Study on the Impact of Different Temperatures, Humidity and Drought on the Success Level of the Hatching of Stored Mites (*Suidasia nesbetti*)

Nada.O. Edrees

Department of Biology – Zoology- Faculty of science, King Abdulaziz University– Jeddah- Saudi arabia
nedrees@kau.edu.sa; nada.algalb@hotmail.com

Abstract: Eggs hatching of stored mites(*Suidasia nesbetti*) were investigated after exposing them to different temperatures ranging between(-70, +70) in different relative humidity rates (dry, wet heat, direct sunlight).The exposure time took place over seven phases ranging between half an hour to five hours, they were exposed to freezing temperatures using deep freezer which was set it different temperatures(-10, -20, -40, -70).fifty eggs were placed on the slide prepared for testing in each phase of exposure to certain temperature. After treatment, all experimental groups were kept on an open work bench for 15 days of observation at ambient room temperature (ca. 28^0C) and ca. 75% relative humidity. Thirty eggs were placed as control samples in were kept in an incubator with condition similar to room temperature and natural relative humidity (25 C relative humidity 75%) Five replicates were used from each group, the egg is considered to have been hatched if a larva is observed to come out from the craciceal shell regardless of the time of survival after hatching. Results indicated that at 40^0C for both dry and wet heat, approximately 80% of all eggs survived. At direct sunlight and dry heat at 50^0C, the thermal death point (TDP) occurred at 3 and 5 h, respectively. At 60 and 70 C both wet and dry heat, TDP occurred almost instantaneously. Under cold conditions, only the deep freezer at -70 ^{0}C was effective in preventing hatching. It may be concluded that exposure to direct sunlight for 3 h, dry/wet heat of 60 and 70^0C for a minimum of 30 min, and -70^0C prevent egg hatching.

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1. Introduction:

It is recorded that about ten species of mites of the family Pyroglyphidae occur in house dust (Platts-Mills *et al*., 1992). In addition, other species such as storage mites (*S. nesbetti* , Acarussiro and *Tyrophagusputres centiae*) can found in houses and become the predominant population (Edrees, 2006). House dust is the main cause of many different allergens, but mites is considered the major allergen. Tovey *et al*., 1981 and Arlian *et al*.,1987 reported that mite bodies and mite feces are considered the main the sources of many allergens. Mite's digestive tract excrete enzymes in the faeces that causes allergic conditions .Also enzymes resulting from molting process (mites change from one life stage to the next) can cause allergy.

Mite saliva contain some components which responsible for inducing some allergens ,that is left in the environment on food substrates where mites feed. Mahakittikun, 2001, reported that the supracoxal glands secretions which are responsible for the active uptake of water contain also proteins, as well as sodium and potassium chloride. Disintegration of dead bodies liberates soluble protein from body fluids, some of these proteins can be induce allergic conditions. The allergic conditions which results from most species of synanthropicmites can induce sever harmeful symptoms such as allergic rhinitis, bronchial asthma and conjunctivitis (1-3). Many authors (Voorhorst, 1969; Arlian, 1989;) reported that the most important source of allergen in the house dust are mites [*Dermatophagoide spteronyssinus* (Trouessart) and *D. farinae* (Hughes)]. while in stores and mills there are another mite which names 'storage mite (Hughes, 1976; Arlian,1990) are causing occupational allergies (Spieksma, 1990; Stejskal and Hubert, 2008). Recently, this classification has been changed due to clinical finding of the allergenic importance of some 'storage mites' in households e.g Caplin, 2009 found that *Tyrophagusputres centiae* and *Suidasia nesbetti* occurred in mixed populations with Dermatophagoides spp. in house dust . Close association between mites with human households (in Carpets, beds and chairs) increase the difficulty of allergen control. Relative humidity (RH) play an important role for disseminating of infection and control the level of spread of mites in the house. Therefore, maintaining Relative humidity below 50% is important for reducing dust mites and their allergen levels mite. The mites are sensitive for the humidity , so the mites require sufficient water from the air to survive. Practically , Arlian *et al*., 2001 found that adult mites die of dehydration within 5 to 11 days, according to the ambient temperature (25°C-34°C).

May methods were applied recently for reducing the high humidity in houses through using of high-efficiency dehumidifiers and air conditioners and it was effective for reducing the humidity from surrounding air and thereafter the rate of mites spreading in the

place. Ouhelli and Pandey, 1984, reported that, to reduce or even eradicate the level of spreading of dust mites and allergen in the house must maintain the relative humidity in the temperate climate below 50% RH. The same authors reported that to prevent the dust mites from multiplication and spread to the surrounding can be achieved by maintaining RH at/or less than 35% for at least 22 hrs per day (when daily RH is around 75 - 85% for the remainder of the day).

The life cycle of *S.nesbetti* and *Suidasia medanensis* (= *pontifica*) was studied under laboratory conditions at 26°C and 86% relative humidity. Freshly laid eggs were observed until they developed into adults and the periods between stages were recorded. Production of eggs by mated females was monitored until they died. The eggs required an average of 12.6 ± 0.6 days to develop into adults. Mean longevity of mated females and males was similar (48.6 ± 13 and 49.1 ± 20 days, respectively), The conditions used for *in vitro* culture of *S. medanensis* is considered optimal for this study (Mercado *et al*, 2001).

The growth and Development of Dermatophagoides (Dp) is depend upon the environmental temperature, even the relative humidity less than the critical lower level, desiccation will ensue. The length of life cycle of Dp increases and averaged 122 days, when the RH is adjusted at 75%, at the temperature at 16 ^{0}C, whereas the life cycle duration decrease to 15 days when the temp. at 35 ^{0}C.(Arlian *et al*. 1990). Otherwise, Pike *et al*. 2005 found that Dp mites when were reared under constant temperatures (18 - 25 ^{0}C) but at dry conditions), fluctuating RH (38 - 60,) , at damp conditions (55 and 70%) or at optimal conditions (75% RH), all mites in the desiccated environment died in an interval of 18 days , while the survival and growth of mites reared under wet environment not varied significantly than reared under controlled optimal conditions .Accordingly , the capability of mites for adaptation under different relative humidity levels are a pointer for phenotypic plasticity of mites . Some researchers (Hawes *et al*., 2007) described that the dropping of the lethal temperature, associated with rapid induction is considered one of the most rapid cold acclimatization in Antarctic mite *(Halozetesbelgicae)*, the reared at 10^{0}C after 2 hrs of acclimation to 0 C a.

Mahakittikun, 2001 found that exposing of adult Dp mites , nymph and larval stages to wet cold air at -30 ^{0}C for 10 min was an effective for eradication, whereas 80% of eggs exposed to 35 min failed to hatch. While, it was found that exposing for 4 and 5 minutes to dry cold condition (-30 ^{0}C) ,the mortality rate averaged between 40 and 100% of all stages of Dp, respectively; whereas, exposing of Dp eggs for 1 minute is sufficient for hindering of eggs hatchability .

The influence of temperature on mite eggs was studied by Colloff (1986), he found that Dp eggs incubated at 55 and 100% relative humidity and at a temperature of 10 and 35 ^{0}C , all eggs were hatched. In the same study, When the rearing condition (dry temperature was between 10 - 20 and 30 - 35 ^{0}C and the relative humidity was less than 65%, the Dp eggs were susceptible to mortality, it was 79% lower than that reared under normal condition . In another trial (Mahakittikun *et al*. ,2001) exposed life mites for higher temperature (50 ^{0}C) for 20 minutes and a low humidity, he found that all mites were killed .

The aim of this study:

This study aims to identify the effect of temperature, taking into account the differences in humidity degree of stored mites *S.nesbetti*, particularly which is observed it prevalence frequently in dust samples taken from many houses in Jeddah city,located on the west coast of Saudi Arabia, which is characterized of high moisture, that forms a key factor for increasing this pest inside houses, and to determine the degree of temperature needed to prevent egg mites from hatching either by the application or removal of heat at different intervals of time.

2. Material and methods:

(according to Mahakittikun *et al*.,2011**)**

Mite eggs:

In this experiment, *S.nesbetti* eggs were used, the eggs were examined under stereomicroscope with suitable magnification power. The selection of eggs not based on the age . A total of 30 eggs were selected individually from laboratory cultures according to the techniques described by Mahakittikun *et al*.,2011 . Sets of three slides were treated in five separate sets of experiments in which they exposed to variable conditions of (dry or wet heat, direct sun light, cold environments) that varied in intensity and duration of treatment. The control experiment 30 eggs were put in a slide in triplicate .

Treatment conditions:

The control status for each of the temperature variations were identical .The incubator used was adjusted at 28^{0}C and 75% relative humidity (RH), similar to room temperature in Saudi's room equipped with air conditioning. Dry Heat were obtained from an incubator producing hot air , and exposed to the light of sun directly for all groups for 0.5, 1, 1.5, 2, 3, 4 and 5 hrs. while in case of dry heat an average temperatures was 40, 50,60, and 70 ^{0}C, measured at the beginning and at end of each experiment . The duration of observation time is more than the 6 days which needed for hatching of eggs under optimal condition. When the eggs are hatched , the duplicated tape hindered the larvae from passing via the adhesive anchor. The experimental conditions were stable along the

observation time(15 days) post treatment which adjusted at 22 ^{0}C and 75% RH. at room temperature (Mahakittikun *et al*, 2001)

Statistical analysis:

Duncan test according to Edrees,2006

3. Results

Findings revealed, in the process of dry and wet heat at 40˚c, that 80% of the eggs survived. the thermal death point (TDP) occurs, in the process of direct sun light and drought at 50^{0}C,while exposure to three and five hours, respectively, when using moist heat at 60˚c, 70˚cthethermaldeathpointoccurredofteninstantaneously. It was observed in conditions of cold, even freezing in the deep freezer, that temperature-70˚c, was the only effective degree to prevent the hatching process, and as a result, it may be useful to expose quilts, carpets, children's toys and others similar things which may be swept by houses dust mites, to one of the following; direct sunlight for three hours, dry or wet heat at 60˚c, 70˚c at least for 30 minutes, and drying at -70˚c to prevent the hatching of eggs as another way to eliminate the spread of mites.

Probationary periods for each test:

First: Dry heat in an incubator and direct sunlight

Times of dry heat 0.5, 1.5, 2, 3,4, and 5 average temperatures 50, 40, 60, 70˚c, as for samples processed by direct sunlight, they were exposed to heat by placing them in a table close to a window from which sunlight comes starting at six o'clock in the morning of Jeddah timing in summer season as the sun rises of high heat the early morning, and for the same periods specified above, the temperature of this time ranged between 36, 37, 38, 39, 41, 42, 45. For each of the corresponding time interval, that was verified at the startement and end of contact to sunlight.

Second: humid heat in hot water

Temperatures and periods of time were matched to those of the dry heat condition, in return to provide consistent and constant in wet heat temperature, an amount of 250 ml of water in a beaker was exposed to heat in hot air oven according to the design of each experiment, mite`s eggs were fixed on glass slides. Drooped from the rim was dipped for the designed period (excluding the the short time during opening of oven door) which differ slightly than the target temperature. In an experiment, 30 eggs/slide was located in each of three beakers for designed temperature and potential condition.

Third: Cold condition

The duration of exposure to cold environment was similar to the seven periods as demonstrated before.

Findings:

1- Findings revealed significant differences when comparing eggs hatching after direct contact to sunlight and the four thermal variables of dry heat and control samples, except the samples exposed to temperatures ranged between 60-70 ^{0}c which didn't hatch.

2- Egg hatching exposed to 40˚c of range between (76-92%) in the periods from 30 minutes to five hours respectively.

3- No egg is survived at 70 ^{0}c.

4- Eggs exposed to direct sunlight: Revealed reduction at the rate of hatching from 39% at 31c for an hour to 14% at 30c for two hours, while the rate of TPD increased after 3, 4, 5 hours at 32, 35, 38 respectively, 499 eggs of 450 eggs were damaged by desiccation.

5- Control samples, of samples revealed hatching rate of 98% while the eggs exposed to dry heat conditions revealed hatching rate of 90%.

6- Wet experiments :Egg hatching

It was similar to those which were exposed to dry heat conditions, it was observed that TDP at 70, 60˚, five eggs of 360 egg (0.8%) hatched at the period between 30 to 1.5 minutes at 60 ^{o}c at bath, a zero survived rate 0.0% of immersion was recorded, after 50c in a bath, little number of eggs hatched as time progressed, the process at 40c˚ achieved the large number for survivors which extended to 80% upon the period of 30 minutes, and to 77% upon the period 5 hours (range of 80 higher than the seven periods).The various comparison in the curve revealed significant differences except between 60-70c, as control sample for heat revealed hatching rate of 93.3%

Table 1. Exposed to drought and temperature

Time	Number of not hatch eggs†			
(h)	Temperatures			
	40ºC	50ºC	60ºC	70ºC
0.5	43.00 ±2.08^{*a}	43.00 ±3.79^{*a}	18.00 ±1.53^{*a}	8.00 ±2.00^{*a}
1.0	41.00 ±1.16^{*ab}	41.00 ±2.08^{*a}	14.00 ±1.16^{*b}	6.00 ±1.73^{*b}
1.5	40.00 ±0.58^{*b}	32.00 ±2.31^{*b}	10.00 ±1.16^{*c}	1.00 ±0.58^{*c}
2	32.00 ±1.53^{*c}	24.00 ±1.00^{*c}	3.00d±1.16*	0.00 ±.00^{*c}
3	26.00 ±1.53^{*d}	19.00 ±2.31^{*d}	1.00 ±0.58^{*de}	0.00 ±0.00^{*c}
4	24.00 ±1.53^{*e}	8.00 ±1.53^{*e}	0.00 ±0.00^{*e}	0.00 ±0.00^{*c}
5	22.00 ±1.16^{*e}	4.00 ±1.00^{*f}	0.00 ±0.00^{*e}	0.00 ±0.00^{*c}

† Control: 28.00±1.00 * Significant at 0.05 level compared with control.

Duncan test: the same letter in each column is not significant but different letters are significant to each other.

Table 2. Exposed to sun with elevated temperature degrees

Time	Number of not hatch eggs†			
(h)	Temperatures			
	33ºC	37ºC	40ºC	50ºC
0.5	57.00 ±1.15^{*a}	51.00 ±1.16^{*a}	41.00 ±1.16^{*a}	32.00 ±1.16^{*a}
1.0	51.00 ±0.58^{*b}	47.00 ±1.73^{*b}	38.00 ±1.16^{*b}	29.00±0.58^{b}
1.5	48.00 ±1.16^{*c}	44.00 ±2.52^{*c}	37.00 ±1.73^{*b}	26.00±1.53^{c}
2	45.00 ±0.00^{*d}	41.00 ±1.73^{*c}	34.00 ±1.16^{*c}	24.00 ±1.53^{*d}
3	42.00 ±0.00^{*e}	37.00 ±2.08^{*d}	30.00±2.00^{d}	22.00 ±1.53^{*de}
4	39.00 ±1.73^{*f}	34.00 ±1.00^{*e}	26.00 ±0.58^{*e}	21.00 ±1.16^{*ef}
5	37.00 ±1.16^{*g}	32.00 ±1.53^{*e}	20.00 ±1.00^{*f}	19.00 ±1.16^{*f}

† Control: 28.00±1.00 * Significant at 0.05 level compared with control.
Duncan test: the same letter in each column is not significant but different letters are significant to each other.

Table 3. Elevated temperatures with humidity

Time	Number of not hatch eggs†			
(h)	Temperatures			
	40ºC	50ºC	60ºC	70ºC
0.5	62.00 ±1.00*a	52.00±3.06*	24.00 ±1.00^{*a}	2.00 ±1.53^{*a}
1.0	54.00 ±1.53^{*b}	48.00 ±1.73^{*a}	17.00 ±1.16^{*b}	1.00 ±0.58*^{ab}
1.5	43.00 ±2.08^{*c}	39.00 ±1.16^{*b}	14.00 ±3.06^{*c}	1.00 ±0.00^{*bc}
2	39.00 ±2.08^{*d}	33.00 ±1.53^{*c}	9.00 ±0.58^{*d}	0.00 ±0.00^{*c}
3	34.00 ±2.08^{*e}	30.00±1.00^{d}	4.00 ±2.00^{*e}	0.00 ±0.00^{*c}
4	29.00±1.53^{f}	26.00±2.52^{d}	1.00 ±1.16^{*f}	0.00 ±0.00^{*c}
5	26.00±2.08^{f}	13.00 ±2.52^{*e}	0.00 ±0.00^{*f}	0.00 ±0.00^{*c}

† Control: 28.00±1.00 * Significant at 0.05 level compared with control.
Duncan test: the same letter in each column is not significant but different letters are significant to each other.

Table 4. Low temperatures

Time	Number of not hatch eggs†			
(h)	Temperatures			
	4ºC	-20ºC	-40ºC	-70ºC
0.5	98.00 ±1.00^{*a}	94.00 ±1.53^{*a}	90.00 ±0.58^{*a}	4.00 ±1.53^{*a}
1.0	97.00 ±0.58^{*b}	93.00 ±1.16^{*ab}	88.00 ±0.00^{*ab}	4.00 ±1.16^{*a}
1.5	95.00 ±0.00^{*c}	92.00 ±0.58^{*abc}	86.00 ±1.16^{*bc}	2.00 ±0.58^{*b}
2	94.00d±0.00^{*c}	91.00 ±0.00^{*bc}	86.00 ±1.53^{*bc}	1.00 ±1.00^{*bc}
3	93.00 ±0.58^{*de}	90.00 ±0.00^{*c}	84.00 ±1.53^{*c}	0.00 ±0.00^{*c}
4	93.00 ±0.58^{*de}	85.00 ±1.53^{*d}	71.00 ±2.00^{*d}	0.00 ±0.00^{*c}
5	92.00 ±.58^{*e}	82.00 ±2.00^{*e}	69.00 ±1.73^{*d}	0.00 ±0.00^{*c}

† Control: 28.00±1.00; * Significant at 0.05 level compared with control.
Duncan test: the same letter in each column is not significant but different letters are significant to each other.

7- **In cold process:**

The eggs hatched in all conditions, in contrast, control samples revealed highly significant differences: (A) at 40C hatching rate was 92%. (B) At-10C hatching rate was 92.2%.(C) At-20˚C hatching rate was 90.6%. (D) Control samples revealed hatching rate of 93.3%. (E) The more consistent declines in seven the periods were at -40C.(F) While-20 ^{0}C revealed a low reduction in hatchability only after the fourth and fifth exposure to cold. (G) A few number of eggs survived at-70˚C.

4. Discussion:

The results reported here demonstrated that temperature and relative humidity are the domineering environmental conditions on the survival rates of eggs at different stages . Similar observations were recorded on *Rhipicephalusappendiculatus* (Brangan, 1973; Tukahirwa, 1976), *Amblyommaamericanum* (Riek, 1957) *Hyalommalusitanicum* OCH (Platts – Mills, 1990) *Hylommadormederaii* (Koch,1981). The mortality rate in different developmental stages were increased rabidly at 45◦C and decreased in the RH, which might indicate that all stages are not capable of

active water vapor uptake from the surrounding at low RH (Arlian, 1975; Ouhelli, and Pandy, 1984). In case of the environments containing water vapor less than the critical equilibrium activity CEA, more water is transpired than absorbed from the atmosphere and thus dehydration occur. The results revealed that the increase in the temperature was associated with increase in the dehydration rate (Kahl, and Knulle, 1988). Following exposure to increased dehydration the mortality (hatchling) rate increased in response to an increased temperature and decreasing of humidity (Brandt and Arlian, 1976). A similar trend was found with increasing temperature when exposed to the same dehydrating conditions. Breeding activity is decreased after raining season specially during November. The obtained results in the present work revealed to similarity in the physiological patterns of these species when exposed to the same stressors or environmental conditions either in the mortality or survival rates. The recorded data revealed that long exposure of the instars to constant temperatures affect slightly on the length and duration of life cycle , while at higher temperatures (40,45◦C) the growth or developmental changes of immature stages are affected greatly or even stopped. This results coordinate with finding from the previous study on *S.americaum* (Koch, and Tuck, 1986). Unlike other observations on *A. americaunm* (Koch and Mount, 1980; Ouhelli, and Pandey, 1984).

It is obvious from the present work that the relative humidity play an important role on the life and development of immature stages of eggs and instars as shown in table (3), the effect of RH on the development represented in high in mortality rate (low in survivability) associated with decreasing of the relative humidity. The mature and immature stages are also affected and it was unable to moult or survive at low relative humidity and higher temperatures.

Many investigators found a strong relationship between the prevalence of house dust mites in homes and the percentage of relative humidity in doors. The RH affect on the development and feeding rate of mites (Arlian, 1989;Custovic *et al*, 1995).Also, Edrees (2006) mentioned the importance of outdoor humidity. The data show that house dust mites are especially abundant in houses with high relative humidity. Some other at different countries (Daniel *et al*., 1981; Edrees, 2006) stated that there are positive relationship existed between theincrease in the numbers of house dust mites and elevation in the relative humidity, that were no Dermatophagoides in very high temperature up to 45°C, and humidity lower than 40 %RH (Daniel *et al*, 1981; Edrees, 2009 a,b). As observed in this study, the durability of eggs for severe disparity in temperatures, which indicates the extent of the power of endurance and the ability to continue in extreme conditions compared to the other phases in other earlier studies (Edrees 2009 a,b). The observations of Ordman (1971) in South Africa and of Gitoho and Rees (1971) in Kenya, they confirmed the importance of humidity on prevalence of mites. Gitoho and Rees recorded a high number of *D. pteronyssinus* in mattress dust in Nairobi, despite the altitude of 1650 m above the sea level. The results indicated that prevalence and proliferation of mites not depends mainly on the altitude but on environmental conditions (Spieksma *et al*.,1971, Custovic, *et al*.,1995; Mumcuoglu*et al*.,2003;Edrees, 2009a). Other environmental factors such as the type and locations of dwelling affect the prevalence of mites , this finding are in agreement with Edrees (2006). Central and Northern areas of USA are characterized by a prolonged dry period during winter season, which are considered unsuitable condition of mite`s survival, but the modern technology introduction specially application of modern energy efficient housing with external and roof insulation and reduced ventilation, leads to elevation in indoor humidity which facilitate the growth and development of mites during all seasons of year (Wickman, 1991; Platts – Mills,1990, 2000).

The previous studies stated that the mites can survive under stress conditions(relative humidity <50%) for many days if a suitable environment even for a short time in the day are available (Arlian *et al*.,1999;Edrees,2009).

*D. farinae*and *D.pteronyssinus* are more prevalent in humid climates, but absent in drier climate (Brug*et al*., 2007). The (CEA) of adult females of *D.farinae* and *D.pteronyssinus* was found to be 70% and 73%RH , respectively (Robert *et al*.,1976). Fasting standardized mite are capable of surviving by maintaining a water balance, that is gain is equal to the loss of water in an environments containing water vapor at or above the indicated CEA,. When the water vapor in the environments was below the CEA, more water is transpired than absorbed from the atmosphere and thus dehydration occur. The increase in the rate of dehydration mainly due to elevation in the temperature surrounding . *D. pteronyssinus* and *D.farinae* when exposed to dehydrating condition (as seen in tables 1,2) the mortality rate are increased as a normal response to elevation in the temperature and decreasing in the relative humidity . A similar trend was found in another study carried by Voorhorst *et al*.,1969 ,that increasing temperature and dehydrating condition was associated with increasing in the mortality rates.. *D. farinae* in the last 48 hours have a slight survival comparing to the males of *D.pteronyssinus* With respect to inter specific relationship between the recorded dust mites species which revealed that a significant negative correlation between the hatchling eggs generally in this study

In temperate countries, whoever, a cost practical way to remove mites their facial matter and products is to resort to sunning the bedding and carpets to kill

living mites (Nadchatram, 2005). House dust mite population may be decreased by maintaining dehydrating ambient conditions (Zheltikova *et al*., 2007). For instant, short-term exposure to low RH and high temperature, or long term exposure to low RH only will decrease mites populations (Edrees, 2006). The elevation in both temperature and humidity in the modern houses enhance the prevalence of dust mite (Wright *et al*.,2009). Since the control of temperature and humidity nowadays can be controlled by application of modern instruments/engines in doors. The influence analysis of specific relative humidity and temperatures characteristics on the limit of the prevalence of mite will shed light on the established of mite control strategy and draw the suitable and available design for mite eradication and control.

In the present work, the incubated eggs were bred in the lab. under control conditions of heat and relative humidity. After that the eggs were put under the light of sun directly, different low temperatures , and also for humidified and dry temperature. Generally, all effectors in these experiments had a deleterious action on mite`s egg viability . In earlier study, Tovey and Woolcock (1994), reported that, the mortality rate was 100% when the wool carpets containing eggs and or live mites are exposed to direct sunlight for at least 6 hrs ,at 55 ^{0}C and 24%RH. In addition, not hatchability of cultured eggs collected from the carpet's fine dust , cultured for 4 weeks .Therefore, exposing of mite`s eggs to sunlight for at least 3 hrs is considered lethal for eggs of mites, but after 5hrs of exposure to direct sunlight it was lethal for both viable mites and or eggs.

In the current investigation, exposure of mites eggs to direct sun light for three hours ,the average TDP was 32 ^{0}C outdoor temperature . The obtained results may be attributed to the type mattresses used (8 cm in thickness) which hold eggs of mites which exposed to direct sunlight for at least 3 hours or longer time. In case of live mites , TDP differ according to the species and raring condition; for an instant *Humerobatesrostrolamellatus* one of oribatid species, exhibited lethal temperature at 44 ^{0}C, while *Hypochthoniusrufulus* an another species can exhibit temperature at 29^{0}C. Mahakittikun (2011) reported that when *Sarcoptes scabiei* was exposed for 10 minutes ,the TDP was 49 ^{0}C ., whereas, TDP recorded was 47.5 ^{0}C when exposure was 30 min.

The experiments which carried out to study the impact of dry heat on egg hatchability, the results suggesting that the dry temperature must be above 60 ^{0}C with a duration of 30 min to be effect as lethal for mites eggs . (less practical, for not less than 5 hrs at 50 ^{0}C). Using of electric dresses dryers is considered an effective in eradication of live mites and/or their eggs or their allergens in the cloths , because the electric dryers are considered a suitable source of dry heat . Exposing blankets containing Dp in a tumble dryers for 10 minutes at 105 ^{0}C ,it found that its lethal for Dp.(Miller and Miller, 1996). The lethal effect may be returned to drowning. In Australia, McDonald and Tovey, 1992, found that after 10 minutes in water containing detergents at 55°C and 50°c, 100 ^{0}C , the mortality rate was 47% which is in agreement with the results of studies carried out at Saudi Arabia by Edrees (2013) in the use of detergents traded in Saudi Arabia. Another study was carried out to estimate the lethal temperature for mites in four electric dryers , 175 0C is sufficient to eradicate and lethal for mites and or their eggs (Mahakittikun *et al*., 2011). In addition, cleaning with dry steam (vapor) followed by vacuuming was efficient in eradicating and lethal killing for mites and or eggs or their allergens from wool carpets (Colloff *et al*., 1995).The similar results were recorded by Vojta *et al*.(2001), they found that vapor cleaning and vacuuming was sufficient for reduction in the concentration of dust mite allergens in upholstered furniture as compared with pre-intervention loads. Generally, dry (vapor) cleaners adjusted to 160 ^{0}C at 100 and 250 PSI pressure (Mahakittikun,2011), otherwise, when the hot water changed to vapor under heating and passed via narrow opening , and suddenly dropped to 100 ^{0}C which is sufficient to be lethal for mites and/or eggs, on the fabric surface.

The vapor cleaning from practical point of view ,it effective partially due to its limited capability for penetrating deeply in the fabrics ,carpets to kill the mature mites and their eggs inside the fabrics. Whereas, McDonald and Tovey, 1992, found that the wet heat (50 ^{0}C) was effective to eradicate the mites and or eggs from beds when the washing temperature was at 50 ^{0}C .

The data in table 4 (Table4) which carried at cold environment, indicate that the hatching rate averaged 3.3% when freeze at -70 ^{0}C over the seven trials . The hatching rate was increased with decreasing the degree of freezing , it recorded 58.4% hatching rate when preserved at -40 ^{0}C in the deep freezer , They supposing that, in the houses , it is essential to retaining egg-laden soft toys at low temperatures (in a freezer) for at least 5 hrs is practically sufficient for killing the eggs. The low temperatures higher than -40 ^{0}C were not operative in eradicating /killing mite eggs. Colloff (1986)reported that exposing of dust-treated mattresses to very low temperature medium such as liquid nitrogen (-196 ^{0}C) followed by vacuum cleaning, it highly reduced the numbers of live mites. In case of hospitals and medicinal services , beds and carpets of patients complaining from asthma , the use of liquid nitrogen(LN) was effective efficiently for reducing mite population after exposing for 8-weeks period in addition to improving in some signs in case of

wheezing and peak expiratory flow rates (Dorward *et al*.,1988).

Conclusion:

This study indicates the ability of these mites to survive in high temperature conditions in ovulatory phase, these are the prevailing conditions on the climate of kingdom of Saudi Arabia throughout the year, the matter that makes houses suitable ware houses for continuous existence and reproduction of this pestover the year, especially if appropriate humidity provided for it through using modern means of all eviation, some of which were mentioned in this study and their effectiveness was proved in previous studies in providing the required humidity for their growth and reproduction.

It is observed in this study, that the extent to which eggs can bear excess temperature ranged between very low and very high, which indicates the strength of endurance in biological formation and the ability to survive in extreme conditions compared to other phases.

Recommendations:

This study Consistent with suggestions that recommends that retaining elastic toys and small objects like pads and clothing in a freezer at low temperature(-70 ^{0}C) for 24 hrs is sufficient for eradicating of live mites. In addition, Chang *et al*. (2011) found that about the numbers of live mites reduced to 95.1% when placed in freezing apparatus overnight. It is observed in this study, that the extent to which eggs can bear excess temperature ranged between very low and very high, which indicates the strength of endurance in biological formation and the ability to survive in extreme conditions compared to other phases.

Conclusion:

This study indicates the ability of these mites to survive in high temperature conditions in egg phase, these are the prevailing conditions on the climate of kingdom of Saudi Arabia throughout the year, the matter that makes houses suitable ware houses for continuous existence and reproduction of this pest over the year, especially if appropriate humidity provided for it through using modern means of alleviation, some of which were mentioned in this study and their effectiveness was proved in previous studies in providing the required humidity for their growth and reproduction.

Recommendations:

Use of the direct heat of the sun available in Saudi Arabia climate throughout the year almost on a regular way for specific hours in reducing the prevalence of mites inside the homes, in the other hand, the use of deep freezer is very useful in addressing house dust mites infestations.

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