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# Cheyletid mites (Acari: Cheyletidae) from stored foods in Kashmir

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**ABSTRACT:**Mites are widespread in distribution and are present almost in all the habitats. A huge number of stored foods like dried fruits, grains, cereals, pulses and various other stored foods are often infested with various types of mites. An acarological survey was conducted on 10 stored food types from December 2014 to November 2017 in Kashmir (India). A total of 2400 samples ( each sample of 25 grams) from stored foods namely almonds (*Prunus dulcis*), dry coconut (*Cocos nucifera*), groundnuts (*Arachis hypogaea*), maize (*Zea mays*), mustard (*Brassica juncea*), rice (*Oryza sativa*), walnuts (*Juglans regia*), wheat (*Triticum aestivum*), wheat flour (*Triticum aestivum*) and white gram (*Cicer arietinum*) were collected and examined for the presence of mite fauna. Twenty samples per food type were collected per season, i.e. Winter (December to February), Spring (March to April), Summer (May to August) and Autumn (September to November). A total of 439 samples (18.29%) were mite positive. Nineteen mite species belonging to the three orders, eleven families and fourteen genera were reported. A total of 5746 mite specimens were obtained. In this paper, the emphasis is on the data pertaining to the presently reported mite species of the family Cheyletidae. Cheyletids were reported in samples of 9 (90%) food types. A total of 66 samples (15.03%) with 512 (8.91%) specimens out of the 439 total mite positive samples with 5746 specimens were positive for the Cheyletids. During the summer, both occurrence and abundance were the highest, so were during December 2014-November 2015. Cheyletidae was the third-most frequent and abundant mite family found in stored food samples after the first-most family Acaridae and second-most family Glycyphagidae. Among the Cheleytids, *Cheyletus eruditus* was the most frequent and abundant species reported.

**KEYWORDS**

Mites, Cheyletids, Cheyletidae, Acaridae, Glycyphagidae, Stored foods, Seasons, Occurrence, Abundance

## INTRODUCTION

Mites are mostly among the serious pests damaging agricultural and stored foods especially food grains, grain flour and other cereal products. The mites can severely reduce the quality of stored products and can also reduce the quantity of it as well. In wheat, these mites damage the seeds and make them incompatible for germination (Solomon, 1946). Mites often infest grain and stored food during transporting, processing for consumption and storage. The stored products fed by storage mites become deficient in carbohydrate and protein contents. Some mite genera from the family Acaridae and Glycyphagidae are the important source of allergens to the workers of farm and stores (Arlian, 1991; Cuthbert *et al.*, 1979; Hallas and Iverson, 1996; Hughes, 1976). *Acarus sp*. and *Tyrophagus sp.* from the family Acaridae; and *Lepidglyphus destructor*, *Glycyphagus demesticus and Gohieria fusca* from the family Glycyphagidae are the most common mite species reported from stored food products from all over the world (Arlian, 1991; Arlian *et. al*., 1993; Fian, 1990; Hallas, 1985; Hughes, 1976). Tyroglyphid mites, commonly known as "Cheese mites" infest most stored products particularly grain, flour and other cereal (Solomon, 1945).

Mites of the family Cheyletidae have been recognized as predators of phytophagous mites in some parts of the world. Presently, the family Cheyletidae (Acariformes: Cheyletoidea) includes over 440 species in 75 genera (Zhang *et al*. 2011; Bochkov and Abramov 2016). About 78% of cheyletid species are free-living predators, while the remaining species are permanent parasites of mammals and birds. The predatory species occupy a wide variety of habitats including patchy or ephemeral substrates requiring dispersal by phoresy on insects or vertebrates (Bochkov and Oconnor 2004). Some of them are free-living predators inhabiting plants, soil and plant debris while some representatives of this family are also quite important for agriculture and the health of humans and domestic animals (Volgin 1969; Bochkov and Fain 2001).

The storage mites are the source of many allergies and cause occupational allergy among farmers and other agricultural workers. The relationship between storage-mite sensitivity and allergic symptoms such as asthma, rhinitis, and conjunctivitis was first studied among a group of farmers in Scotland (Cuthbert *et al*., 1979). Allergens produced by stored mites cause respiratory disease and atopic

dermatitis of farmers (Hage-Hamsten-van *et al*., 1988; Arlian *et al*., 1997; Colloff 2009). Mites are also harmful to bakers, shopkeepers and some of the occupational categories (Arlian *et. al*., 1993; Dutkiewicz *et. al*. 1988; Hage and Johansson, 1992; Hallas *et al*., 1991; Tee, 1994). Considering the fact that stored foods like Almonds, dry coconut, groundnuts, maize, mustard, rice, walnuts, wheat, wheat flour and white gram are the most commonly used foods in Kashmir (India), therefore the research was undertaken to explore mite fauna associated with such stored foods.

## MATERIALS AND METHODS

During this research work carried out seasonally from December 2014 to November 2017, samples from 10 types of stored foods from 4 districts (Anantnag, Kulgam, Pulwama and Shopian) in Kashmir (India) were collected and examined for the presence or absence of mite specimens by using modified Tullgren-Berlese funnel method or/and Flotation method. For each food type a total of 20 samples (each of 25 grams weight) in each season (Winter, Spring, Summer and Autumn) were collected in Ziplock polythene bags and examined in the Laboratory. Sampling was done from different grain stores and grocery shops. A complete record of the date, time, temperature, moisture and locality was also maintained. The extracted mites in 70% alcohol were subjected to clearing in 60% lactic acid for 2 days at 50°C temperature prior to examination under dissection microscope and cleared specimens were sorted into what appeared to be similar taxonomic entities and then representatives were mounted singly to get better understanding of which mite species was present or dozens of mites of similar taxonomic entity were mounted on a single slide to save time and materials. The mounted specimens were observed under a microscope and identified by using keys and literature. This way, the individual population of each mite species in each infested food sample of each stored food was counted and recorded in every season over a period of research work. For making permanent slides, mite specimens cleared in 60% lactic acid were mounted on slides in Hoyer's medium for further identification (Fain *et al.,* 1990). Photography of the specimens was done with the help of Leica microscope at a magnification of 100X and 200X.

## RESULTS AND DISCUSSION

In this research work, a total of ten food types were studied for the presence of mite fauna in Kashmir from December 2014 to November 2017. The samples were collected seasonally from the four districts- Anantnag, Kulgam, Pulwama and Shopian. Seasonally, 20 samples per food type were collected and examined. Thus a

total of 2400 food samples were examined over a period of 36 months (Dec 2014-Nov 2017). A total of 5746 specimens from 439 samples of 19 species, 14 genera, 11 families and 3 orders were obtained. Among infested samples, only 66 samples were positive for 512 specimens of Cheyletids. The food-wise frequency of total mite and Cheyletid infested occurrence and abundance are shown in the figures 1, 2, 3 & 4, respectively. The food-wise seasonal and yearly frequency (number) of Cheyletid infested samples and specimen abundance are shown in the figures 5, 6, 7 & 8, respectively. Only 3 mite species of the only one genus *Cheyletus* viz. *Cheyletus aversor*, *Cheyletus destructor* and *Cheyletus malaccensis* of the family Cheyletidae were reported in 66 (15.03%) samples with a total of 512 specimens. The frequency of occurrence and abundance of *Cheyletus aversor*, *Cheyletus eruditus* and *Cheyletus malaccensis* was 15 & 103, 34 & 275 and 17 & 134, respectively. Among the Chelitids, occurrence and abundance frequencies (%) of the *Cheyletus aversor*, *Cheyletus destructor* and *Cheyletus malaccensis* were 22.72% & 20.12%, 51.52% & 53.71, and 25.76% & 26.17%, respectively (Figure 9 & 10, respectively). Within the Order Trombidiformes, the Cheyletids were reported in 68.75% infested sample with a proportion of 61.32% specimens.

As per their feeding habits, two kinds of mites were reported: pest mites and predatory mites. In the predatory group, nine species were reported. Predatory mites were present in 126 samples out of the 439 total mite infested samples reported. Similarly, 1111 specimens out of total 5746 were of predaceous mite group. Within the predaceous mites reported, the frequency (number and %) of occurrence and abundance of Cheyletids was 66 (52.38%) out of 126 predatory mite infested samples and 512 (46.08%) out of 1111 predatory mite specimens, respectively (Figure 11). Among the predacious mites reported, the *Cheyletus aversor* was present in only 11.90% samples with a population proportion of 9.27%. However, *Cheyletus eruditus* and *Cheyletus malaccensis* were present in 28.98% samples with a population proportion of 27.45% and 13.49% samples with a population proportion of 12.06%, respectively.

The seasonal based distribution of cheyletid mite infested samples showed that 36 samples were infested during the Summer season, 18 samples during the Autumn, 12 samples during the Spring and not a single cheyletid mite positive sample was obtained during the Winter season. Similarly, the seasonal distribution of the frequency of abundance of the cheyletid mites was highest during the Summer season

(344 specimens), medium in the Autumn (117 specimens), low in the Spring (51 specimens) and none in the Winter. The yearly distribution of the frequency of occurrence of the cheyletid mites was highest during the survey period from December 2014-November 2015 (27 infested samples), medium during December 2016-November 2017 (20 infested samples) and lowest during December 2015-November 2016 (19 infested samples. Similarly, the yearly distribution of the frequency of abundance of the cheyletid mites was highest during the survey period from December 2014-November 2015 (186 specimens), medium during December 2015-November 2016 (171 specimens) and lowest during December 2016-November 2017 (155 specimens). The seasonal and yearly frequencies (Number & %) of distribution of occurrence and abundance of Cheyletids including the respective remarks on their grouping based on their level of frequencies as proposed by Rajski's (1991) are presented in the tables 1, 2, 3 & 4, respectively.

The present work investigated Cheyletid mite fauna from the samples of 10 stored foods on a seasonal basis for a period of 36 months (December 2014 to November 2017). The data revealed that only the 3 species of the genus *Cheyletus* were reported. The Season-wise and Year-wise monthly average temperature (maximum) and relative humidity values were used to show/estimate their effect on the frequency of mite infestation and population size. The Seasonal monthly average temperate appears to represent a significant figure related to the seasonal frequency changes of mite occurrence and abundance (Figure 12 & 14). In addition, the seasonal and yearly based frequency changes in occurrence and abundance of mites in food samples do not appear to be in a direct positive or negative relationship with the atmospheric averaged monthly recorded values of Relative humidity (%) (Figure 12 & 13). However, the estimated amount of water present in per kilogram of air at the given temperature and relative humidity indicated that the absolute humidity was the highest during the summer followed by the autumn, spring and winter which showed a direct positive effect on the seasonal based change in mean population values of cheyletid infested samples (Figure 15). The survey emphasizes the importance of mites in stored food products, and further studies like how to prevent their presence in our daily used stored foods and how to control their population build up once are in the stored foods, is highly desirable.

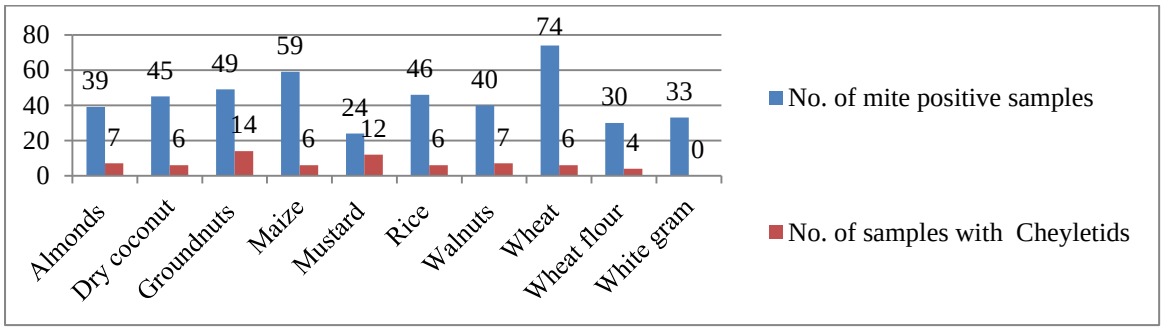



Figure 1- Showing the food-wise number of the total mite positive samples and only Cheyletid mite positive samples

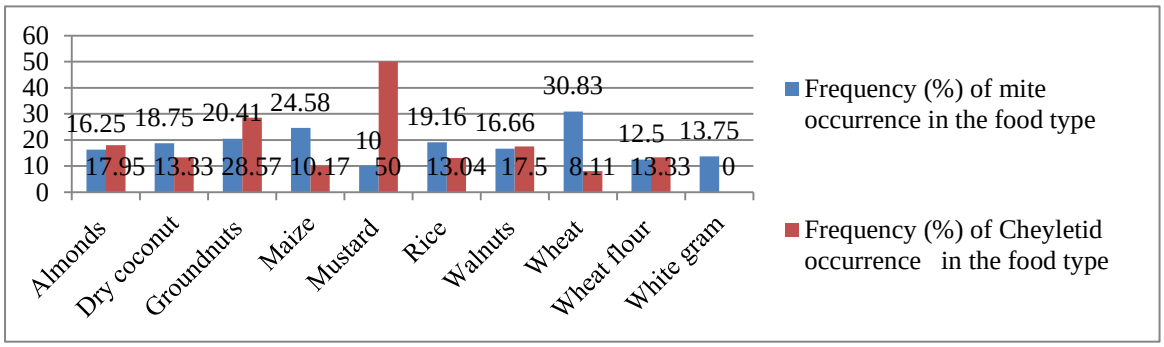



Figure 2- Showing the food-wise frequency (%) of the total mite positive samples and only Cheyletid mite positive samples

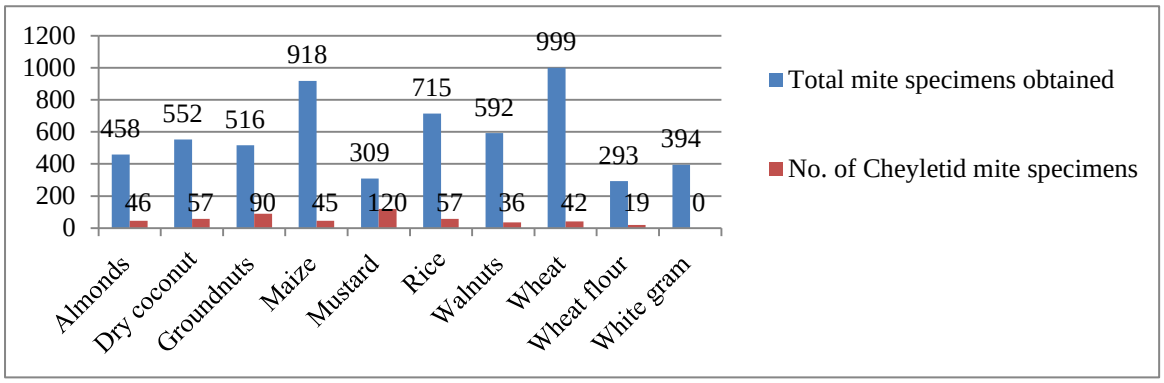



Figure 3- Showing the food-wise number of the total of mite specimens and only Cheyletid mite specimens

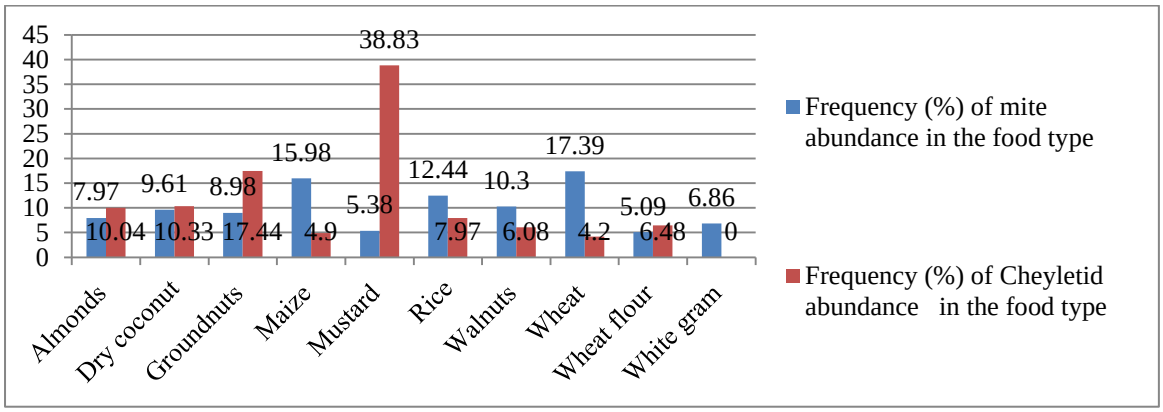



Figure 4- Showing the food-wise frequency (%) of the total mite specimens and only Cheyletid mite specimens

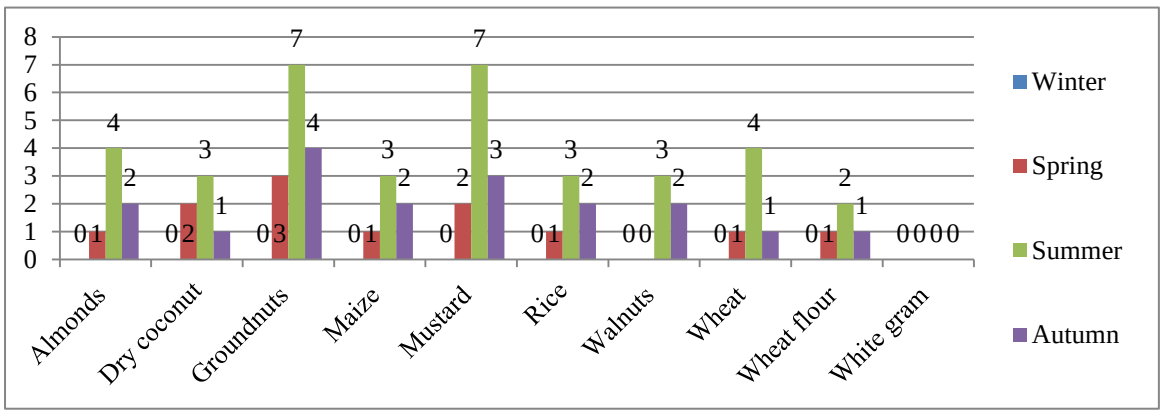



Figure 5- Showing the food-wise seasonal distribution of obtained Cheyletid infested samples

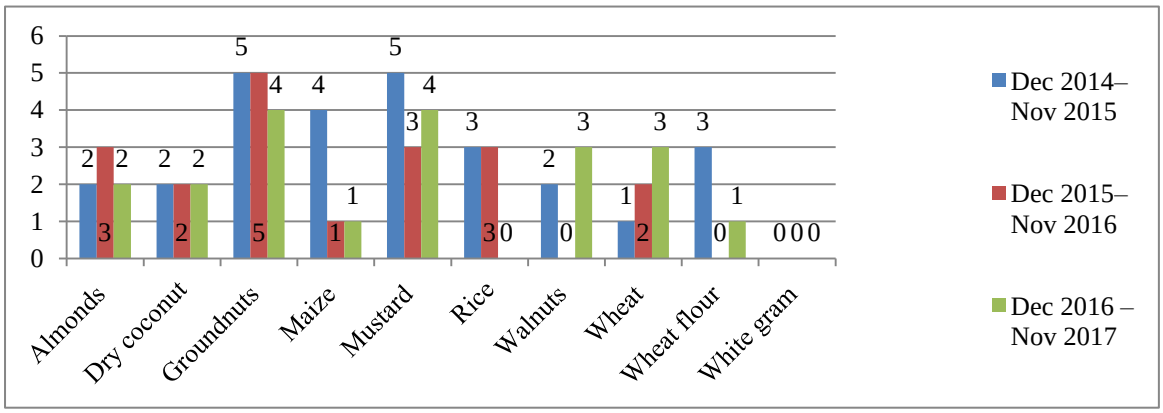



Figure 6- Showing the food-wise yearly distribution of obtained Cheyletid infested samples

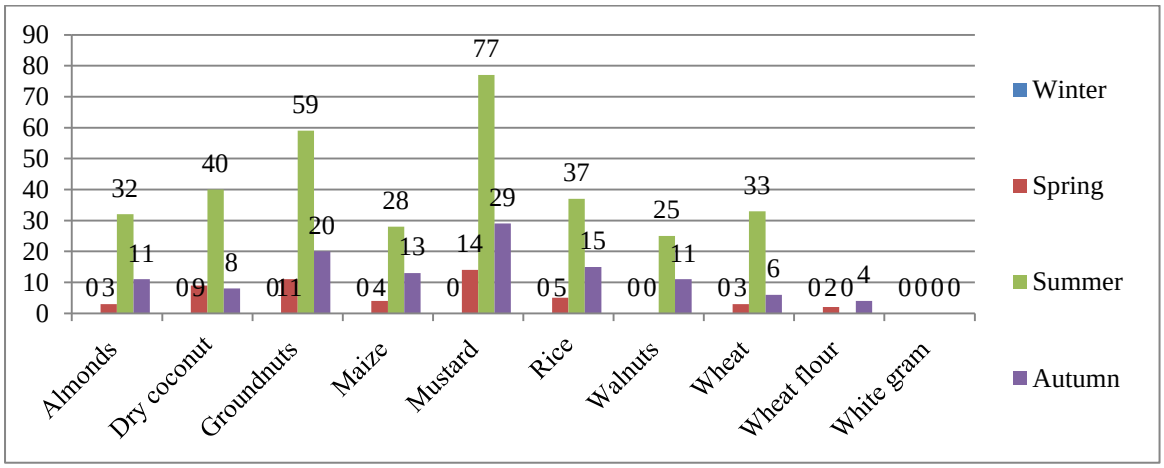



Figure 7- Showing the food-wise seasonal distribution of obtained Cheyletid specimens

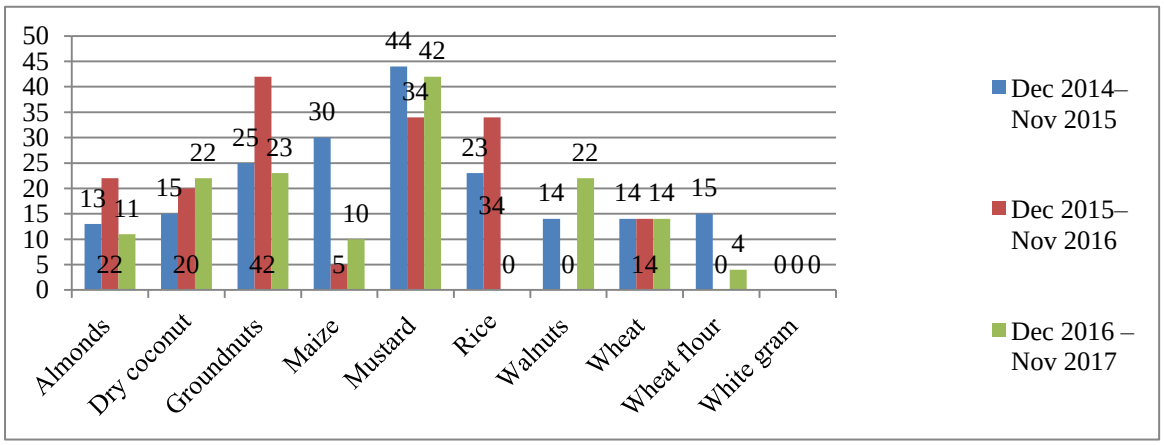



Figure 8- Showing the food-wise yearly distribution of obtained Cheyletid specimens

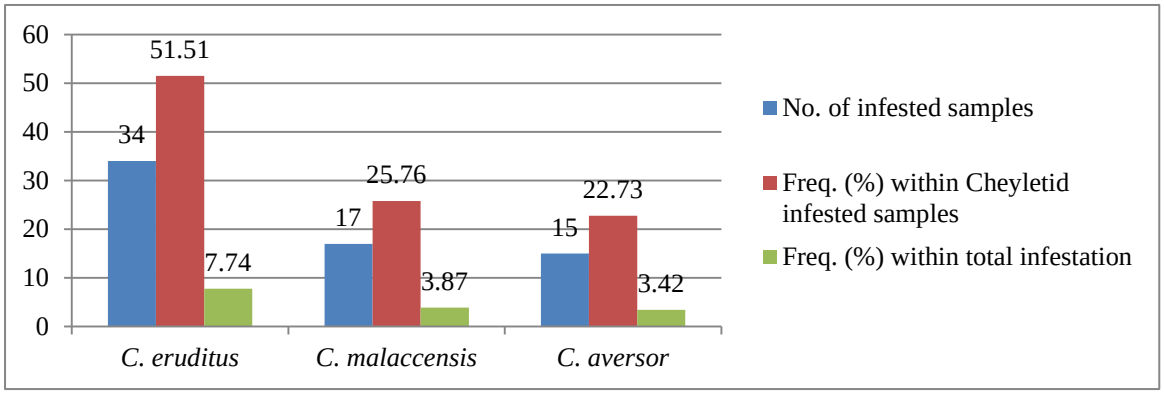



Figure 9- Showing the number of samples infested with the *C. eruditus*, *C. malaccensis* and *C. aversor*, and their frequency (%) of the infestation within the Cheyletid infested samples (66) and total infestation (439)

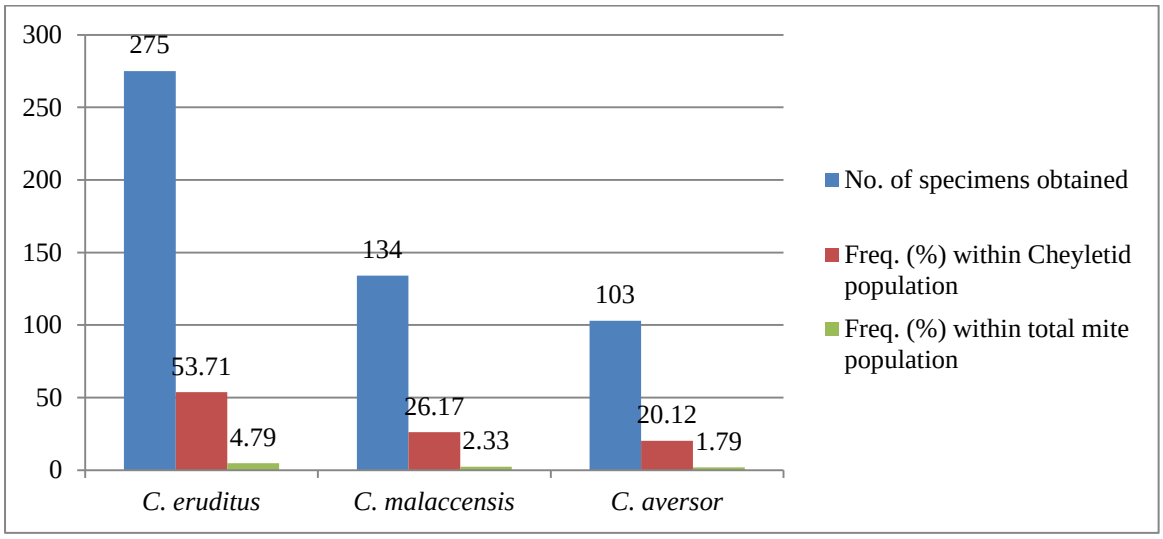



Figure 10- Showing the number of specimens of *C. eruditus*, *C. malaccensis* and *C. aversor*, and their frequency (%) of abundance within the Cheyletid specimens (512) and total mite specimens (5746)

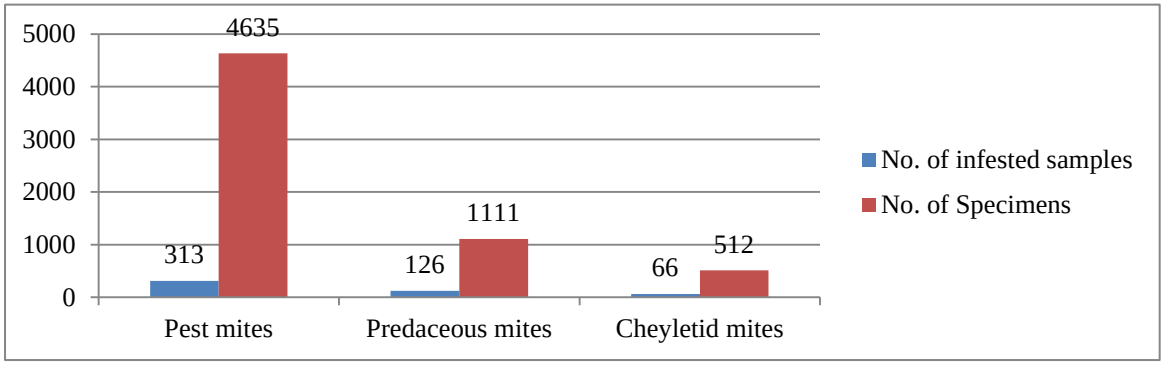



Figure 11- Showing the number of samples infested with and number of specimens of pest mites, predaceous mites and cheylitid mites

Table 1- Showing total mite and Cheyletid infested samples, their seasonal distribution, and seasonal frequency (%) of Cheyletid infested samples and their frequency based grouping given by Rajski (1991)

| Mite group | No. of infested samples | Seasonal frequency distribution of mite infested samples | | | |
|---|---|---|---|---|---|
| | | Winter | Spring | Summer | Autumn |
| All mites | 439 (18.29%) | 19 | 78 | 205 | 137 |
| Cheyletid | 66 (15.03) | 0 | 12 | 36 | 18 |
| Cheyletid frequency (%) | | 0 | 15.38 | 17.56 | 13.14 |
| Cheyletid grouping level | | Absent | Constant | Constant | Constant |

Table 2- Showing total mite and Cheyletid infested samples, their yearly distribution, and yearly frequency (%) of Cheyletid infested samples and their frequency based grouping given by Rajski (1991)

| Mite group | No. of infested samples found in | Yearly frequency distribution of mite infested samples | | |
|---|---|---|---|---|
| | | Dec 2014-Nov 2015 | Dec 2015-Nov 2016 | Dec 2016-Nov 2017 |
| All mites | 439 | 142 | 159 | 138 |
| Cheyletid | 66 (15.03) | 27 | 19 | 20 |
| Cheyletid frequency (%) | | 19.01 | 11.99 | 14.49 |
| Cheyletid grouping level | | Constant | Constant | Constant |

Table 3- Showing total mite and Cheyletid specimens obtained, their seasonal distribution, and seasonal frequency (%) of Cheyletid specimens and their frequency based grouping given by Rajski (1991)

| Mite group | No. of specimens found | Seasonal frequency distribution of specimens | | | |
|---|---|---|---|---|---|
| | | Winter | Spring | Summer | Autumn |
| All mites | 5746 | 81 | 645 | 3406 | 1614 |
| Cheyletid | 512 (8.91%) | 0 | 51 | 344 | 117 |
| Cheyletid frequency (%) | | 0 | 7.91 | 10.09 | 7.25 |
| Cheyletid grouping level | | Absent | Dominant | Eudominant | Dominant |

Table 4- Showing total mite and Cheyletid specimens obtained, their yearly distribution, and yearly frequency (%) of Cheyletid specimens and their frequency based grouping given by Rajski (1961)

| Mite group | No. of specimens found | Yearly frequency distribution of specimens | | |
|---|---|---|---|---|
| | | December 2014-November 2015 | December 2015-November 2016 | December 2016-November 2017 |
| All mites | 5746 | 1660 | 2399 | 1687 |
| Cheyletid | 512 (8.91%) | 193 | 171 | 148 |
| Cheyletid frequency (%) | | 11.63 | 7.13 | 8.77 |
| Cheyletid grouping level | | Eudominant | Dominant | Dominant |

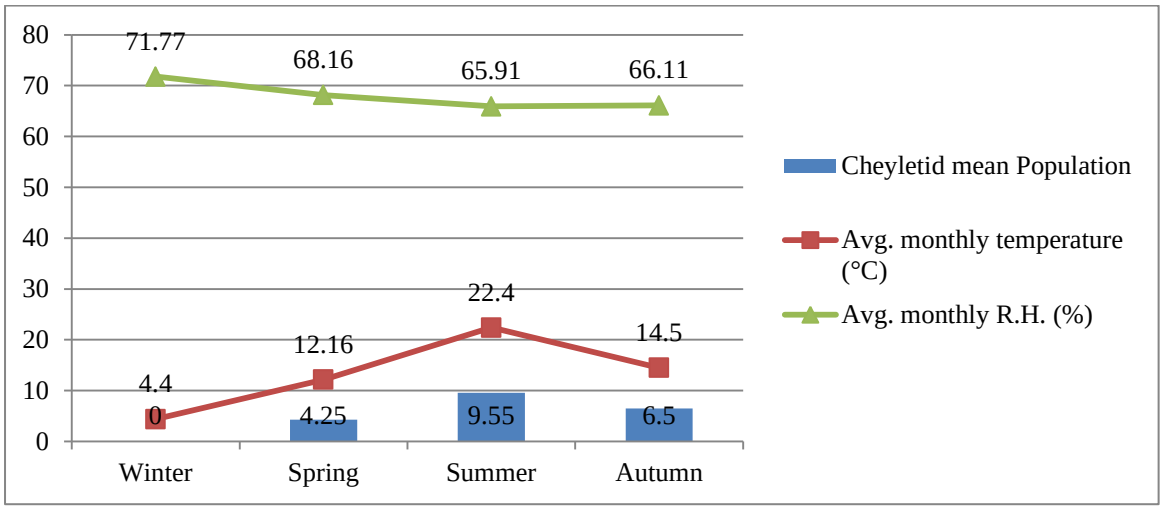



Figure 12- Showing the Seasonal based Cheyletid mean mite population obtained, and Average monthly temperature (°C) and Relative Humidity (%) recorded

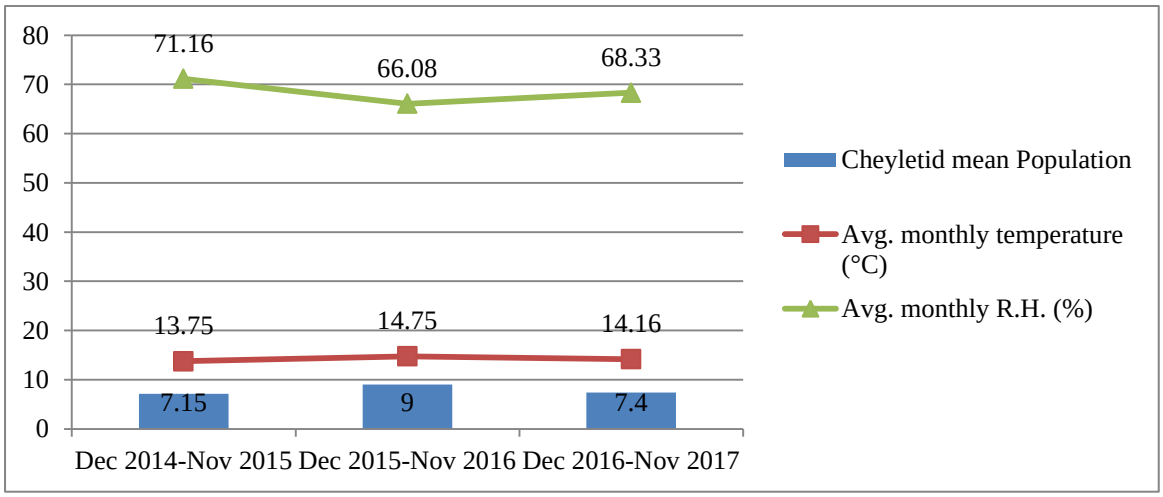



Figure 13- Showing the Yearly based Cheyletid mean mite population obtained, and Average monthly temperature (°C) and Relative Humidity (%) recorded

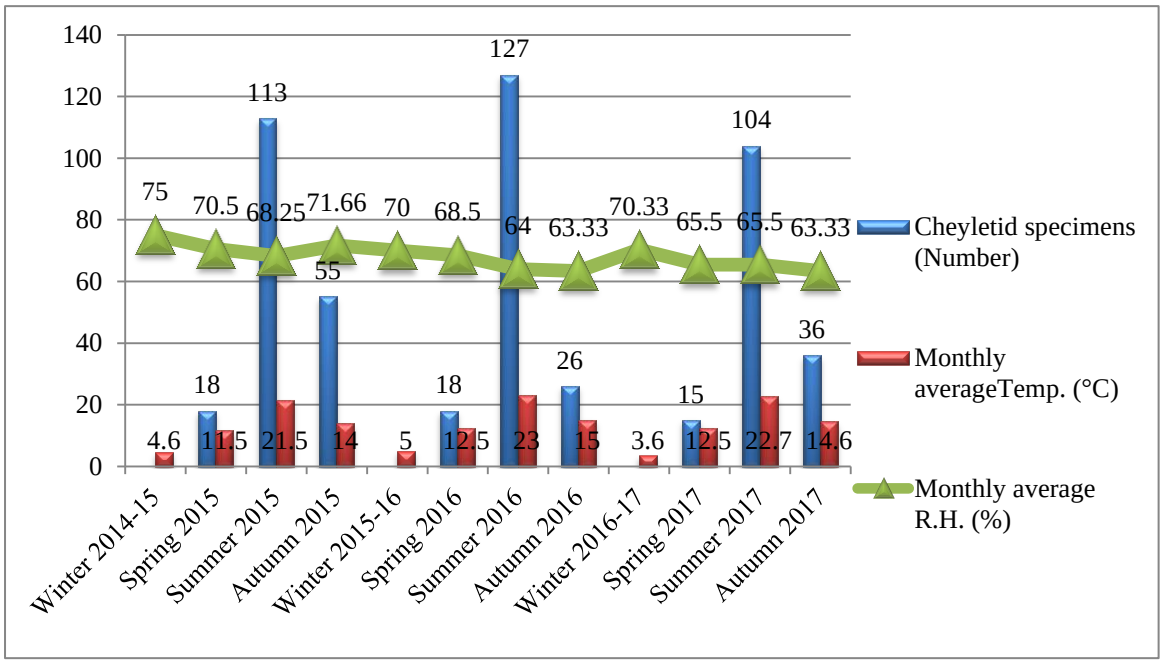
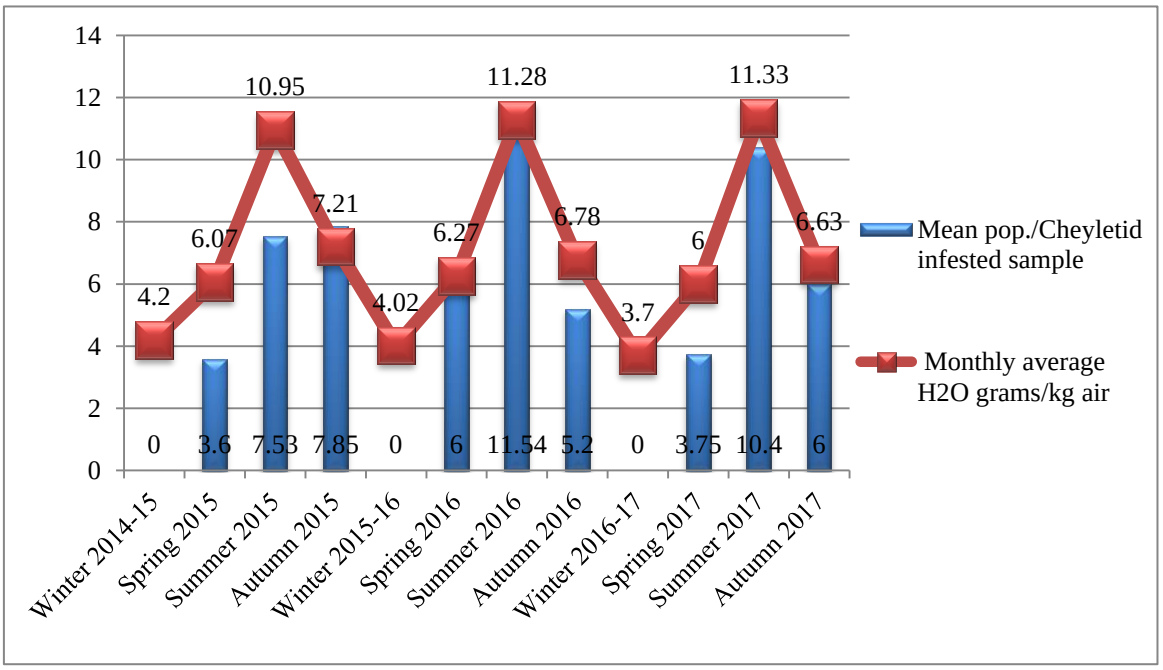


Figure 14- Showing the Seasonal based number of Cheyletid specimens obtained, and Monthly Average Temperature (°C) and Relative Humidity (%) recorded From




December 2014 to November 2017

Figure 15- Showing the Seasonal based Cheyletid Mean population obtained and Monthly Average Absolute Humidity ($H_2O$ grams/Kg air) from December 2014 to November 2017

**CONCLUSION**

The Cheyletid mites were reported in 9 out of 10 stored food samples investigated. White gram samples were negative from Cheyletids. Three Cheyletids *Cheyletus aversor*, *Cheyletus destructor* and *Cheyletus malaccensis* were reported. Among Cheyletid infested food sample and mite specimens obtained, *Cheyletus destructor* contributed the maximum proportion and *Cheyletus aversor* contributed the minimum proportion. Not a single Cheyletid specimen was reported during the winter season. Maximum proportion of Cheyletids was obtained the Summer season followed by the Autumn and then Spring. The number of Cheyletid-infested samples and the Cheyletid specimens obtained were directly in correlation with the temperature and moisture content (absolute humidity) in air but not with relative humidity. Cheyletids, based on their infestation (%) proportion in the total number of mite infested samples obtained, showed Constant level of infestation during Summer, Autumn and Spring, and year to year. Also, based on their population proportion (%)

among other mites, they were Eudominant during the Summer and Dominant level during the Autumn and Spring.

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