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Home freezers kill house dust mites

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KEY MESSAGE/CAPSULE SUMMARY

Freezing stuffed toys, pillows, food and other articles in a home freezer for 48 hrs should kill and control both *Dermatophagoides farinae* and *D. pteronyssinus* house dust mites.

KEYWORDS

Dermatophagoides farinae; *Dermatophagoides pteronyssinus*; house dust mite; cold acclimation; freezing

To the Editor

A high percentage of individuals with allergies are sensitive to the house dust mites, *Dermatophagoides farinae* and *D. pteronyssinus* that are ubiquitous in homes worldwide.^(1, 2) Also, these mites have been found in packaged baking mixes that may be refrigerated or frozen for storage. Various recommendations are made to reduce mite populations and exposure to mite allergens in the home. These generally target creating climatic conditions that are unsuitable for mite survival, eliminating or reducing mite breeding microenvironments or reducing patient contact with mite allergens where mites breed and allergens accumulate.⁽³⁾ These recommendations include reducing relative humidity (RH) in the home to < 50% so that mites die from dehydration and regular house cleaning to remove accumulated allergens in carpets, fabric covered furniture and mattresses.⁽⁴⁾ Other suggestions include removing carpeting and fabric-covered furniture to eliminate habitats where human skin scales collect and where mites feed and breed and their allergens collect. It is also recommended that mattresses and pillows be encased in mite-impermeable covers to prevent skin scales from collecting in them and to reduce human skin contact with and inhalation of mite allergens. Regular washing of bedding and clothing to remove mites and allergen is also advocated.⁽³⁾ Finally, it is recommended that children's stuffed toys, pillows, other small items, baking mixes and pet foods be frozen, presumably to kill mites.⁽³⁾ However, there have been no studies to determine what freezing temperatures and durations are required to kill mites and their eggs or to stop their reproduction. The current study investigated the survival and egg production of female *D. farinae* and the viability of eggs exposed to various freezing temperatures.

To investigate this, female *D. farinae* mites from thriving cultures were individually confined to small, screened glass viewing cages along with sufficient diet (lyophilized raw scrambled egg and baker's yeast, 9:1, v:v) to support the mite for the duration of the experiment. The mites were subjected to various freezing temperatures for varying durations of time, with and without a cold acclimation period at +4°C. Temperatures were selected for study that would allow us to determine [1] the freeze tolerance of *D. farinae* to a temperature (-4°C) that mites may encounter in the natural environment (in the nests of birds and mammals) and [2] freezing temperatures at or near those of a home freezer (-12°C).

and -15°C) and the duration of time needed to kill these mites and their eggs in household articles (e.g., stored products, stuffed animals). In parallel, as a control, a set of caged females was maintained at room temperature (21°-23°C) and 75% RH. Acclimated and frozen mites, along with untreated controls, were then held at 75% RH and room temperature for up to 2 weeks. Female survival, egg production and larval emergence were determined at various times post-freezing. In addition, fresh mite eggs were frozen at -15°C for 24 or 48 hrs and then egg viability determined.

The typical temperature of a home freezer is -15° to -17°C. The present study found that more than 50% of adult female mites survived 5-6 days after freezing at -15°C for 24 hrs (Table I). However, all mites that survived freezing died within 10-15 days following freezing when returned to ideal RH and temperature conditions and none of the surviving mites produced eggs during the time before their deaths. By comparison, 98% of the control mites produced eggs.

Fresh eggs that were frozen for 24 hrs at -15°C did not develop and hatch within 15 days and only 2 of 68 eggs (3%) hatched by 20 days after freezing. No eggs frozen for 48 hrs at -15°C hatched after 32 days at room temperature and 75% RH. The normal time for *D. farinae* eggs to incubate and hatch is 10 days at 23°C and 75% RH.⁽⁵⁾ Thus, 97% of eggs frozen for 24 hrs and all frozen for 48 hrs were not viable.

Only 20% of females survived freezing at -12°C for 8 hrs and none produced eggs while no females survived 12 hrs at -12°C without prior acclimation at +4°C (Table IIA). A significant finding of this study was that female mites could survive freezing temperatures of -4°C for up to 24 hrs and the surviving females, when returned to their normal climatic conditions, produced viable eggs that developed and gave rise to larvae (Table IIB). Thus, it is important to freeze objects at -12°C or lower for at least 12 hrs to kill mites.

Prior conditioning to cold (acclimation) but not freezing conditions can increase survival during exposure to freezing conditions for some insect and mite species.⁽⁶⁾ Our study found that in most experiments, this was not the case for *D. farinae*. Acclimation for 4 or 24 hrs at +4°C did not substantially improve survival.

Some baking mixes can be contaminated with house dust mites.⁽⁷⁾ The present study along with life cycle studies⁽⁵⁾ show that refrigeration (at +4°C or +15°C) of baking

mixes contaminated with *D. farinae* does not kill dust mites but significantly extends the length of the life cycle and upon return to room temperature, reproduction resumes and a mite population could expand.

Based on very little data in the published literature, it appears that *D. pteronyssinus* is much less freeze tolerant than *D. farinae*. Tsunoda⁽⁸⁾ reports that no females survived at -15°C for 30 minutes. To our knowledge there are no published data showing the ability of *D. pteronyssinus* and *D. farinae* to withstand extended periods at any freezing temperatures above -15°C (e.g. 0°C to -10°C).

In conclusion, our study using cultured mites found that these mites have the ability to tolerate and survive some freezing conditions. However, based on the data from this study, coupled with the available published data for *D. pteronyssinus*, freezing stuffed toys, pillows, food and other articles in a home freezer at -15°C for 48 hrs should kill both *D. farinae* and *D. pteronyssinus* house dust mites and their eggs. It should be noted that the freeze tolerance of mites in wild populations may vary some from that of cultured mites. It should also be noted that freezing articles and baking mixes does not remove mite allergens. In the case of stuffed toys, bedding, pillows and other cloth items, washing is required to remove the remaining mite allergens following freezing.

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Table I. Female mite survival, egg production and larval emergence for mites frozen for 24 hr at -15°C.**Experiment 1**

Day	Controls (N = 10)			-15°C for 24 hr (N = 10)		
Post-freeze	Alive	Eggs	Larvae	Alive	Eggs	Larvae
6	10 (100%)	66	0	6 (60%)	0	0
7	10 (100%)	83	0	6 (60%)	0	0
15	9 (90%)	134	51	0	0	0

Experiment 2

Day	Controls (N = 20)			-15°C for 24 hr (N = 25)		
Post-freeze	Alive	Eggs	Larvae	Alive	Eggs	Larvae
1	20 (100%)	43	0	20 (80%)	0	0
3	19 (95%)	99	0	20 (80%)	0	0
6	19 (95%)	174	0	15 (60%)	0	0
9	19 (95%)	266	0	7 (28%)	0	0
12	19 (95%)	322	43	1 (4%)	0	0
15	19 (95%)	309	127	0	0	0

Experiment 3

Day	Controls (N = 20)			-15°C for 24 hr (N = 25)		
Post-freeze	Alive	Eggs	Larvae	Alive	Eggs	Larvae
3	20 (100%)	93	0	17 (68%)	0	0
5	20 (100%)	166	0	13 (52%)	0	0
7	20 (100%)	239	0	4 (16%)	0	0
10	20 (100%)	324	2	0	0	0

Following freezing, mites were held at room temperature (21-23°C) in 75% RH and were observed periodically. Controls were held at room temperature in 75% RH for the duration of the experiment. Of the 50 control mites, 49 (98%) laid eggs. The normal time for eggs to incubate and for larvae to emerge at these conditions is 10 days.⁽⁵⁾

Table IIA. Female mite survival, egg production and larval emergence for mites frozen at -12°C with and without acclimation at +4°C for 4 hrs.

Acclim. +4°C	Freeze -12°C	N	Day 4 Post-freeze			Day 6 Post-freeze			Day 10 Post-freeze			% with eggs
			Alive	Eggs	Larvae	Alive	Eggs	Larvae	Alive	Eggs	Larvae	
0 hr	0 hr	10	9	21	0	9	28	0	9	33	1	90%
4 hr	0 hr	10	10	30	0	10	42	0	10	67	1	100%
0 hr	2 hr	10	4	5	0	4	5	0	4	5	0	20%
4 hr	2 hr	10	5	0	0	5	0	0	4	0	0	0%
0 hr	4 hr	10	7	0	0	6	0	0	3	0	0	0%
4 hr	4 hr	10	4	1	0	4	1	0	2	1	0	10%
0 hr	8 hr	10	7	0	0	3	0	0	2	0	0	0%
4 hr	8 hr	10	4	0	0	1	0	0	0	0	0	0%
0 hr	12 hr	10	3	1	0	2	1	0	0	1	0	10%
4 hr	12 hr	10	3	0	0	3	0	0	2	0	0	0%

Table IIB. Female mite survival, egg production and larval emergence for mites frozen at -4°C with and without acclimation at +4°C for 4 hrs.

Acclim. +4°C	Freeze -4°C	N	Day 1-3 Post-freeze			Day 4-6 Post-freeze			Day 7-8 Post-freeze			Day 12-14 Post-freeze			% with eggs
			Alive	Eggs	Larvae	Alive	Eggs	Larvae	Alive	Eggs	Larvae	Alive	Eggs	Larvae	
0 hr	0 hr	10	10	55	0	10	93	0	10	130	0	10	170	48	100%
4 hr	0 hr	10	9	50	0	9	93	0	8	122	0	8	165	47	100%
0 hr	4 hr	10	10	11	0	10	27	0	10	44	0	10	91	4	90%
4 hr	4 hr	10	10	5	0	10	20	0	10	44	0	10	115	5	100%
0 hr	6 hr	10	-	-	-	10	28	0	-	-	-	10	76	2	100%

4 hr	6 hr	10	-	-	-	10	34	0	-	-	-	9	124	1	90%
0 hr	8 hr	10	10	21	0	10	71	0	10	105	0	10	142	18	100%
4 hr	8 hr	10	10	7	0	10	40	0	10	59	0	10	100	3	100%
0 hr	10 hr	10	10	6	0	9	32	0	-	-	-	9	67	10	80%
4 hr	10 hr	9	9	5	0	6	12	0	-	-	-	5	17	6	56%
0 hr	12 hr	8	8	13	0	8	16	0	5	17	0	5	22	9	75%
4 hr	12 hr	10	7	11	0	7	21	0	7	29	0	7	43	13	60%
0 hr	18 hr	10	8	11	0	7	18	0	7	26	0	6	26	6	80%
4 hr	18 hr	10	8	7	0	7	17	0	6	24	0	5	19	10	70%
0 hr	24 hr	10	9	6	0	6	17	0	7	17	0	4	15	5	60%
4 hr	24 hr	10	6	3	0	3	3	0	2	3	0	1	3	0	20%

Following freezing, mites were held at room temperature (21-23°C) in 75% RH and were observed periodically. The number of mites at the start of each experiment is shown (N).