BT 806 T	Goose, Tan-O-Quil-QM-treated, Gov't stored	0.21
CT 807 U	Duck and Goose, untreated, Gov't stored	0.21
CT 807 T	Duck and Goose, Tan-O-Quil-QM-treated, Gov't stored	0.23

It is obvious from these data that the process used to remove DDT from the feathers prior to the Tan-O-Quil-QM treatment was not completely effective. An average of 0.21% DDT was present on the feathers, representing a possible reduction from the 0.5% minimum required by specification. It is also obvious that the Tan-O-Quil-QM treatment had no inhibitory effect on the biological effectiveness of DDT.

Conclusions

1. Feathers treated by the Tan-O-Quil-QM process are susceptible to attack by black carpet beetle larvae.
2. DDT-treated feathers which were washed and then treated by the Tan-O-Quil-QM process, retained an average of 0.21% DDT, and were protected from attack by black carpet beetle larvae.
3. The Tan-O-Quil-QM process has no chemical or physical effects on DDT applied prior to the Tan-O-Quil-QM process, nor on its biological effectiveness.

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