

Methods of destroying house dust pyroglyphid mites

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Summary

Attempts to reduce the growth of house dust pyroglyphid mites by vacuum cleaning, and modifications of temperature and humidity are useful but not sufficient. Their absence in dust from hospital beds which are disinfected led the authors to test PARAGERM AK, a non toxic bactericidal and fungicidal spray. This proved highly effective as an acaricide, killing off cultures of *Dermatophagoides* spp. and other mites with acceptable and easily produced concentrations, thus providing a new way of combating the house dust allergy mite.

Introduction

The house dust pyroglyphid mites' important part in the etiology of bronchial asthma and rhinitis was demonstrated by Voorhorst & Spieksma (1964, 1969) and then by numerous other authors from various countries. This led us, in addition to specific hyposensitization, to look for prophylactic measures which would either prevent these mites from developing, or kill them.

Prophylactic measures at present in use

Most consist in modifying the mites' biotope. The pyroglyphid mites' development depends mainly upon both the microclimate of the mattress, especially heat and dampness, and the human skin scales which constitute their substrate. The most favourable growth conditions are temperature varying between 25 and 30°C (77–86°F) and a relative humidity of 75–80%. Therefore, prophylactic measures consist in altering both the temperature and humidity of the rooms, especially of bedrooms. According to Spieksma (1967), the best way to reduce the number of mites is to maintain a dry atmosphere within the house (Spieksma, 1967; Voorhorst, Spieksma & Varekamp, 1969). According to Solomon (1961), the rooms should be quite hot and the humidity should be reduced to not more than 60% in order to kill the mites. A 24 hr exposure at 40°C (104°F), an 8 hr exposure at 45°C (113°F), 2 hr exposure at 50°C (122°F) or even 10 min exposure at 60°C (140°F) is quite enough to destroy them (Solomon, 1961). Although these temperatures can be reached *in vitro*, they

cannot be obtained at home. Decrease of humidity below 60% would be a fairly good method of combating the pyroglyphid mites but it is often difficult to achieve and is even sometimes ineffective since the mites can withstand drought. Too dry an atmosphere also does not suit asthmatics.

Van Bronswijk & Sinha (1971) noted that 24 hr exposure to a temperature of -18°C (about 0°F) killed the mites. In countries with severe winters exposure of the mattress and pillows to the cold would be effective. Regular vacuum cleaning of the mattress is a most useful prophylactic method. Cunningham & Gregory (1968) found that the number of mites that become airborne during bed making is eight times less when the mattress is first vacuum cleaned. Hughes & Maunsell (1973) have also shown the value of this method especially at those periods of the year when the mites are more numerous. In addition to mattress cleaning, vacuum cleaning of the furniture and floor is also needed, with special regard to the cracks and skirting boards, for these often shelter the mites when their conditions of life are difficult.

Washing down does not necessarily reduce their number since the cracks where they are hidden are seldom damped and a period of over 48 hr is needed to cause the mites to drown in soapy water (van Bronswijk & Sinha, 1971). A tightly sealed plastic sheath around the mattress could also be an efficient step. The allergen from the pyroglyphid mites (Bruchhansen, Geissler & Haschem, 1969), can be almost completely inactivated by ultraviolet radiation for 2 hr. These prophylactic measures, even though some can be most useful and more so when combined, are on the whole disappointing because they are not adequate for complete removal of the mites.

Chemical means of control: PARAGERM AK

The only really efficient method available up to now of combating the pyroglyphid mites is to use an active acaricide, harmless to man. We found such a product in our systematic research into mites in bed dust (Penaud *et al.*, 1973a, b). The pyroglyphid mites are most frequent in dusts of dwelling houses (about 75% of positive results) and are practically non-existent in those of hospitals (about 4% of positive results). In both cases the temperature and humidity were almost identical. The disinfectant in use within the hospital, namely PARAGERM (forte ambiance), newly called PARAGERM AK was suspected of destroying the mites.

Materials and methods

PARAGERM AK is a complex, ten constituent solution mainly composed of balsamic essences associated with various chemical antiseptics [Benzoic acid (A)*, Salol (B) Thymol (C), Terpeneol (D), citrus fruit natural essence (E), natural essences from *Syringa* and *C. nardus* (F and G), two halogenized phenyl alcohols (H and I), light liquid paraffin (J)]. It is anhydrous, very volatile and has bactericidal and fungicidal properties. It is used in hospitals by spraying, with a special portable device called 'MCR'. (Average emission output 10 ml/min; dish content: 1.5 l; with meter-bell from 0 to 30 min; height: 42 cm; width: 30 cm; load: 8.2 kg.) The duration of the spray process depends upon the volume of the room since the flow of the device is fixed.

PARAGERM sprays are a genuine micro-fog, devoid of toxicity. The oral LD_{50} represents 6.95 g/kg in the Swiss mouse and 7.29 g/kg in the Wistar rat (Broussy,

* We have used capital letters as a key to a further study of fractions. The firm PARAGERM has not provided further details of the formula so far, as it is being patented.

1972). In addition, 90 days daily spraying of 4.5 ml/m³ of PARAGERM (forte ambiance) solution has been tolerated well by both the Wistar rat and Swiss mouse. PARAGERM (forte ambiance) solution according to the manufacturer can be sprayed in the presence of humans and was approved by the French Ministry of Public Health in 1951.

Effects of PARAGERM AK spray on mite cultures

We have tested the action of PARAGERM AK on the pyroglyphid mites in our laboratory. Cultures of *Dermatophagoides pteronyssinus* with their nutritive milieu in Petri dishes with lids removed and edges lubricated with vaseline were placed in rooms of different sizes. Five Petri dishes were placed in different parts of each room, each containing twenty mites. The temperature of 23–25°C (73–77°F) and the humidity of 68–72% were quite compatible with the growth of the cultures. At one session the PARAGERM AK was sprayed in the rooms with the windows shut. In some tests humans were exposed to the spraying during their emission time only and in others during their contact time. The duration of spraying and of contact were varied.

Table 1. Acaricidal effects of PARAGERM AK upon *Dermatophagoides pteronyssinus* cultures

Room volume (m ³)	Emission time (min)	Amount sprayed in the room (ml)	Sprayed amount per m ³ (ml)	Contact time (hr)	Results (%)
40	30	300	7.50	4	†100
40	2	20	0.50	4	†80
40	3	30	0.75	2	†100
40	2.40	26.5	0.66	2	†100
40	2.40	26.5	0.66	1	†80
40	2.40	26.5	0.66	1.30	†85
50	3	30	0.60	2.30	†85
50	3.30	35	0.70	2	†100
80	6	60	0.75	2	†100
80	5.20	53	0.66	2	†100
100	6.36	66	0.66	2	†100

For each result mentioned on this table, the experiments have been carried out three times. The MCR flow is constant in every attempt: 10 ml/min; temperature of premises: 23–25°C (73–77°F); rate of wetness: 68–72%.

Results (Table 1)

Each test was carried out three times. All the mites were killed when the amount sprayed was at least equal to 0.66 ml/m³ and when the contact time was 2 hr at least. This time was needed for all the particles of spray to fall to the floor.

Mites belonging to different species, genera and even families (*Tetranychus urticae*, *Rhipicephalus sanguineus*) were also treated with the same results. In addition to its bactericidal and fungicidal properties, PARAGERM AK is an effective acaricide even when used in very low concentration.

We have tried to determine the active principle and have tested the various fractions. The results are recorded in Table 2. Fractions 1(J), 2(E+F+G+J) and 3 (A+B+C+D+J) have no effect. Fractions 4 (A+B+C+D+E+F+G+J) and 5 (D+H+I+J) destroy all the adult mites as well as the larvae, but only after a period

Table 2. Acaricide tests of PARAGERM AK various fractions. (a) Circumstances of experimentation; (b) fractions.(a) *Dermatophagoides pteronyssinus* cultures: adults, larvae, eggs

Temperature of premises: 23°C (73°F)

Relative dampness: 70%

Volume of premises: 40 m³ and 100 m³MCR induced amount: 0.66 ml/m³

Contact time: 2 hr

(b) Fraction no.	Constituents (no.)	Results	
		Adults and larvae	Eggs
1	1 (J)	0	0
2	4 (E-G,J)	0	0
3	5 (A-D,J)	0	0
4	8 (A-G,J)	† 100% after 48 hr	No effect
5	4 (D,H-J)	† 50% after 24 hr	No effect
		† 100% after 48 hr	
(PARAGERM 6 AK)	10 (A-J)	† 100% after contact of 2 hr time	No effect

of 48 hr. Fraction 6, which represents the product in its entirety, destroys all adult mites and all larvae after a 2 hr contact time. There is no effect on the eggs. The efficiency of this acaricide is, therefore, explained by a synergistic action of its main components.

Effects of PARAGERM AK on mites in homes

We have begun to use PARAGERM AK in dwelling houses in the form of easily used spray bombs.

These contain 100 ml and have a total emission duration of 7 min 30 sec. Their flow is 0.22 ml/sec. They were first tested *in vitro* and then in the houses of those patients whose bed dust samplings had proved positive. The patients and their families were asked to spray the product into the bedrooms, onto all sides of the mattresses and the rest of the bedding, and on the floor and furniture. We asked them to spray for 4 sec for every cubic metre to achieve an *in vitro* active dose, namely 0.66 ml/m³ equal to spraying 3 sec/m³. An increase of dose appeared necessary owing to numerous factors not existing in the laboratory, but which in a dwelling house could possibly limit the diffusion of the product and its impact upon the mites. We asked the users to leave the rooms immediately after the spraying and to re-open them only after the necessary 2 hr minimum contact time. The spraying could be applied to other rooms. One must remember that the secret, excreta and dead mites are as allergenic as the living mites (Voorhorst *et al.*, 1969). Complete vacuum cleaning is necessary after the death of the mites.

Our first attempts yielded the following results. So far we have made tests in fifteen bedrooms which were particularly overrun with mites. After the first two dust-samplings (a period of 15 days before each sampling), no mites were left in six cases. In another two cases about 50% of the mites were left according to counts before

and after the operation (a decrease from 450 to 200/g for the one and a fall from 250 to 110 for the other); in the other seven cases, the number of mites remained the same. However, of these seven failures, in three instances the patients did not abide by the instructions for use. The experimental sprayers used at home may not diffuse the spray as well as the MCR device does.

Discussion

These first attempts to control the mites appear encouraging; nevertheless, more work is needed for definitive conclusions. Control of the mites in the home can only be assessed from the dust samples, however easy it may be in the laboratory. Our criteria of estimation concerning the acaricidal effect within the houses are indirect; they are also based upon the absence, after the product has been sprayed, of mites in the dust samplings for quite a long time or, upon a quick decrease in the counts. There is another means of checking the effect, but it is too early for assessment. For a period of 1 year, 2-monthly dust samplings were performed in each of the ten mite overrun houses; the first sampling was performed before the PARAGERM operation and the second sampling afterwards. The two samples were immediately and separately cultured. The PARAGERM acaricidal efficiency could be regarded as adequate if the only growing cultures were those of the first sample. Double blind tests are also necessary to improve our investigations, and we have, therefore, asked the manufacturer for placebos.

PARAGERM AK is acaricidal but is not ovicidal. As the pyroglyphid mites only copulate once or twice in their lifetime, carefully spaced out sprayings should be sufficient to kill the larvae that might hatch. The rhythm of spraying must be determined to avoid any new invasion. It is highly likely that several sessions a year will be needed, more especially in autumn because of the mites usual proliferation at that period of the year.

With the MCR device, the PARAGERM particles vary between 5 and 8 μ . Those obtained with spray bombs have a bigger size of about 10–20 μ . This limits their entry into the respiratory tract of exposed subjects. Patients are not inconvenienced by the non-toxic PARAGERM sprays, as shown by measuring their bronchial resistance before and after exposure to an atmosphere containing the product at effective doses.

The demonstration of the acaricidal properties of PARAGERM AK leads the way to new possibilities of destruction of the house dust pyroglyphid mites.

Acknowledgments

This work was carried out with the assistance of INSERM, 3 rue Léon Bonnat, 75016 Paris.

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