# Study on impact of household environment factors regarding milk storage and wheat powder prepared for feeding infants and some other regular storage flour infested with *Suidasia nesbetti*

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**Abstract:** In this study, three types of nutrition intended for infants were selected, treated with storage mites, *Suidasia nesbetti* were raised in the laboratory in a suitable environment, then culturing 100 mites in each sample and preserving them in different places in each selected kitchen at temperature and humidity varying relatively for a period of six months including autumn and winter. Fifteen houses having the same characteristics were chosen in terms of the region, age of the building, standard of living, the level of hygiene in the house, number of family members which on average was eight members per family home, and the level of health education. The samples were examined after opening directly to make sure of the safety and suitability for the secure feeding, and the examination was conducted periodically, every two weeks after storage to estimate the population dynamics of the mites with increasing duration for storage by one gram of each sample at the various houses and places. The study showed the highest population dynamics of the samples to be stored in Sealed box In Kitchen Cupboard, Kitchen Cupboard, Kitchen Shelf, Fridge, and finally Freezer which showed a significant decrease in population dynamics resulted in a reduction in the activity of reproduction and growth resulting from the lack of the appropriate conditions. The study found the greatest increase in the population dynamics of mites in the milk (M1), followed by (M2) and sweetened wheat powder (P) respectively, causes by the presence of specific factors leading to these differences in the chemical composition of the material, evidenced by the integration of all the environmental conditions for all samples, and the physical examination of the preserved materials a change in the color, smell, agglomeration of the powder (milk powder, sweetened wheat) resulted in a high level of humidity and the chemical reaction for the biological activities of the mites inside the selected materials.
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**Keywords:** Saudi Arabia Jeddah, Milk, Sweetened Wheat, nutrition of infants, Sealed box, Kitchen, Cupboard, Fridge, Freezer, Population dynamics, species, storage mite, *pyroglyphidae, T. putrescentiae, D. pteronyssinus, S.nesbetti,, D. farina,*

## 1. Introduction

Some species of mites have demonstrated a major impact on generating allergic diseases; bronchial asthma, allergic rhinitis, and conjunctivitis. previous studies have shown the main rule of house dust mites *Dermatophagoides. farainae* and *Dermatophagoides. pteronyssinus* as two main sources for allergic diseases. The following researches have proved the role of storage mites in causing allergic diseases **(Edrees, 2008b, Al-Nasser 2007);** notable, *Tyrophagous putrecenttiae* species was found during some surveys mixed with population of species belonging to Dermatophagoides **(Stara *et al*., 2011).**

In recent years, there has been a growing interest of mites for their damage to mankind, fauna and flora. Mite that infects stored material is called "storage mite" as it comes after insects as a lesion affecting stored products for its fast growth and major economic losses in nutrients around the world **(Franzolin & Baggio, 2000; Thind & Clark, 2001, Hubert, *et al* 2002, AL-Nasser 2007)**. Mite is characterized by rapid prevalence as it exists in temperate, tropical and subtropical regions; and in the Saudi arabia **(Edrees 2006, 2009c, 2012 and Al-Nasser, 2007)**. Mite is capable of such prevalence for its vast variation in adaptability, nutritional habits and tiny size that allows it to live in many areas hard to reach for other arthropods; as well as, its superior ability to live in different environments **(Arlian *et al.* 1999, Sharshir and Tadros 1995, Racewicz, 2001, AL-Nasser, 2007).**

It was noted by Iversen *et al* 1990 and AL-Nasser, 2007 that storage mites existed in the interior environment (indoor). The different species of mites appeared in homes depending on environmental factors; temperature and moisture **(Wraith *et al*., 1979, Inversen & Dahl, 1990, and Edrees 2006, 2012).**

The existence of *Suidasia nesbetti* mite, one of the prevalence species inside homes, is associated with high relative humidity and poorly ventilated areas where it can grow and reproduce to massive numbers inside stored cereals, flour, cheese, and dried fruits

**(Munro, 1966, AL-Nasser, 2007, Nada and Laila, 2011).**

Population dynamics of mites increase in materials stored for a while if compared with directly consumed materials as poor storage for long periods in stores with previous infections leads to fast reproduction and growth of mites; in addition to, infection transfer to new products **(Peace, 1983; Sharshir *et al*., 1988).**

**2. Method and Materials**

**Breeding of Mites cultures:**

*Suidasia nesbetti* mite was *raised* in an environment comprising of wheat palm and solid yeast powder at a temperature of 25 ± 3% and relative moisture of 75 ± 5% in complete darkness (Saleh, 1980 & 1989; Rezk, 1988).

Fifteen homes in Jeddah, Kingdom of Saudi Arabia were selected with the same characteristics; region, building age, living standard, cleanliness level inside homes, number of family members; which reached eight members in each home, and level of health and scientific culture.

Three types of canned foodstuff for infant nutrition commercially available in markets, were selected. They were milk powder of two different types symbolized by (M1 and M2) and sweetened wheat powder symbolized by (P). The canned foodstuff has been examined directly after being opened to ensure the safety of samples from infection and suitability for human. They were infected with *Suidasia nesbetti* mite by injecting a number of 100 mite in each sample then preserve them in five different places inside the kitchen; refrigerator, fridge, shelves, kitchen cupboard. and the last samples were preserved inside a plastic container tightly sealed inside perfectly closed kitchen cupboard. The samples are to be periodically examined twice a month for six months during all autumn and winter seasons. A sample is to be examined through one gram each time.

*House Dust Mite S. nesbetti was sowed within a lab in three types of yields (*Bran, Cracked wheat and White flour*) inside an electrical incubator at 32° temperature and 75% relative humidity for all three yields. The mite was separated in order to calculate its population density after the passage of one month from the beginning of experiment, keeping the temperature and relative humidity stable throughout the study period.*

**3. Results:**

**First line of experiment:**

**The numbers of *S.nesbetti* in Milk1, Milk2 and Sweetened Wheat Powder. A comparison according to storage place**

**Milk1 (Type1):**

The data distribution is not following the normal curve, so Kruskal-Wallis test was applied to compare between the five places of storage which are (Freezer, Fridge, Kitchen Shelf, Kitchen Cupboard, and Sealed box In Kitchen Cupboard).

**(Table 1): The result of Kruskal-Wallis test is shown as follows**

| Mean Rank | | | | | Chi-Square ($\chi^2$) | Sig (P.Value) |
|---|---|---|---|---|---|---|
| Freezer | Fridge | Kitchen Shelf | Kitchen Cupboard | Sealed box In Kitchen Cupboard | | |
| 6.50 | 25.04 | 30.88 | 42.21 | 47.88 | 41.117 | 0.000 |

It noticed from the results of this test that P.Value is (0.000), this value is smaller than the significant value of 0.05. So the null hypothesis that the number of *S.nesbetti* species is equal on the different spots of storage is rejected. It is shown through the table that the spot that has highest number of *S.nesbetti* species is the "Sealed box In Kitchen Cupboard" then "Kitchen Cupboard" then "Kitchen Shelf" then "Fridge" and the lowest number of *S.nesbetti* species was at the "Freezer".

**The comparison within the group "Milk1":**

To recognize the source of difference within the group "Milk1" Mann-Whitney analysis was conducted to each two components within the group.

**(Table 2): The differences are presented in the following table**

| Sig (P.Value) | | | | |
|---|---|---|---|---|
| | Fridge | Kitchen Shelf | Kitchen Cupboard | Sealed box In Kitchen Cupboard |
| Freezer | .000 | .000 | .000 | .000 |
| Fridge | | .088 | .002 | .001 |
| Kitchen Shelf | | | .009 | .003 |
| Kitchen Cupboard | | | | .088 |

It is noticed from the results of the previous analyses that P. Value was smaller than 0.05 in all cases of storage place of Milk1, expect (Fridge with Kitchen Shelf) and (Kitchen Cupboard with Sealed box In Kitchen Cupboard). Therefore it could be concluded that there are significant differences between most of the storage place in the kitchen. And the best place to store Milk1 is in the freezer and the worst is to store it in sealed box in kitchen cupboard.

**Milk2 (Type2):**

The data distribution is not following the normal curve, so Kruskal-Wallis test was applied to compare between the five places of storage which are (Freezer, Fridge, Kitchen Shelf, Kitchen Cupboard, and Sealed box In Kitchen Cupboard).

**(Table 3): The result of Kruskal-Wallis test is shown as follows**

| Mean Rank | | | | | Chi-Square ($\chi^2$) | Sig (P.Value) |
|---|---|---|---|---|---|---|
| Freezer | Fridge | Kitchen Shelf | Kitchen Cupboard | Sealed box In Kitchen Cupboard | | |
| 6.50 | 22.50 | 33.08 | 41.25 | 49.17 | 43.700 | 0.000 |

It noticed from the results of this test that P.Value is (0.000), this value is smaller than the significant value of 0.05. So the null hypothesis that the number of *S.nesbetti* species is equal on the different spots of storage is rejected. It is shown through the table that the spot that has highest number of *S.nesbetti* species is the "Sealed box In Kitchen Cupboard" then "Kitchen Cupboard" then "Kitchen Shelf" then "Fridge" and the lowest number of *S.nesbetti* species was at the "Freezer".

**The comparison within the group "Milk2":**

To recognize the source of difference within the group "Milk2" Mann-Whitney analysis was conducted to each two components within the group.

**(Table 4): The differences are presented in the following table**

| Sig (P.Value) | | | | |
|---|---|---|---|---|
| | Fridge | Kitchen Shelf | Kitchen Cupboard | Sealed box In Kitchen Cupboard |
| Freezer | .000 | .000 | .000 | .000 |
| Fridge | | .008 | .002 | .000 |
| Kitchen Shelf | | | .050 | .002 |
| Kitchen Cupboard | | | | .073 |

It is noticed from the results of the previous analyses that P.Value was smaller than 0.05 in all cases of storage place of Milk2, expect (Kitchen Shelf with Kitchen Cupboard) and (Kitchen Cupboard with Sealed box In Kitchen Cupboard). Therefore it could be concluded that there are significant differences between most of the storage place in the kitchen. And the best place to store Milk2 is in the freezer and the worst is to store it in sealed box in kitchen cupboard.

**Sweetened Wheat Powder:**

The data distribution is not following the normal curve, so Kruskal-Wallis test was applied to compare between the five places of storage which are (Freezer, Fridge, Kitchen Shelf, Kitchen Cupboard, and Sealed box In Kitchen Cupboard).

**(Table 5): The result of Kruskal-Wallis test is shown as follows**

| Mean Rank | | | | | Chi-Square ($\chi^2$) | Sig (P.Value) |
|---|---|---|---|---|---|---|
| Freezer | Fridge | Kitchen Shelf | Kitchen Cupboard | Sealed box In Kitchen Cupboard | | |
| 6.50 | 23.04 | 31.33 | 44.42 | 47.21 | 43.487 | 0.000 |

It noticed from the results of this test that P.Value is (0.000). This value is smaller than the significant value of 0.05. So the null hypothesis that the number of *S.nesbetti* species is equal on the different spots of storage is rejected. It is shown through the table that the spot that has highest number of *S.nesbetti* species is the "Sealed box In Kitchen Cupboard" then "Kitchen Cupboard" then "Kitchen Shelf" then "Fridge" and the lowest number of *S.nesbetti* species was at the "Freezer".

**The comparison within the group "Sweetened Wheat Powder":**

To recognize the source of difference within the group "Sweetened Wheat Powder" Mann-Whitney analysis was conducted to each two components within the group.

**(Table 6): The differences are presented in the following table**

| Sig (P.Value) | | | | |
|---|---|---|---|---|
| | Fridge | Kitchen Shelf | Kitchen Cupboard | Sealed box In Kitchen Cupboard |
| Freezer | .000 | .000 | .000 | .000 |
| Fridge | | .030 | .000 | .000 |
| Kitchen Shelf | | | .006 | .003 |
| Kitchen Cupboard | | | | .371 |

It is noticed from the results of the previous analyses that P.Value was smaller than 0.05 in all cases of storage place of Sweetened Wheat Powder, expect (Kitchen Cupboard with Sealed box In Kitchen Cupboard). Therefore it could be concluded that there are significant differences between most of the storage place in the kitchen. And the best place to store Sweetened Wheat Powder is in the freezer and the worst is to store it in sealed box in kitchen cupboard.

**Second line of experiment:**

**Determining the best environment of S.n growth among three different media (Bran, Cracked wheat and White flour)**

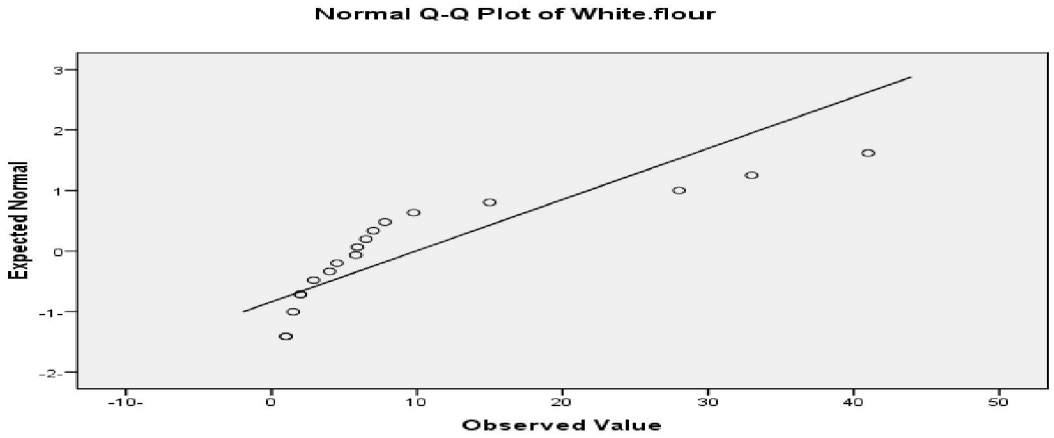
The data distribution is following the normal curve, so ANOVA test was applied to compare between the growth numbers of S.N. in three different media which are Bran, Cracked wheat and White flour.

**(Table 7): the growth numbers of *S.nesbetti* at the three media of Bran, Cracked wheat and White flour is equal is accepted.**

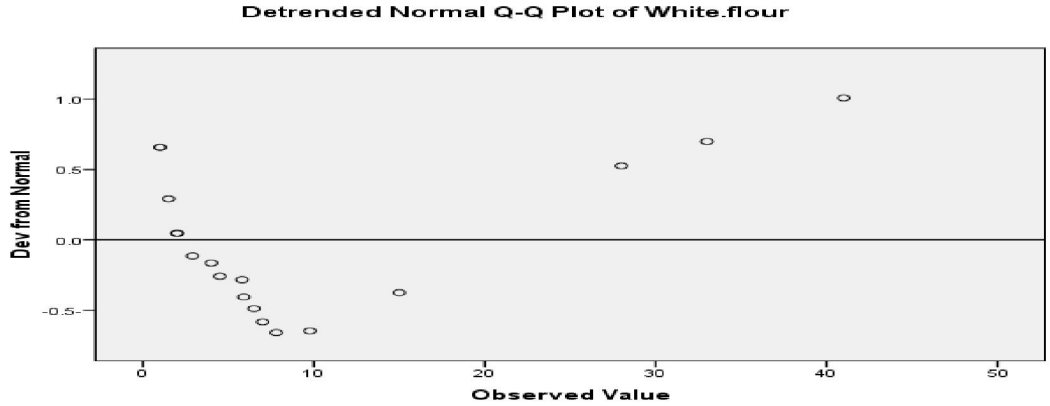
| Source of variation | Sum of Squares | Degrees of Freedom | Mean Square | Calculated F Value | P. Value |
|---|---|---|---|---|---|
| Between Groups | 42128.933 | 2 | 21064.467 | .839 | .456 |
| Within Groups | 301372.000 | 12 | 25114.333 | | |
| Total | 343500.933 | 14 | | | |

(The result of ANOVA test is shown in the following table)

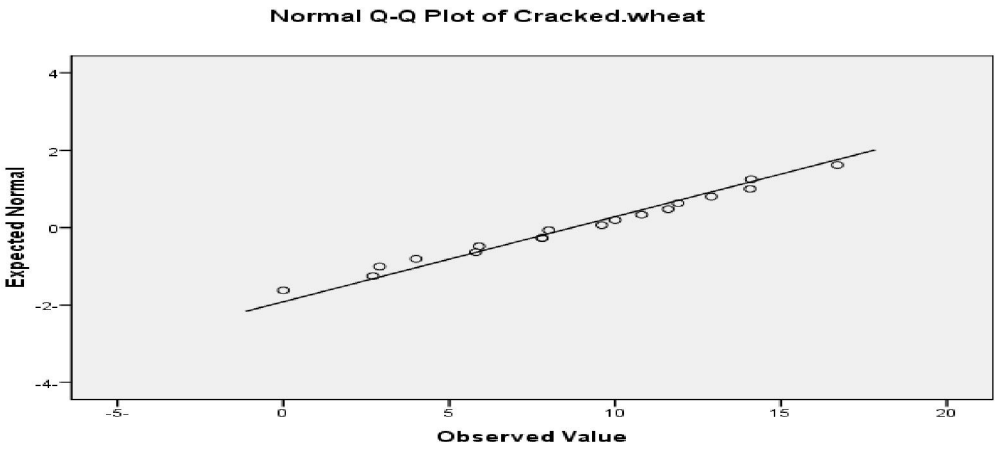
It noticed from the previous table that P.Value is (0.456), this value is bigger than the significant value of 0.05. So the null hypothesis that the growth numbers of ***S.nesbetti*** at the three media of Bran, Cracked wheat and White flour is equal is accepted.



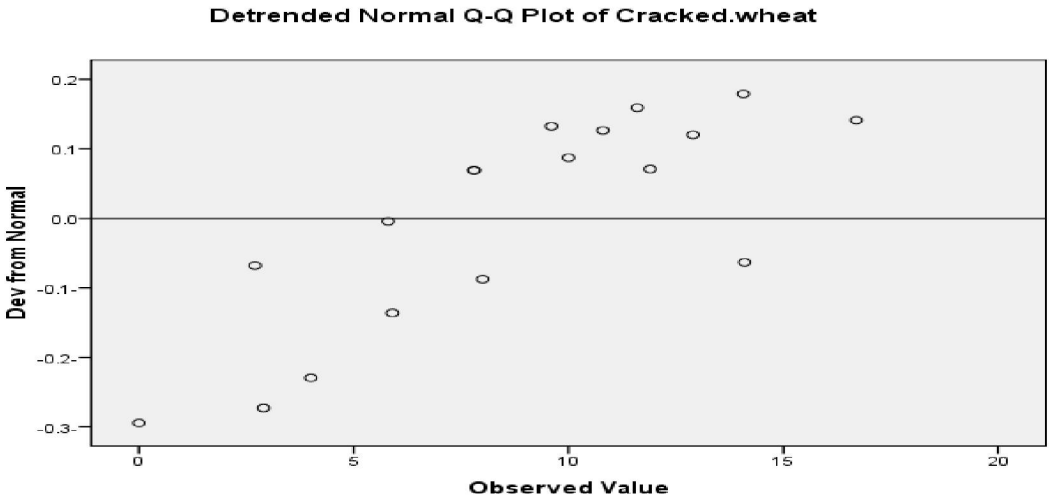

**Histogram: 1**



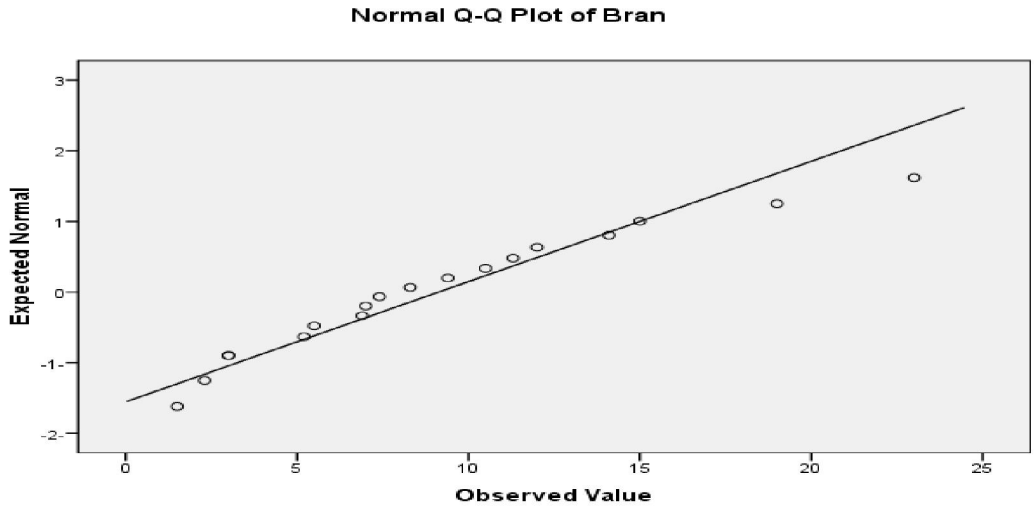

**Histogram 2:**



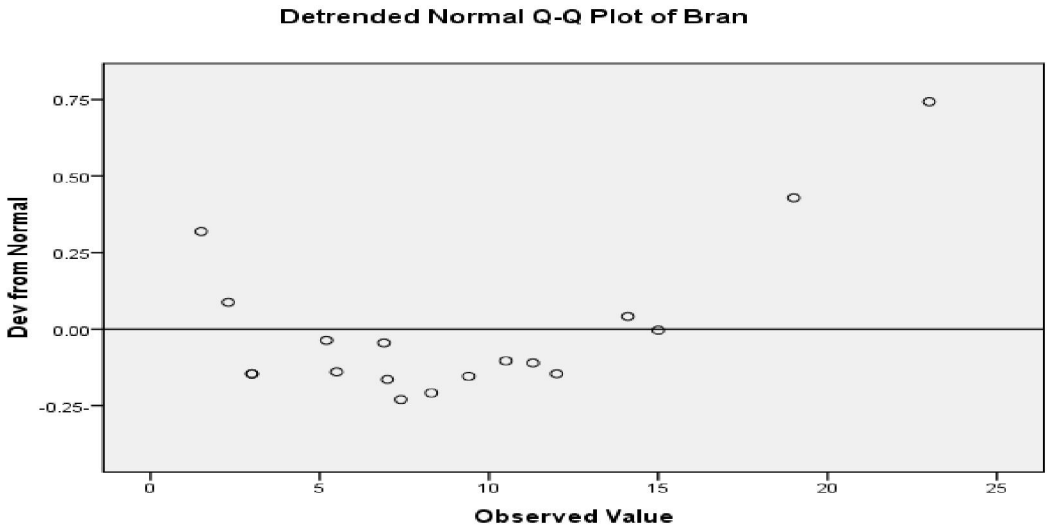

**Histogram 3:**




**Histogram 4:**




**Histogram 5:**




**Histogram 6:**

**4. Discussion**:

Many studies have demonstrated that nutrients infections with mites occur on the availability of convenient environmental conditions for growth and reproduction. These conditions include temperature of 25-30 °*C*, relative humidity that ranges from 65-75 %, and moisture content for the nutrient higher than (12-14%). Mites fed on the nutrient, causes its corruption and reduction of nutritional value; as well as, reduction in growth speed and loss of weight and nutritional value of infected seeds (Hughes, 1976, Wraith *et al*., 1979, Khan *et al*, 2012)**.**

Mites carry many tiny fungi and bacteria on their bodies that grow on wastes of mites (Guanine) besides moist and warm environmental conditions (Franzolin *et al*., 1999). Mlodecki 1960, 1961 noted that 85% of nitrogenous components of mites' wastes consist of guanine that triggers the microorganisms to infect the nutrient. It was noticed there is a significant increase of population dynamics in milk powder compared with wheat powder, a matter consistent with the notes of *Peace* (1983) concerning dried cheese infected with mites as mites fed and reproduced on it; in addition to dead bodies, detached skin and wastes, which is why mites appeared in the form of dust on the infected cheese.

The outcomes of the current study after comparing the infected samples with the sound samples have showed that there is a change in color of the infected food from light cream to grey or yellowish color in case of milk powder and to dark brown instead of beige in sweetened wheat powder that for infant nutrition. This is due to many factors including such as increase of moist content of the material, proteins metabolism, oxidation and corruption from decomposition of oxidizing fats. Unsaturated fatty acids are infected by oxidation during long storage periods accompanied by changes in color and smell that indicate that fast decomposition of stored materials is caused by infection with mites according to(AL-Nasser 2007, Prickety, 1997, Baker 2000, Mahakittikum *et al*, 2011).

This study has demonstrated the variation in population dynamics of mites resulting from its reproduction irrespective of preservation location. Tightly sealed boxes in kitchen cupboards show an enormous increase in density compared with other storage places in this experiment, while freezers recorded the lowest density for the previously mentioned causes in which increase of moist content and availability of suitable temperature are the most influential factors in increasing mite reproduction activity according to AL-Nasser 2007, Edrees 2008b, 2009c, Edrees and Saleh, 2008.

This study has also indicated that milk of the first type of milk (M1) is more prone to corruption than milk of second type (M2). In general, milk is more subject to corruption compared with wheat powder (P). All types of food are available in markets as a food for infants. Corruption that infects stored materials, the subject-matter of this study, may be attributed to increasing moisture content which leads to enzymatic activity of mites present in stored materials and this corresponds to what is concluded by (**Baker 2006, 2000, Yacout & Saleh, 1988, AL-Nasser 2007).**

*Chemical analysis findings of the contents of three types of yields (*Bran, Cracked wheat and White flour) infected with ***S.nesbetti*** revealed that they are a very suitable environment for the growth and proliferation of mites, together with diversity in

population density as per the type of infected yield. These three substances are common foodstuffs at homes, which are stored, handled and eaten on a daily basis, while the fall of their small fragments in the bedroom, living room and elsewhere is considered a very suitable food source for the growth and proliferation of mites inside homes, especially in case the carpet, moquette and all other humidity-absorbing furniture are not cleaned. This is in addition to the permanent closure of windows which result in non-renewal of air and prevent daily sunbeam. In this study, we notice a change in the color and smell of three infected yields, due to being invaded by mites and their rapid proliferation. In addition, there are several researches which pointed out that amino acids in the samples of infected flour are affected by the mites, and all aminos are noticed to be reduced as compared to intact samples **(Baker, 2000).** The findings revealed a decrease in most of amino acids due to consumption of protein as a main source for the growth of mites and microorganisms. This is attributable to the proteolytic activity of microbial enzymes for metabolism processes in mites, which causes a change in the color and smell in the foodstuff, and relate to the presence of bacteria and toxic fungi in the infected foodstuff, which, in turn, adversely affects the consumer's health, in addition to the animals that depends in their food on the infected foodstuffs. **(Al- Nasser 2007).**

**Conclusion:**

When preserving wheat and milk powder for infant nutrition, mothers should keep the canned foodstuff after being opened in dry places with good ventilations of dry air and sunlight or in a freezer to reduce corruption that may infect the children with diarrhea, vomiting, and food poisoning in general.

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