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Occupancy of house dust mites (HDMs) at different niche of homes and their associate causative factors

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ABSTRACT

People carry out various type of activities in their day today life at homes. Among these activities, cleaning is the most essential activity. Cleaning involves various types of activities like dusting, sweeping, moping, washing etc. All these activities devote a lot of time to do in a proper way but when the homemaker lacks in doing these activities properly, the dust accumulates and it makes productive environment for HDMs. HDMs are abundant in settled household dust. They may be the most common trigger of year-round allergies and asthma. They are found almost every all over the world. Various causative factors are responsible for the growth of HDMs. Some of the most affecting factors are: type of family (Nuclear and joint), per person occupancy area in house (Sq. feet), humidity in summers and winters and time spent in cleaning different rooms (min/day). House is the place where people live and These dust particles contain minute (microscopic) organisms called 'house dust mites' which are a serious common indoor pollutant. HDMs due to their very small size (250 to 300 microns in length) and translucent bodies are not visible to the naked eyes (Layon, 2004). Mites living in house dust fall under the classification of acari. They are found in high densities where there is more humidity, low light intensity, high air flow rate, improper ventilation, unhygienic or faulty cleaning practices, improper waste disposal, overcrowding, increased gadgets, poor housing conditions, pets etc. Unlike some other kind of mites, house dust mites are not parasites living on plants, animals and humans. House dust mites primarily live on dead skin cells, commonly called dander, which are shed regularly by humans and their animal pets (Barbogg, 2003).

INTRODUCTION

A number of species of house dust mites have been found throughout the world. Dermatophagoides farinae and Dermatophagoides pteronyrsinus are the two most common species that are found in house dust samples of India (Lakhmi and Haq, 1999). Estimates are that dust mites may be a factor in 50 to 80 per cent asthmatics. Studies have stated that almost 30 per cent of the world's population displays allergic symptoms triggered by dust; and over 80 per cent of all asthmatics react badly to dust (Modak and Saha, 2002; Zock *et al.*,2002 and Bharadwaj, 2008).

Many research studies reported a strong association

Fig. 1 : Microscopic (10x) view of house dust mite

between house dust mite exposure and asthma symptoms. In centres where the indoor house dust mite exposure was also high, the prevalence of asthma was also higher. House dust mites are the major cause of year round complaints of stuffy nose, sneezing and watery eyes what some people describe as a 'permanent cold'. However, there are reports of red rashes around the neck. Other allergic reactions may include headaches, fatigue and depression (Arlian *et al*., 2002 and Bharadwaj, 2008).

Data were collected in the months of summer (rainy) and winter season. Data collection started in the month of November 2007 to September 2009. The study was conducted in three phases in the city of Udaipur. In the first phase, a survey was conducted on the sample of 120 households which were selected purposively. Information was gathered regarding their family background, cleaning pattern and health problems faced by the respondents. Settled house dust samples were also collected from four different rooms of the households *viz.*, living, dining, bed room and kitchen. Two grams of settled dust was collected through vacuum cleaner from carpet, sofa, TV cabinets and curtains, below bed, bed surface, below and above the almirah, floor area below furniture, kitchen cabinets, sink and refrigerator. After collecting the settle dust samples, HDMs were counted under binocular microscope in the laboratory. On the basis of mean ±SD of house dust mites', households were divided into three categories as low (L), moderate (M) and high (H). In the second phase, 3 households with high concentration of HDMs were selected from the sample irrespective of associated factors and treated with chosen 8 different local plant product components *viz.*, *Sahjan*, *Satyanashi*, *Dhatuta*, custard apple, castor, *Timru*, *Babool* and *Mahandi* at different levels of concentration (3, 5, 7%) to test its efficacy on HDMs mortality rate. The three most effective plant product components were selected for field experiments in laboratory. The procedure for making partially purified plant product component given by Sharma and Simlot (1971) was followed. In the third phase, three most effective plant product components (at 5% level) were applied in different areas of 30 households', that is,10 households for each plant product component. Plant product components were sprayed in living, dining, bedroom and kitchen area furnishings, furniture, flooring, drawers and cabinets of the respondents' houses. The rooms were kept closed for four hours so that the efficacy of the PPC may not lessen and it will be more effective on HDMs. Dust samples were collected from different areas of these rooms on 1st, 15th and 28th day with a portable handy vacuum cleaner.

The associations of various causable factors of HDMs were found in relation of households, housing, climatic factors and cleaning conditions in indoors. Data was categorized into three different zones that were residential (RZ), commercial (CZ) and industrial zone (IZ). The main associated factors that found in relation to HDMs were as follows:

Type of family:

Human being is a social animal who live in a family with other family members. Perusal of data in Fig. 2 clearly depicts that 60.83 per cent of the respondents belonged to joint families and rest of them (39.17%) to nuclear families. Inter zonal comparison showed that most of the respondents belonged to joint families in CZ (80%) as compared to RZ (47.5%) and IZ (55%). Majority of high HDM category CZ respondents belonged to joint families. Commercial zone is a centre of the city. All the infrastructural facilities of daily life like market, banks, hospitals, schools etc. are very close to this zone. Due to commercial market and business as the main occupation, respondents prefer to live in this zone in their old houses with joint families.

The household activities of joint family members may affect the dust settlement in indoors which serve as good base for the occurrence of HDMs (Hoeven *et al.*, 1992).

Per person occupancy area:

Per person occupancy area determines the growth

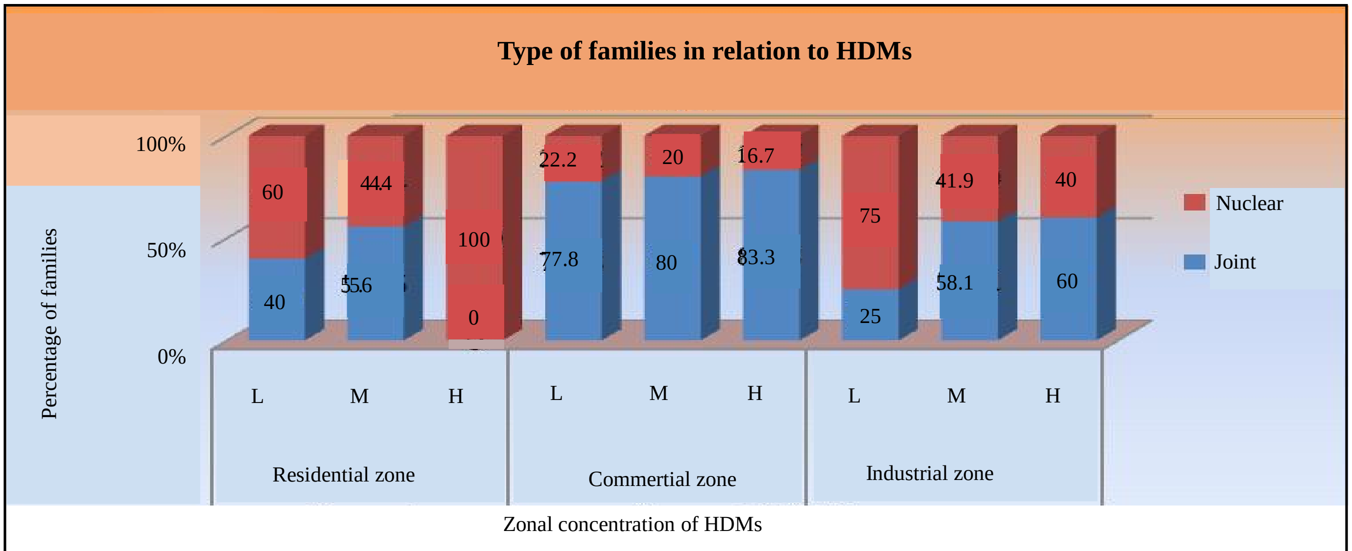


Fig. 2 : Type of families and house dust mites, (L) low, (M) moderate, (H) high

of micro-organism. In congested houses where per person occupancy is very low leads to less air circulation. This causes dust accumulation leading to HDMs problems (Rae *et al*., 2002 and Bency *et al*., 2003). The per person occupancy area determined crowdedness in the house. The overall occupancy per person area of respondents house was 233.55 sq feet (SD=46.98). Not much variation was found in per person occupancy area of IZ (237.47 sq feet) and RZ (233.96 sq feet) respondents' house. Though, per person occupancy area of respondents' house in CZ (229.21 sq feet) was lower. Respondents of IZ belonging to moderate HDM category had lower per person occupancy area of house (234.93 sq feet), whereas in CZ, respondents belonging to high HDM category had lower per person occupancy area (145.17 sq feet) in house. Higher per person occupancy area in houses of IZ and RZ was due to more constructed area as well as small family size. This may be because some of the respondents in IZ were residing in big houses allotted by companies. Apart from this RZ houses were also open

Table 1: Average distribution of respondents according to per person occupancy area in house (Sq. feet) (n=120)

Sr. No.	Per person room occupancy (in sq feet)	RZ				CZ				IZ				Overall
		L n=10	M n=27	H n=3	Total n=40	L n=9	M n=25	H n=6	Total n=40	L n=4	M n=31	H n=5	Total n=40	
1.	**Living room**													
	Mean	24.20	25.98	16.00	24.79	33.17	31.56	37.80	32.86	13.44	22.63	22.96	21.75	26.46
	S.D.	6.28	7.42	0.00	7.27	4.37	6.77	8.44	6.79	5.87	9.31	12.86	9.70	9.24
2.	**Dining room**													
	Mean	44.82	49.49	10.50	45.40	29.06	28.86	30.69	29.18	47.50	40.35	46.86	41.88	38.82
	S.D.	28.37	26.19	23.00	27.36	3.04	4.25	4.30	3.97	17.00	25.36	31.65	25.06	22.48
3.	**Bedroom**													
	Mean	48.53	43.70	26.67	43.63	38.88	57.28	63.33	54.50	50.00	52.93	63.00	53.90	50.52
	S.D.	20.51	20.39	25.00	20.06	17.91	14.58	8.16	16.68	11.54	18.26	17.88	17.68	18.69
4.	**Kitchen**													
	Mean	30.65	39.96	10.00	35.30	39.70	36.26	41.77	37.86	60.00	39.01	29.60	39.93	37.72
	S.D.	27.47	26.44	0.00	26.64	16.62	15.26	20.07	16.01	16.32	25.10	17.84	24.36	22.68
5.	**Per person occupancy area**													
	Mean	220.84	233.98	253.60	233.96	228.20	239.14	145.17	229.21	250.94	234.93	242.43	237.47	233.55
	S.D.	27.68	25.41	22.48	26.80	72.72	63.51	23.00	67.43	23.85	40.72	29.19	37.86	46.98

and large in size. In CZ houses were congested without proper planning therefore, per person occupancy area was low.

Living room:

In respondents' living room average occupancy area per person was 26.46 sq feet (SD=9.24). Respondents of CZ had more per person occupancy area in living room (32.86 sq feet) than RZ (24.79 sq feet) and IZ (21.75 sq feet). CZ respondents belonging to high HDM category had higher per person living room occupancy area (37.80 sq feet). Thus, it can be said that due to the high per person occupancy area in living room, the HDMs concentration was more.

Dining room:

The average per person occupancy area of respondents' dining room was 38.82 sq feet (SD=22.48). The average per person dining room occupancy was higher in RZ (45.40 sq feet) than IZ (41.88 sq feet) and CZ (29.18 sq feet). In RZ respondents belonging to moderate HDM category had more than average per person (49.49 sq feet) dining room occupancy area. In CZ respondents belonging to high HDM category had 30.69 sq feet per person dining room occupancy area. Thus it can be said that per person dining room occupancy affects the concentration of HDMs.

Bedroom:

The average occupancy area of respondents' bedroom was 50.52 sq feet per person (SD=18.69). In CZ per person occupancy area of respondents' bedroom was higher of (54.50 sq feet) as compared to IZ (53.90 sq feet) and RZ (43.63 sq feet). Respondents belonged to higher

Table 2: Average indoor RH of respondents' different rooms during summer and winter season (n=120)

Sr. No.	RH of rooms (in %)	RZ L n=10	RZ M n=27	RZ H n=3	RZ Total n=40	CZ L n=9	CZ M n=25	CZ H n=6	CZ Total n=40	IZ L n=4	IZ M n=31	IZ H n=5	IZ Total n=40	Overall
1.	Humidity in summer (in %)													
	Living room													
	Mean	65.20	66.29	66.33	66.02	66.33	66.20	67.66	66.45	68.25	66.96	67.40	67.15	66.54
	S.D.	1.48	1.56	2.30	1.62	1.32	1.41	2.16	1.56	2.36	1.74	1.51	1.77	1.70
	Dining room													
	Mean	65.10	65.62	65.66	65.50	65.55	65.88	66.33	65.87	66.50	66.19	66.40	66.25	65.87
	S.D.	1.20	1.11	1.15	1.14	1.01	1.30	1.75	1.30	1.73	1.40	1.67	1.42	1.31
	Bed room													
	Mean	65.60	67.92	67.66	67.32	67.66	66.88	69.83	67.50	68.50	67.90	67.60	67.92	67.58
	S.D.	1.57	2.23	3.05	2.32	2.73	2.16	2.31	2.49	2.64	2.38	1.81	2.30	2.36
	Kitchen													
	Mean	64.90	66.92	67.00	66.42	66.88	66.60	69.16	67.05	68.25	67.29	67.40	67.40	66.95
	S.D.	0.56	2.03	2.64	1.99	1.69	1.82	2.31	2.03	2.36	1.98	1.51	1.94	2.01
2.	RH in winter (in %)													
	Living room													
	Mean	51.40	51.44	51.00	51.40	51.33	50.44	49.66	50.52	59.00	59.00	59.00	59.00	53.64
	S.D.	0.84	0.84	0	0.81	1.32	1.29	0.51	1.30	0.93	1.21	0.42	0.26	3.92
	Dining room													
	Mean	50.73	50.81	50.00	50.73	51.54	52.30	51.30	51.98	58.05	58.19	58.20	58.06	53.57
	S.D.	1.54	1.55	0	1.48	1.75	3.44	3.47	3.10	0.45	0.52	0.43	0.24	3.74
	Bed room													
	Mean	52.90	52.88	53.00	52.90	52.55	53.12	52.66	52.92	58.02	58.01	58.03	58.01	54.60
	S.D.	1.19	1.21	0	1.15	1.58	2.84	3.61	2.69	0.80	0.26	0.14	0.12	2.93
	Kitchen													
	Mean	50.70	50.77	50.0	50.70	51.16	51.67	51.00	51.46	59.02	59.03	59.04	59.04	53.72
	S.D.	1.49	1.50	0	1.43	2.62	4.57	5.86	4.33	0.61	0.05	0.23	0.24	4.58

HDM category had higher per person bedroom area occupancy in CZ (63.33 sq feet) and IZ (63 sq feet).

Kitchen:

Average occupancy area of respondents' kitchen was 37.72 sq feet (SD=22.68) per person. In IZ per person kitchen occupancy area was higher (39.93 sq feet) than CZ (37.86 sq feet) and RZ (35.30 sq feet). Respondents belonged to RZ moderate HDM category had higher per person kitchen occupancy area (39.96 sq feet).

Humidity:

In microbial culture, survival of mites depends upon the relative humidity. There is a significant association between relative humidity and presence of live HDMs (Charpin and Vervloet, 1990). An increase in RH leads to an increase in average development time of HDMs at all stages of life cycle (Arlian *et al.*,1983 and Colloff, 1987).

Summer humidity:

Indoor RH of respondents' houses was taken to identify its effect on HDMs growth.

Living room:

In summer season average RH of respondents' living room was 66.54 per cent (SD=1.70). RH was found to be higher in IZ (67.15%) as compared to other zones (RZ=66.20 % and CZ=66.45%). Higher than the average living room RH (67.66%) was observed in high HDM category of CZ. In RZ respondents falling in high HDM category had higher than the average living room RH (66.33%). In IZ the lower HDM category respondents' houses had higher than average RH (68.25%) of living room.

Dining room:

Average RH of respondents' dining room was 65.87 per cent (SD=1.31). Among all the three zones average RH was higher in IZ (66.25%) and CZ (65.87%) as compared to RZ (65.50%). In high HDM category of RZ (65.66%) and CZ (66.33%) average RH of respondents' dining room was found to be higher. Lower HDM category respondents had higher RH (66.50%) in IZ.

Bedroom:

The average RH of respondents' bedroom in summer season was 67.58 per cent (SD=2.36). Average RH of respondent's bedrooms was found higher in IZ (67.92 %) as compared to RZ (67.32%) and CZ (67.50%). Intra zonal variation revealed that in higher HDM category of CZ respondents' bed room had higher than the average RH (69.83%). It can be attributed to the mattresses in the bedroom retain moisture for longer periods and therefore provide a more suitable habitat for HDM. In RZ respondents of moderate HDM category had higher than the average RH (67.92%) in bedroom. Warner (1999) also found a significant association between the maximal mite count and RH of bedrooms.

Kitchen:

Average RH of respondents' kitchen in summer season was 66.95 per cent (SD=2.01). Inter zonal variation revealed that respondents' kitchen RH was more than the average in CZ (67.50%) and IZ (67.40%) as compared to RZ (66.42%). Intra zonal variation showed that respondents' kitchen RH was higher than the average in high HDM category of RZ (67.00%) and CZ (69.16 %). It can be due to high water vapour content in kitchen air while cooking which increases the moisture and helps in the expansion of HDMs.

The summer RH of respondents' different rooms was between 66.54 to 67.58 per cent. During favourable conditions of humidity and temperature HDMs osmoregulate from the surface cuticle (Layon, 2004). Corroborated inferences were also drawn by several researchers that HDM grows well in the dust at 45-80 per cent of RH (Shivpuri and Dua, 1974; Shivpuri, 1977; Carswell, 1982; Hunter *et al.*, 1996; Lakhmi and Haq,1999 and Singh and Rao, 2001).

Humidity in winter:

Indoor RH affects the HDMs growth in winter season also.

Living room:

In winter season average RH of respondents' living room was 53.64 per cent (SD= 3.92). Respondents' living room RH was higher than the average in IZ (59.00%). Moreover, the average RH of living rooms was similar (59.00%) in all the HDM categories of IZ. Respondents falling in moderate HDM category of RZ (51.44%) and lower HDM category of CZ (51.33%) had high RH of their living room.

Dining room:

The average RH of respondents' dining room was 53.57 per cent (SD= 3.74). Respondents' dining room's

RH was higher than the average (58.60%) in IZ than CZ (51.98%) and RZ (50.73%).Variation among each zone showed that moderate HDM category respondents had higher dining room RH in RZ (50.81%) and CZ (52.30 %).Whereas in IZ higher HDM category respondents dining room had higher RH (58.20%) of dining room.

Bedroom:

The average RH of respondents' bedroom was 54.60 per cent (SD=2.93) in winter season. Inter zonal variation showed that higher than the average respondents' bedroom RH was found in IZ (58.10%). Intra zonal variation reflected higher bed room RH of high HDM categories of RZ (53.00%) and IZ (58.30%).

Kitchen:

Average RH of respondents' kitchen was 53.72 (SD=4.58%). Respondent's kitchen of IZ had high RH (59.40%) than other zones (RZ=50.70% and CZ=51.46 %). Respondents belonging to moderate HDM category had higher RH of their kitchens in RZ (50.77%) and CZ (51.67%). In IZ high HDM category respondents had high kitchen RH (59.40%). High RH of respondents' kitchen encourages the HDMs growth because it provides moisture and suitable temperature to develop HDMs in indoor environment.

HDMs will only be active and proliferate when the RH is high enough to allow water to gain from the surrounding air (Wharton, 1976; Bronswijk, 1979 and Dautartien, 2007). Hence, in winter season RH of respondents' different rooms varied from 53.57 to 53.72 per cent.

Moreover, HDMs are higher in number in house or areas where there is high RH. They just love to live in higher RH of 70 to 80 per cent in which their development and food consumption increases Hart *et al.* (1998). Adult mites can live upto two months, depending on the humidity level and temperature of their environment (Layon, 2004).

Time spent in cleaning different rooms:

Time spent in household cleaning by the homemaker is a significant determinant for the occurrence of HDMs (Mahamic *et al.*, 1998; Modak and Saha, 2002; Patil *et al.*, 2001 and Sharma *et al.*, 2009). Mostly three type of cleaning activities were followed in the houses *i.e.* sweeping, dusting and mopping. In the present empirical study time spent in house cleaning includes mainly four areas of the house *i.e.* living, dining, bed room and kitchen. Time spent in cleaning was determined on the basis of frequency, number of times the activity performed and time taken in a normal day.

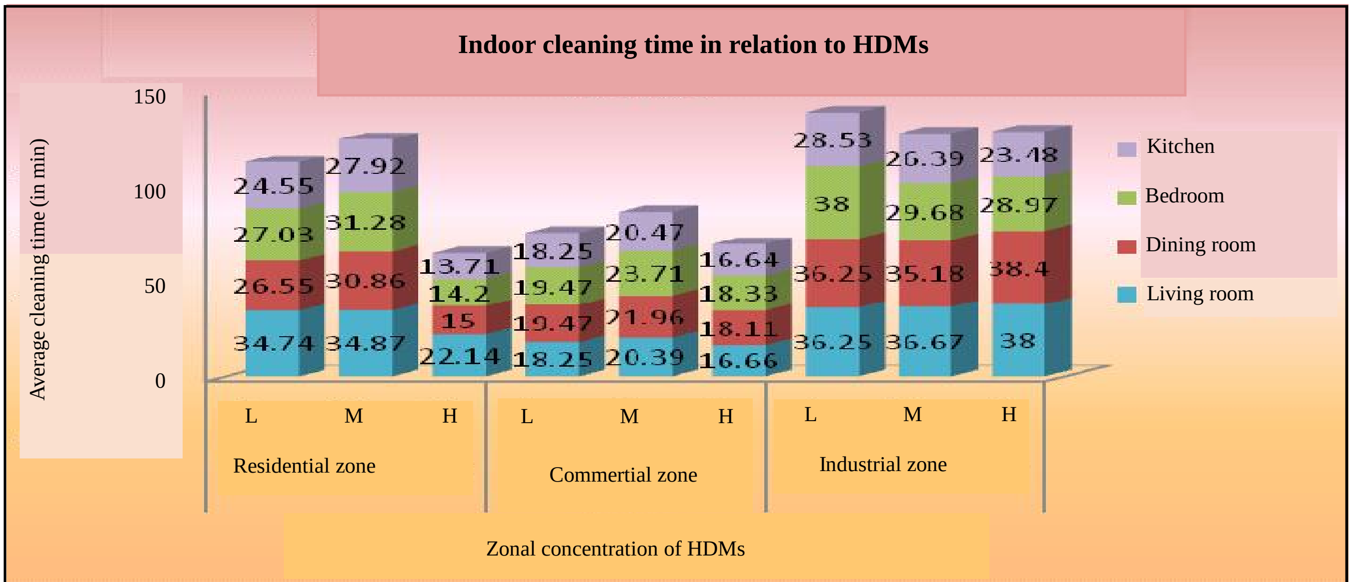
Living room:

Data in Fig. 3 revealed that average time spent daily in cleaning living room was 30.01 min/day (SD=11.99). More than the average time (36.80 min/day) was spent by IZ respondents in living room cleaning than other zones (RZ=33.88 min/day and CZ=19.35 min/day). Respondents of moderate HDM category of RZ (34.87 min/day) and CZ (20.39 min/day) spent more than the average time in living room cleaning activities. Proper cleaning practices reduce concentration of HDMs indoors. Thus, it can be attributed that as the respondents' living room cleaning time increases lower will be HDMs.

The average time spent by respondents daily in living room sweeping was 9.62 minutes, dusting 8.98 minutes and mopping 11.40 minutes. Lesser time was spent by higher HDMs category respondents in living room cleaning in RZ and CZ. Respondents spent more time in living room because it is the centre of daily routine activities hence, more HDMs. Identical findings were also found by Warner (1999) that HDMs in the dust samples of living room were higher as compared to other rooms.

Dining room:

Dining room is the place where all the family members assemble to eat food. Data in Fig. 3 shows that average time devoted in cleaning of dining room was 28.37 min/day (SD=10.86). More time of the IZ respondents (35.69 min/day) was required in cleaning of dining room as compared to CZ (20.82 min/ day) and RZ (28.60 min/day). In CZ most of the houses were situated on the roadside and are attaching ones. Commercial activities of the market and vehicular traffic leads to dust which settle in indoors situated along roadside hence it require more time in cleaning the dining room. Respondents belongs to moderate HDM category spent more time in cleaning RZ (30.86 min/day) and CZ dining room (21.96 min/day). In IZ more time (38.40 min/day) was devoted by the respondents of high HDM category. This implies that more cleaning time needed to clean pollutants from indoors.



L= Low, M= Moderate, H=High

Fig. 3 : **Indoor cleaning and house dust mites**

Bedroom:

Bedrooms are a habitat where HDMs cluster very successfully (Luend, 2005). Average time devoted in respondents' bedroom cleaning was 27.10 min/day (SD=10.94). Inter zonal variation showed that IZ respondents spent more time in bedroom cleaning (30.42 min/day) as compared to other zones (RZ=28.94 min/day, CZ=21.95 min/day). Intra zonal discrepancy reflects that in IZ moderate HDM category respondents spent more time (RZ =31.28 min/day and CZ =23.71 min/day) in bedroom cleaning. However, in IZ more time was spent (38.00 min/day) by respondents in bedroom cleaning falls in lower HDM category. This entails that increased cleaning time of bed room lowers HDMs concentration.

Kitchen:

Kitchen is the energy centre of the house. Heat and water vapour evaporated from the kitchen increases the temperature of kitchen. Respondents' time devoted in cleaning activities of kitchen was 23.88 min/day (SD=10.40). Inter zonal variation showed that more time (26.24 min/day) was devoted by IZ respondents than RZ (26.01 min/day) and CZ (19.39 min/day). Intra zonal variation revealed that respondents belonged to moderate HDM category spent more time in kitchen cleaning activities in RZ (27.92 min/day) and CZ (20.47 min/day).

However, in IZ respondents belonged to lower HDM category spent more time (28.53 min/day) in kitchen cleaning activities. Thus, it can be said that increased kitchen cleaning time lowers HDMs.

Respondents spent more time in kitchen mopping (9.69 min/day) than sweeping (7.66 min/day) and dusting (6.52 min/day). Hence, proper time given to house cleaning practices reduces indoor settled dust and HDMs but this is not the only efficient method of house cleaning other methods also need to be utilized for effective cleaning. More time was spent in cleaning different rooms by IZ respondents as compared to RZ and CZ, respectively. Higher HDM category respondents spent less time in cleaning of rooms in all the three zones.

Lesser time devoted by respondents in house cleaning creates unhygienic and insanitary conditions thus increases HDMs concentration. This can be said that in IZ due to industrial effluents air pollution is more. Apart from this industrial solid waste accumulation pollute soil also. These pollutants enter indoors through human beings, air and foot traffic. Industrial zone also have heavy duty traffic nuisance connected with highways leading to air pollution.

Control treatment of HDMs through NCPPCs (Non-conventional plant product components):

Normal cleaning practices are not enough to get rid of HDMs. Various chemical disinfectants are available in the market but their use instigates many health

Table 3: Difference between NCPPCs and HDMs mortality rate in indoors					
Sr.No.	Source	DF	SS	MS	F value
1.	Treatments	3	18957.6	6319.2	437.339**
2.	Days	2	618.864	309.432	21.415**
3.	Treatments x days	6	305.922	50.9871	3.529*
4.	Error	108	1560.51	14.4492	

* and ** indicate significance of values at P=0.05 and 0.01, respectively

problems. Physical measures have their own limitations. One of the safest, cost effective and eco-friendly methods is the use of non-conventional plants which are locally available in our environment. Moreover, this leads to value addition to non-conventional plant products.

On the basis of laboratory experiments for testing the bio efficacy of NCPPCs on HDMs mortality rate, three most effective PPCs selected were *Sahjan*, castor and *Satyanashi* (at 7 % concentration level) for further experimentation at household level. For the application of these three most effective NCPPCs thirty households with high concentration of HDMs were selected from the surveyed households. Ten households were selected from these thirty high HDMs concentrated households for the application of each PPC in different rooms (living, dining, bed room and kitchen) furniture and furnishings. Dust samples were collected from different areas of the selected rooms in separate polythene bags after the application of NCPPC on 1st, 15th and 28th day. These dust samples collected in polythene bags which were sealed and brought to the laboratory for testing the HDMs mortality rate.

On the basis of pooled mean, all the treatments were observed to be significantly superior over control in HDMs mortality rate. *Satyanashi* PPC was proved to be most effective (57.93%) followed by castor PPC (51.36 %) in reduction of HDMs from furniture and furnishings of respondents' different rooms. At the same time, *Sahjan* PPC was found to be least effective treatment because HDMs motality rate was low (48.40%).

Thus, the Table 3 shows order of PPCs effectiveness on HDMs mortality rate in different room areas after the treatment was *Satyanashi*, castor and *Sahjan* PPCs at 7 per cent concentration. Hence, *Satyanashi* PPCs (7%) was recommended for the control of HDMs population in houses. Statistically the difference between the mortality rates of mites was highly significant with respect to all the three PPCs treatment (F value =437.34, sig. at 1%), days of application (F value =21.41, sig. at 1%) and also among these (F value =3.53, sig. at 1%). These NCPPCs are eco friendly and cost effective too. They are available as weeds in abundance which are underutilized. Nadachatram (2005) revealed numerous species of herbal plants that are reputed to be efficacious in the practice of herbal medicine. These have been long known for its medicinal value. These extracts can be used as weapon for the protection of individuals, highly sensitive to dust mites and other allergies Thus, remediation can significantly reduce HDMs from indoors (Charles *et al.*, 2007).

Conclusion:

The present study established that household, housing, season and microclimatic conditions affect the proliferation and concentration of the HDMs. Lack of awareness amongst home makers about the factors that lead to generation and endurance of HDMs renders the challenge of getting rid of them more onerous. Any excessive use of disinfectant (chemicals) may and do have grave side effects for the human beings. It is, therefore, of critical significance that alternative mediums are investigated which have the efficacy to kill the HDMs without causing any deleterious impact on human health. The research has clearly vindicated the vitality and vibrancy of ancient and indigenous knowledge in this regard. Indoor household experiments have showed bio efficacy of non-conventional plant product components in getting rid of the HDMs from homes.

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