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Relation of household cleaning practices with household indoor allergens: House dust mites (HDMs) and control with plant product components

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Abstract

Cleaning is considered to be heavy of the physical labor involved and the time spends in keeping the house spic and span. Hence daily, weekly, periodical or seasonal cleaning is done. House cleaning comprised of sweeping, dusting, mopping etc. Apart from this it also include removal of cobwebs, washing of clothes, storage of household items and pets in the house. Household cleaning also depends upon the help received from family members to clean the house. If the homemaker is preoccupied in other activities like studying or employed outside the house, she gets less time for cleaning activities. The accumulation and resuspension of dust in readily influenced by airflow patterns and activities taking place in the area. The research paper enlightens the importance of cleaning through the cleaning activities viz. dusting, sweeping and mopping and there interrelation with the growth of HDMs in home. HDM mortality rate were analyzed through the plant product components made up of *Satyranashi*, *Sahjan* and Castor at 7 percent concentration level. The cleaning activities viz. dusting, sweeping and mopping were judged by the number of time and frequency of activities. The cleaning of cobweb with bamboo attached with brush/broom was found to be more effective than broom cleaning. The results showed that the respondents who were cleaning their rooms twice in a day, concentration of HDMs was found very low in their houses or rooms, than the other respondents that were cleaning their rooms once in a day.

Keywords: House dust mites, household cleaning practices, plant product components, indoor allergens

Introduction

Cleaning is the process of removing unwanted substances, such as dirt, infectious agents (Dust), and other impurities, from an object or environment. Cleaning occurs in many different contexts, and uses many different methods which also helps in getting rid of household pests (Vargheese *et al.*, 1985) [27]. (<https://en.wikipedia.org/wiki/Cleaning>) Dust particle size is of particular importance as it influences the accumulation and resuspension of dust in the indoor environment (Morawska and Salthammer, 2003) [16]. Exposure to dust and its associated contaminant load may be of particular concern for children who tend to play or crawl on the floor and place objects in their mouths that have been in intimate contact with dusty floors (Lewis *et al.*, 1994) [13]. Environmental Protection Agency defines house dust as a complex mixture of biologically derived particulate material (animal dander, fungal spores etc.) deposited from the indoor aerosols, and soil particles brought in by foot traffic that needed to be clean.

One of the most strongly allergenic components of house dust, often heavily contaminated with the fecal pellets and cast skins, is house dust mites (Pepsy and Moria, 1968) [18]. House dust mites are tiny creatures related to ticks, chiggers, and spiders that live in close association with humans. Their primary food is dander (skin scales) shed from human and pet activity. Estimates are that dust mites may be a factor in 50 to 80 percent of asthmatics, as well as in countless cases of eczema, hay fever, and other allergic ailments. Symptoms are usually respiratory in nature (sneezing, itching, watery eyes, wheezing, etc.); however, there are reports of a red rash around the neck. Other allergic reactions may include headaches, fatigue, and depression (Lyon, 1991) [14].

Dust mites are found in high concentration in pillows, mattresses, carpeting and upholstered furniture. They remain in mattresses, carpets, furniture and bedding, since they can climb lower down through the fabric to avoid sun, vacuum cleaners, and other hazards and climb higher up to the surface where humidity is high to get another skin cell to feed on. Even in dry climates, dust mites survive and reproduce easily in bedding, especially in pillows because of

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the humidity generated by the human body during breathing and perspiring. Human beings are important carriers of dust mites from one place to another through their bodies and clothing (De Lucca *et al.*, 2000) [6]. Bathrooms and kitchen are also important places that create a higher concentration of house dust mite allergen in houses; due to pets; the severity of allergy increases many folds (Modak and Saha, 2002; Reinero *et al.*, 2007) [15, 20].

Interestingly, in Indian environment house dust mites are uniquely fitted for a life in dry environment as well as seasons of higher humidity and can survive without problem for long period. The reason behind this is that the mites have means for extracting moisture directly from air. They can survive in a temperature of 20-45 °C and between 40-55 per cent relative humidity (Denis and Vervolet, 1990) [7].

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; Bhardawaj, 2008) [1, 30]. A number of species of house dust mites have been found throughout the world. *Dermatophagoides farinae* and *Dermatophagoides pteronyssinus* are the two most common species that are found in house dust samples of India (Lakshmi and Haq, 1999) [12].

Inhalations of dust mite allergens by hypersensitive individuals can result in acute attacks of bronchial asthma, accompanied by wheezing, shortness of breath, and perhaps even death. Diagnostic tests and clinical studies by allergists have shown house dust mite to be the most common allergy in asthmatics, and an important "root cause" for the development of asthma in young children.

Nature of household cleaning pattern

Cleaning is time consuming and involves arduous physical labour also. Hence, daily, weekly, periodical or seasonal cleaning is done which help in getting rid of household pests and HDMs (Vargheese *et al.*, 1985) [27]. Several researchers suggested that nature and frequency of cleaning have direct bearing on the HDMs population (Sesay and Dobson, 1972; Blythe *et al.*, 1976; Ho and Nadchatram, 1984; Tandon *et al.*, 1988; Modak and Saha, 2002) [21, 4, 10, 24, 15]. Management of HDMs is possible through proper cleaning of rooms and waste disposal from the dwelling (Singh and Rao, 2001) [21].

The main reason for occurrence of HDMs in the house is faulty cleaning practices (Patil *et al.* 2001) [17]. Nature of household cleaning pattern deals with frequency, number of times and time spent in performance of these activities. Various cleaning activities performed in the respondents' households were sweeping, dusting and mopping. The pattern of these activities carried out in the living, dining, bed room and kitchen of the respondents' household were analyzed in the present empirical research.

Prevention and control of House Dust Mites

Prevention and control of house dust mite can be done in four ways that are chemical, physical, environmental and herbal. In the oral traditions, local communities in every ecosystem from the Trans Himalayas down to the coastal plains have discovered the medical uses of thousands of plants found locally in their ecosystem. India has one of the richest plant medical cultures in the world. It is a culture that is of tremendous contemporary relevance because it can on one hand ensure health security to millions of people and on the

other hand it can provide new and safe herbal drugs to the entire world. There are numerous species of plants that are reputed to be efficacious in the practice of herbal medicine in India. These plants are non-conventional and found locally in abundance, easily available and cost effective too. These plants are effective in controlling micro organisms and have no side effect on human health. The importance of non-conventional partially purified plant product components for the control or management of diseases is being actively pursued by various investigators in India.

Keeping in mind various hazardous effects of house dust mites on human health many physical and chemical measures are available for the control of house dust mites but they may be expensive for people. In addition, use of chemicals requires proper understanding about them, as they are poisonous to human health.

Among old traditional health practices, which depends on the orally transmitted knowledge that is effective, but serving a limited area. Use of herbs and medicinal plants are safe and they play vital role in our day to day life too. There are many plants seed extracts that are found to be effective on house dust mites. These seeds are locally available due to which they are cost-effective and eco-friendly in nature. The application of these herbal extracts will be helpful in reduction of the health problems and improves the quality of life.

Materials and Methods

The study was conducted in Udaipur city, which comes under the sub-humid southern plains surrounded by Aravalli hills in Rajasthan. The climate of Udaipur is tropical. The summer season is intolerably hot, with the average temperature hovering around 42 °C (max.) to 27.5 °C (min.). The climatic conditions of Udaipur are quite pleasant in winters when the average temperature ranges from 28.3 °C (max.) to 4.0 °C (min.). Udaipur experiences scanty rainfall in the monsoon season- the annual total rainfall received was 62.26 cm in the Year 2008-09. Monsoons arrive in the month of July heralded by dust and thunderstorms.

Apart from this, Udaipur is rich in natural vegetation. It has abundance of non conventional plant growth which can be utilized by the people for productive purpose. The investigator has great interest in improving the indoor environment of the urban houses by controlling the HDMs. Hence, value was also added to non conventional plants which were eco-friendly and has potential to control HDMs.

(Field) Household Experiments

Through lab testing three most effective Plant Product Components on HDM mortality rate were *Satyranashi*, *Sahjan* and Castor at 7 percent concentration level were found. From the 120 respondents 30 households with high concentration of HDM were selected for field testing. To test the bio efficacy of each PPC with the selected 7 percent concentration level on HDMs mortality rate ten households were selected. Non Conventional Plant Product Component was 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 plastic tube of the vacuum cleaner was sealed at the bottom with 100 mm. mite proof mesh. The dust samples were collected in the polythene bags, sealed and

carried to the laboratory within 12 hours. In the lab the dust samples were sieved and 2 gm of dust from each area was observed under binocular microscope (10 x) and HDM mortality rate was recorded. HDMs which were non mobile, at least for five minutes were considered as mortile.

Results and Discussion

House cleaning reduces HDMs from indoors. Various methods of cleaning in respondents houses situated in various zones (*viz.* Residential Zone, Commercial Zone and Industrial Zone) were used. Cleaning in the houses were conducted under Sweeping, Dusting, moping activities. The effect of cleaning in the houses were judged by the cleaning of various rooms *viz.* living room, dining room, bedroom and kitchen with reation of House Dust Mites (HDMs).

Sweeping activity

Sweeping with broom is a means of removing dust from large surfaces both rough and smooth. The object is to collect the dust and dirt as completely as possible and dispose it off in such a way that it does not settle (King, 1968) [11]. An appreciable portion of settled dust is constituted of harmful HDMs in home (Lakshmi and Haq, 1999) [12]. Daily sweeping the floor cleans dust, dirt and food particles from the floor hence reduce HDMs concentration in indoors. In all the three zones one fourth of the IZ respondents (25 per cent) sweep more than once in a day as compared to other zones (CZ=17.05 per cent, RZ=10 per cent).

- 1. Living room:** Cent percent of the respondents in the entire three zones sweep their living room floor daily. Data in the Table 4.14 explicitly postulates that an overwhelming majority (82.50 per cent) of the respondents sweep their living room daily at once and rest (17.50 per cent) of them twice a day. One fourth of the IZ respondents (25 per cent) sweep living room twice a day as compared to other zones (CZ=17.50 per cent, RZ=10 per cent). Hence, it can be said that more cleaning is required in IZ due to industrial and vehicular pollution. Majority of the respondents in CZ (88.90 per cent) sweep their house once in a day belonged to low HDM category.
- 2. Dining room:** An overwhelming majority of the respondents (85 per cent) sweep dining room once in a

day. In all the three zones higher number of respondents in RZ (17.50 per cent) swept dining room twice a day than CZ (12.50 per cent) and IZ (15 per cent). Twenty percent of the respondents in IZ belonging to high HDM category sweep dining room twice a day.

- 3. Bedroom:** Respondents sweep their bedroom once (85.83 per cent) or twice (14.16 per cent) in a day. Data reflects that cent per cent of higher HDM category respondents in RZ used to sweep bedroom once a day. Effectiveness of cleaning can be seen from the data that higher percentage of respondents in all the three zones (RZ=30 per cent, CZ=22.20 per cent and IZ=25 per cent) belonged to lower HDMs categories sweep their bedrooms twice a day.
- 4. Kitchen:** Majority of the respondents (85.83 per cent) sweep their kitchen once a day. Only few of the respondents (14.17 per cent) sweep their kitchen twice in a day. Majority of respondents in higher HDM category of IZ (85 per cent) and moderate HDM categories (92.60 per cent) in RZ sweep their kitchen once a day. Daily sweeping and cleaning dust, dirt and food particles from the floor reduces HDMs concentration in indoors.
- 5. Mode of removing cobwebs:** The quality of cleanliness within the house is determined by mode of cobwebs removal which contains dust and micro organism in it. Cobwebs can be removed by simple broom or bamboo attached with brush/broom. Near about three fourth of the respondents (73.33 per cent) used broom for cobweb removal and one fourth (26.66 per cent) used bamboo attached with brush/broom. Among all the three zones, use of bamboo attached with broom/brush was more by RZ respondents (50 per cent) for removing cobwebs than CZ (20.00 per cent) and IZ (10 per cent). Data explicitly shows that cent per cent of high HDM category respondents in CZ and IZ use broom for removal of cobwebs. Thus, cleaning of cobweb with bamboo attached with brush/broom was found to be more effective than broom cleaning. HDMs mortality rate was more by the use of long handle broom because it could reach more area as compared to short broom (Rao and Singh, 2001) [21].

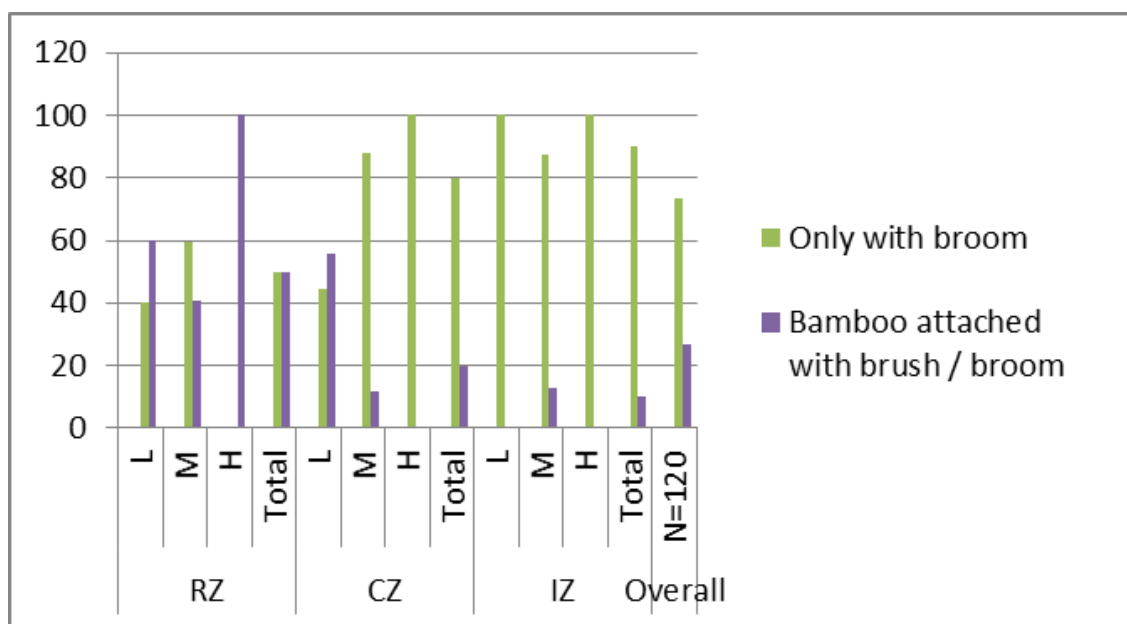


Fig 1: Distribution of respondents according to Cob Web removal

Table 1: Percentage distribution of respondents according to sweeping pattern followed in different rooms

S. No.	Sweeping activity	RZ				CZ				IZ				Overall N=120
		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													
a	Frequency of sweeping													
	Daily	100	100	100	100	100	100	100	100	100	100	100	100	100
b	Number of times sweeping performed													
	Once	90.00	88.90	100.0	90.00	88.90	76.00	100.0	82.50	75.00	80.60	40.00	75.00	82.50
	Twice	10.00	11.10	0	10.00	11.10	24.00	0	17.50	25.00	19.40	60.00	25.00	17.50
2.	Dining room													
a	Frequency of sweeping													
	Daily	100	100	100	100	100	100	100	100	100	100	100	100	100
b	Number of times sweeping performed													
	Once	90.00	88.90	0	82.50	100.0	84.00	83.30	87.50	100.0	83.90	80.00	85.00	85.00
	Twice	10.00	11.10	100.0	17.50	0	16.00	16.70	12.50	0	16.10	20.00	15.00	15.00
3.	Bed room													
a	Frequency of sweeping													
	Daily	100	100	100	100	100	100	100	100	100	100	100	100	100
b	Number of times sweeping performed													
	Once	70.00	88.90	100.0	85.00	77.80	92.00	83.30	87.50	75.00	87.10	80.00	85.00	85.83
	Twice	30.00	11.10	0	15.00	22.20	8.00	16.70	12.50	25.00	12.90	20.00	15.00	14.17
4.	Kitchen													
a	Frequency of sweeping													
	Daily	100	100	100	100	100	100	100	100	100	100	100	100	100
b	Number of times sweeping performed													
	Once	80.00	92.60	33.30	85.00	100.0	88.00	66.70	87.50	100.0	83.90	80.00	85.00	85.83
	Twice	20.00	7.40	66.70	15.00	0	12.00	33.30	12.50	0	16.10	20.00	15.00	14.17

Dusting activity

Regular dusting is an effective and simple method in controlling HDMs among households. Dusting can be done by gathering up the dust in a cloth or on a dusting mop made of cotton fiber or strong material. The dust gathered in duster must be shaken out from time to time (Gandotra and Patel, 2006) [9].

Mode of Dusting

Daily dusting of CZ houses by respondents was more frequent than other zones. Living room dusting was more frequent than other rooms. Different methods were adopted for dusting while house cleaning by the respondents such as wet cloth (12.5 per cent), dry cloth (25 per cent) and wet and dry cloth both (43.33 per cent).

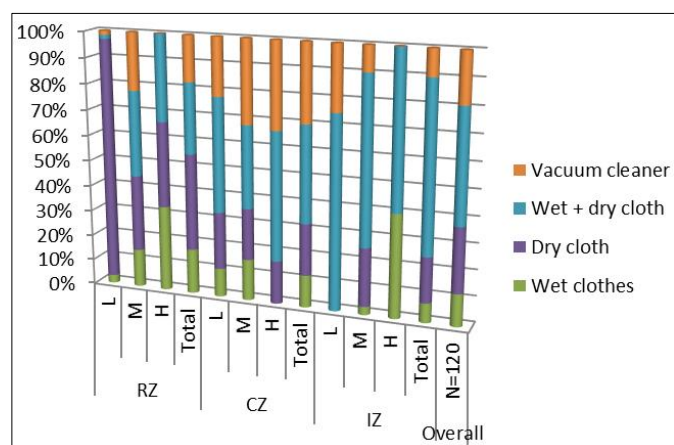


Fig 2: Distribution of respondents according to Mode of Dusting

1. **Living room:** Living room dusting was performed daily by two third of the respondents whereas one third performed it weekly. Cent per cent of the respondents in IZ dust their living room daily. On the other hand, in CZ

cent per cent of the higher HDM category respondents dust their living room weekly. Majority of the respondents (99.16 per cent) in all the three zones dust their living room once in a day. However, meagre percentages (3.20 per cent) of moderate HDM category IZ respondents dust their living room twice in a day.

2. **Dining room:** More than half of the respondents (55 per cent) dust their dining room daily. Among all the three zones majority of respondents in IZ (85 per cent) dust the dining room daily as compared to other two zones (RZ=70 per cent and CZ=10 per cent). Cent percent of the higher HDM category respondents dust their dining room on weekly interval basis. It was explicit from the data that dusting was necessary for removing HDMs from dining room. Only a meagre percentage of the IZ respondents (0.83 per cent) dust their dining room twice in a day. Other respondents (99.16 per cent) dust dining room once in a day.

3. **Bedroom:** More than one third (37.50 per cent) of the respondents dust their bedroom daily. Majority of the CZ respondents (92.50 per cent) perform dusting of their bedroom weekly than RZ (47.50 per cent) and IZ (47.50 per cent) respondents. Two third (60 per cent) of the IZ respondents of high HDM category dust their bedroom daily. Though, in CZ cent percent of the high HDM category respondents dust their bedroom weekly. Respondents of RZ and CZ perform dusting once in a day whereas in IZ half of the respondents dust twice in a day.

4. **Kitchen:** Day to day dusting is important to get rid of HDMs in kitchen. More than half of the respondents (58.33 per cent) dust kitchen weekly. Two third of the respondents (60 per cent) dust their kitchen daily in RZ. Cent percent respondents in CZ and 60 per cent in IZ belonging to high HDM category, dust their kitchen weekly. A small percentage (7.50 percent) of respondents in IZ belonging to moderate HDM category dust kitchen twice in a day.

Different modes were adopted for dusting. Proper cleaning of place is a necessary step after each and every activity of household. After taking food, cleaning is necessary because food particles on the floor create conducive environment for the growth of HDMs. Exposure to dust and its associated contaminant load may be of particular concern for children

who tend to play or crawl on the floor and place objects in their mouths that have been in intimate contact with dusty floors (Floria, 1955) [8]. Dusting should be done systematically in the morning from the top to working downwards of the room (Gandotra and Patel, 2006) [9].

Table 2: Percentage distribution of respondents according to dusting pattern followed in different rooms

S. No.	Dusting activity	RZ				CZ				IZ				Overall N=120
		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													
a	Frequency of dusting													
	Daily	80.00	92.60	100.0	90.00	0	16.00	0	10.00	100.0	100.0	100.0	100.0	66.66
	Weekly	20.00	7.40	0	10.00	100.0	84.00	100.0	90.00	0	0	0	0	33.33
b	Number of times dusting performed													
	Once	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	96.80	100.0	97.50	99.16
	Twice	0	0	0	0	0	0	0	0	0	3.20	0	2.50	0.83
2	Dining room													
a	Frequency of dusting													
	Daily	50.00	74.10	100	70.00	0	16.00	0	10.00	100	80.60	100	85.00	55.00
	Weekly	50.00	25.90	0	30.00	100	84.00	100.0	90.00	0	19.40	0	15.00	45.00
b	Number of times dusting performed													
	Once	100	100	100	100	100	100	100	100	100	96.80	100	97.50	99.16
	Twice	0	0	0	0	0	0	0	0	0	3.20	0	2.50	0.84
3	Bed room													
a	Frequency of dusting													
	Daily	30.00	59.30	66.70	52.50	0	12.00	0	7.50	75.00	48.40	60.00	52.50	37.50
	Weekly	70.00	40.70	33.30	47.50	100	88.00	100	92.50	25.00	51.60	40.00	47.50	62.50
b	Number of times dusting performed													
	Once	100	100	100	100	100	100	100	100	75.00	96.80	100	95.00	98.33
	Twice	0	0	0	0	0	0	0	0	25.00	3.20	0	5.00	1.66
4	Kitchen													
a	Frequency of dusting													
	Daily	50.00	59.30	100	60.00	0	16.00	0	10.00	75.00	54.80	40.00	55.00	41.66
	Weekly	50.00	40.70	0	40.00	100	84.00	100.0	90.00	25.00	45.20	60.00	45.00	58.33
b	Number of times dusting performed													
	Once	100	100	100	100	100.0	100	100	100	100	90.30	100	92.50	97.50
	Twice	0	0	0	0	0	0	0	0	0	9.70	0	7.50	2.50

Different methods were adopted for dusting and house cleaning (Table: 4.19) by the respondents such as wet cloth (12.5 per cent), dry cloth (25 per cent) and wet and dry cloth both (43.33 per cent). Apart from this some of the respondents used vacuum cleaner (19.16 per cent) also for dusting. Dusting was performed to remove settled dust on the surfaces of sofa, curtains, bedcovers, carpet and television cabinet etc. Dry and wet cloth was common mode of dusting in all the three zones (RZ=27.50 per cent, CZ=37.50 per cent and IZ=65 per cent). More than one third (37.5 per cent) of the respondents in RZ used dry cloth for dusting and especially in low HDM category (60 per cent). Three fourth of the IZ respondents (75 per cent) used both dry and wet cloth for dusting various surfaces in the house. Half of the respondents' belonged to higher HDM category in CZ used both wet and dry cloth for dusting.

Hence, dusting reduces settled dust in the households which is a good source of HDMs concentration. Dusting from wet cloth is more beneficial than dry because when blowing is done with dry cloth dust and HDMs disperse in the air and deposit at nearby objects or places.

Mopping activity

Mopping is one of the methods of cleaning floor but without the use of any disinfectant it is ineffective because wet mopping increases moisture content of the house which is

helpful for the growth of micro-organisms like HDMs (Barbogg, 2003) [29]. Mopping removes dust from indoor floor. Various methods were used for mopping like wet cloth, dry mopper and standing mopper. Majority of the respondents in all the three zones mopping their rooms' floor once in a day.

- 1. Living room:** Living room mopping was performed daily by cent percent of the respondents in CZ and IZ. Some of the RZ respondents in (15 per cent) performed it weekly. Two third of the high HDM category RZ respondents mop their living room floor weekly. Weekly mopping of living room floor may be the cause of high HDMs concentration. Majority of respondents in all the three zones mop living room floor once in a day. Only small percentage of the respondents in RZ and CZ (2.50 per cent each) mop living room floor twice in a day.
- 2. Dining room:** Cent percent of the respondents in IZ mop dining room daily as compared to other zones (RZ=70 per cent and CZ=90 per cent). Some of the respondents in RZ (30 per cent) and CZ (10 per cent) mop their dining room floor weekly. Cent percent of the lower HDM category respondents in CZ mop their dining room floor daily. Majority of respondents in all the three zones mop their dining room floor once in a day.
- 3. Bedroom:** An overwhelming majority of the respondents (RZ=70 per cent, CZ=90 per cent and IZ=100 per cent)

mop their bedroom floor daily. Few of the respondents (13.33 per cent) mop their bedroom floor at weekly interval basis. In RZ cent percent of higher HDM category respondents mop their bedroom floor at weekly interval.

4. **Kitchen:** Cent percent of the respondents in all the three zones mop their kitchen daily. Most of the respondents in

all the three zones mop once in a day (RZ=85 per cent, CZ=87.50 per cent and IZ=82.50 per cent). In CZ cent percent of the respondents of high HDM category mop their kitchen once in a day. But, few of the moderate HDM category respondents in RZ (11.10 per cent) and CZ (12.00 per cent) mop their kitchen twice in a day.

Table 3: Percentage distribution of respondents according to mopping pattern followed in different rooms

S. No.	Mopping activity	RZ				CZ				IZ				Overall N=120
		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													
a	Frequency of mopping													
	Daily	70.00	96.30	33.30	85.00	100.00	100.0	100.0	100.0	100.0	100.0	100.0	100.0	95.00
	Weekly	30.00	3.70	66.70	15.00	0	0	0	0	0	0	0	0	5.00
b	Number of times mopping performed													
	Once	90.00	100.0	100.0	97.50	100.0	96.00	100.0	97.50	100.0	100.0	100.0	100.0	98.33
	Twice	10.00	0	0	2.50	0	4.00	0	2.50	0	0	0	0	1.66
2	Dining room													
a	Frequency of mopping													
	Daily	60.00	81.50	0	70.00	100.0	88.00	83.30	90.00	100.0	100.0	100.0	100.0	86.66
	Weekly	40.00	18.50	100.0	30.00	0	12.00	16.70	10.00	0	0	0	0	13.33
b	Number of times mopping performed													
	Once	100.0	100.0	100.0	100.0	100.0	92.00	100.00	95.00	100.0	100.0	100.0	100.0	98.33
	Twice	0	0	0	0	0	8.00	0	5.00	0	0	0	0	1.66
3	Bedroom													
a	Frequency of mopping													
	Daily	60.00	81.50	0	70.00	100.0	88.00	83.30	90.00	100.00	100.0	100.0	100.0	86.66
	Weekly	40.00	18.50	100.0	30.00	0	12.00	16.70	10.00	0	0	0	0	13.33
b	Number of times mopping performed													
	Once	100	100	100	100	100	100	100	100	100	100	100	100	100
4	Kitchen													
a	Frequency of mopping													
	Daily	100	100	100	100	100	100	100	100	100	100	100	100	100
b	Number of times mopping performed													
	Once	80.00	88.90	66.70	85.00	100.0	88.00	66.70	87.50	75.00	80.60	100.0	82.50	85.00
	Twice	20.00	11.10	33.30	15.00	0	12.00	33.30	12.50	25.00	19.40	0	17.50	15.00

Mopping removes dust from the indoor floor. Various methods were used for mopping like wet cloth, dry mopper and standing mopper. An overwhelming majority of the respondents (86.66 per cent) use wet cloth for floor cleaning (Table 4). Moreover, few respondents (13.33 per cent) who cannot mop the floor in squatting position due to back ache problem use standing mopper made of cotton/sponge. Use of wet cloth was common among all the three zones (RZ=80 per cent, CZ=90 per cent and IZ=90 per cent). Cent percent of the high HDM category respondents use squatting posture to mop the floor with wet cloth in RZ and IZ. None of the respondents used dry mopper. Wet mopping increases moisture content in the indoor environment and accelerates the abundance of HDMs especially in the improper ventilated conditions (Patil *et al.*, 2001; Singh *et al.*, 2001; Barbogg, 2003) [17, 22, 29].

To reduce indoor moisture content more than half (56.00 per cent) of the respondents open their doors and windows while mopping (Table 4). Strikingly, 44.00 per cent of the respondents were not aware about importance of ventilation in their house. Near about two third (66.34 per cent) of the RZ respondents opened their doors and windows while mopping. Cent percent of the CZ respondents belonged to lower HDM category opened windows while mopping.

Thus the removal of mites alone will be ineffective if the house environment is not cleared of the debris (mite fecal matter, food material, dead skin, hairs, windblown pollen,

fungi, etc.). Proper cleaning is a necessary step in each and every activity of household or in cleaning after taking food because food particles on the floor creates suitable environment, for the concentration of micro-organisms or house dust mites. (Floria, 1955) [8]. Identical results were also reported by Modak and Saha (2002) [15], that frequency of cleaning has a significant role in reducing the mites concentration, the more frequency of cleaning lesser were the mite densities.

Cleaning activities of Livestock and pets

Livestock and pets have an important role in spreading allergic diseases in indoors. Pets contribute dander and skin scales in dust which is a good source of food for HDMs (Barbogg, 2003) [29]. Livestock and pets are kept indoors or outdoors.

Livestock: Livestock is one of the main sources of spreading HDMs diseases in home (Bronswijk, 1981; Barbogg, 2003) [2, 29]. Respondents' having livestock (18 per cent) keep these in the courtyard (50 per cent), outside the house (41.66 per cent) and inside the house (8.33 per cent). In RZ half of the respondents' keep livestock outside as well as in the courtyard of the house. Half of the moderate HDM category respondents in RZ and CZ keep the livestock in courtyard of the house. Cent percent respondents in IZ belong to high HDM category keep livestock outside the house.

Pets: When pets are kept inside the house, the dander they shed becomes the sources of HDMs accumulation in house (Barbogg, 2003) [29]. Body of pets contains various types of allergens that may transmit various allergic diseases (Bronswijk, 1981; Cohort, 2008) [2, 5]. Those respondents having pets (27.33 per cent) out of which more than one third of the respondents' (43.33 per cent) keep their pets in the house especially in CZ (50 per cent). In RZ (75 per cent) and CZ (60 per cent) moderate HDMs category respondents keep their pets inside the house. Thus keeping pets inside the house are the source of transmitting HDMs allergens. Yet, 80 per cent of the CZ respondents' keep pets in the courtyard. Management of house dust mites can be achieved by physically removing the pests and their food sources and by

altering their preferred environment in the house.

Food given to pets: Table 4, data clearly postulates that respondents who were having pets out of which three fourth of the respondents give food to their pets in the courtyard and rest of them give food inside the home. Cent percent of higher HDM category respondents give food to their pets inside the house in RZ and courtyard of the house in CZ.

Time spent in livestock/pets cleaning: Cleaning of livestock/ pets includes taking out insects from their body, bathing, hair cut, combing etc. Time spent in livestock/pets cleaning practices shows the awareness among respondents about hygiene and sanitation.

Table 4: Mean and percentage distribution of respondents according to their livestock and pet information

S. No.	Livestock information	RZ				CZ				IZ				Overall N=12
		L n=0	M n=2	H n=0	Total N=2	L n=0	M n=4	H n=1	Total N=5	L n=0	M n=4	H n=1	Total N=5	
1.	Livestock													
	Present	20.00	11.10	66.70	17.50	25.00	9.70	20.00	12.50	22.20	20.00	33.30	22.50	18.00
	Not present	80.00	88.90	33.30	82.50	75.00	90.30	80.00	87.50	77.80	80.00	66.70	77.50	82.00
	Place of livestock													
	In the house	0	0	0	0	0	25.00	0	20.00	0	0	0	0	8.33
	Courtyard	0	50.00	0	50.00	0	50.00	100	60.00	0	50.00	0	40.00	50.00
Outside the house	0	50.00	0	50.00	0	25.00	0	20.00	0	50.00	100	60.00	41.66	
2.	Pets information													
	Pets													
	Present	20.00	14.80	66.70	20.00	44.40	36.00	33.30	37.50	50.00	16.10	60.00	25.00	27.33
	Not present	80.00	85.20	33.30	80.00	55.60	64.00	66.70	62.50	50.00	83.90	40.00	75.00	72.63
	Place of pets													
	Inside the house	0	75.00	0	60.00	0	60.00	0	50.00	0	25.00	0	20.00	43.33
	Courtyard	0	25.00	100	40.00	0	40.00	100	50.00	0	75.00	0	80.00	66.67
	Food given to pet (place)													
	Inside the house	0	25.00	100	40.00	0	33.30	0	16.70	0	20.00	0	20.00	25.00
	Courtyard /verandah	0	75.00	0	60.00	100	66.70	100	83.30	0	80.00	0	80.00	75.00
	Time spent in livestock/pet bathing (min./day)													
	Mean	12.38	15.09	14.00	14.33	19.11	17.89	16.20	17.88	22.32	12.82	20.48	14.72	15.65
SD	3.30	9.37	3.46	7.94	15.94	14.46	15.16	14.53	24.51	15.50	19.39	16.49	13.47	
Time spent in shed cleaning (min./day)														
Mean	11.06	15.51	5.77	13.63	14.19	13.88	15.38	14.17	18.50	16.76	15.65	16.79	14.86	
SD	8.88	9.53	5.77	9.48	5.37	3.94	2.90	4.10	6.80	5.74	3.80	5.55	6.86	

The average time spent in livestock/pets cleaning was 15.65 min./day. Respondents in CZ spent more time (17.88 min./day) in livestock/pets cleaning than RZ (14.33 min./day) and IZ (14.72 min./day). In CZ (19.11 min./day) and IZ (22.32 min./day) respondents who spent more than average time belongs to low HDMs category. Respondents' awareness towards cleanliness compels them to devote more time in rigorous cleaning of livestock/pets which reduces micro organism growth.

Time spent in shed cleaning: Proper cleaning of shed is an important step in removing the micro organisms entering within indoors (Bronswijk, 1981) [2]. Unhygienic conditions of pets may create different type of allergic diseases among household members (Bency *et al.*, 2003) [3]. Hence, proper cleaning of pets is necessary by bathing the animals, cleaning and washing of shed. Regular cleaning of household pets is a necessary step in controlling HDMs.

Table 4 reveals that the average time spent by the respondents in cleaning of shed was 14.86 min./day. Respondents of IZ spent more than the average time (16.79 min./day) than CZ (14.17 min./day) and RZ (13.63 min./day). Moderate HDM

category RZ respondents spent more time (15.51 min./day) in shed cleaning. Thus, it can be said that more time devoted in cleaning reduces allergen levels in home. In CZ higher HDM category respondents spent more than the average time (15.38 min./day) in shed cleaning. On the contrary, in IZ higher than the average time (18.50 min./day) was spent by lower HDM category respondents in shed cleaning. This entails that if more time is devoted in cleaning it will lowers HDMs concentration.

Conclusion

Presence of house dust mites is a matter of serious concern. Improper house cleaning accumulates dust in indoors furnishings and furniture which creates unhygienic and insanitary conditions in house. Dust mites live in settle dust that causes severe health problems for inmates. This hazard becomes all the more grave in localities which are not properly designed and are bereft of modern amenities. Insensitivity to ecological concerns aggravates the problem. 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. Our 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 furniture and furnishings. The task before the architects, house and town planners, policy makers, researchers and last but not the least the home makers is to take serious cognizance of the findings of this research and take consequent action to ameliorate the problems caused by house dust mites.

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