

A survey on occurrence of *Tyrophagus putrescentiae* (Acari: Acaridae) in Surk, a traditional Turkish dairy product

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Abstract

Four hundred-fifty samples of mouldy Surk, a Turkish traditional skim milk cheese, were collected at retail markets, small dairy plants and houses in Hatay province of Turkey, and were examined for the presence of storage mites. Only one species of storage mite, *Tyrophagus putrescentiae* (Schränk) was found in 38 of 450 samples (8.44%). The moisture and salt contents and pH value of the mouldy Surk cheese samples studied were determined as 44.59%, 5.88% and 5.31, respectively. In conclusion, in order to avoid storage mites, the production and storage stages of Surk cheese should be carried out under hygienic and right environmental conditions and it should be consumed freshly.

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1. Introduction

Storage mites are mostly found in stored food products and in occupational environments including storehouse, mills, farms and other sites with high density of mites (Armitage & George, 1986; Hughes, 1976; Li, Cui, Wang, Yang, & Tian, 2003a; Thind & Clarke, 2001). Over sixty species of mites contaminating stored foods were listed by Hughes (1976). Among the most common food-contaminating species of mites reported as *Tyrophagus putrescentiae* (Schränk), *Tyrophagus longior* (Gervais), *Thyreophagus entomophagus* (Laboulbène) and *Acarus siro* L., which are from Acaridae, *Suidasia pontifica* Oudemans, which are from Suidasiidae, *Dermatophagoides pteronyssinus* (Trouessart), *Dermatophagoides farinae* Hughes and *Euroglyphus maynei* (Cooreman), which are from Pyroglyphidae,

Glycyphagus domesticus (De Geer), *Lepidoglyphus destructor* (Schränk) and *Gohieria fusca* Oudemans, which are from Glycyphagidae (Olsen, 1998; Thind & Clarke, 2001).

The mold mite, *Tyrophagus putrescentiae* (Schränk) is a cosmopolitan storage mite species and infests commonly stored foods with high fat and protein contents such as cheese, bacon, peanuts, dried eggs, flours and some cereals etc. (Hill, 2002; Hughes, 1976). Development time for one generation of mites is 10 days (ranging from 9.5 to 130 days) depending on environmental conditions. The optimum temperature is average 25 °C (ranging from 8.5 to 36 °C) and optimum relative humidity in the environment is 80–90% for growth of mold mites. Adult mites live for about 2–5 months (Hill, 2002). Mites tend to congregate on the surfaces of food product (Olsen, 1998). These mites may cause acute enteritis, diarrhea, damage to urinary tract and allergic reactions including systemic anaphylaxis when contaminated food products are ingested, handled or inhaled (Armentia et al., 1994; Hughes, 1976; Li, Cui, Wang, Yang, & Tian, 2003b; Matsumoto, Hisano, Hamaguchi, & Miike, 1996; Matsumoto & Satoh, 2004).

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Surk cheese is a special and traditional dairy product and is commonly consumed in the Hatay province, located in the southern Turkey. It is generally produced in small dairy plants and houses in villages. Surk cheese is manufactured from skim milk cheese (çökelek), made from diluted yoghurt (ayran) through boiling, which was then put under pressure for 5–6 h to release its water through a cotton bag. Various spices including peppermint, thyme, cumin, black pepper, cinnamon, ginger, (0.1%–0.3% each), chili pepper (2%) and salt (5%) are added into skim milk cheese. Some may also choose to add garlic (1%). The mixture is given a pear-like shape after kneading. These balls were consumed either fresh or after storage of ≈ 20 –25 days at ambient temperature for making mouldy (Güler, 2000). It has to be noted that there is no standardized manufacturing method of Surk cheese.

Allergenic mites have been recently identified as an food safety issue, based on clinical findings that mite allergens may induce allergic disorders. To our knowledge, there has been no case of human disorder associated with storage mites in poorly stored local products reported in Turkey. However, there is no study carried out on the occurrence of storage mites in Surk cheese, which is commonly consumed food in Hatay province. The aim of this study was to determine the occurrence of mites in Surk cheese concerning public health.

2. Material and methods

2.1. Samples

Four hundred-fifty mouldy Surk cheese samples (each ≈ 200 g each) were collected randomly between June and November 2004 from different retail markets, small dairy plants and houses in villages of the Hatay province. The samples were transported in plastic bags to the laboratory.

2.2. Determination and identification of mites

About 5 g Surk was scraped from the surface of the samples into different petri dishes for each samples and were then squashed. After 8–10 ml of 10% KOH is added. The mixture was heated, but not boiled, to dissolve the cheese. After cooling, the resulting material was poured into a centrifuge tube and a saturated sugar solution was added. The tube was centrifuged at 200 G for 5 min and the surface material collected and then examined morphologically after mounted in Hoyer's medium on microscopic slides

(Sloss, Kemp, & Zajac, 1994). The identification of mite species was based on the keys of Hughes (1976) and Lee and Choi (1980). The numbers of mites and eggs were given as per 5 g of Surk.

2.3. Chemical analysis

The moisture and salt contents and pH measurements were carried out for only 50 samples randomly selected from total 450 mouldy Surk samples. While pH was measured using a pH meter with a glass electrode (Orion, 420A-USA), moisture content was determined by heating at 105 °C to constant weight. Salt content were determined according to the Turkish Standards (Cheese—Determination of Chloride Content, 1978). Duplicate tests were done for each analysis.

2.4. Statistical analysis

The numerical results of chemical analysis are given as mean, minimum, maximum and standard deviations (SD) with n being number of samples, using SPSS software (SPSS for Windows, 9.05 program).

3. Results and discussion

In this study, the presence of storage mites were investigated in total 450 Surk cheese samples. The mites were all identified as *T. putrescentiae*, which is from Acaridae family. Total numbers of *T. putrescentiae* at different developmental stages including eggs, larval, nymphal and adult mites were 1208. Only 38 of 450 (8.44%) were found to be positive for adult mites, while larval and nymphal mites and eggs were determined only in these adult mites-positive samples (MPS) at different rate (Table 1). The mean number of mites at different developmental stages excluding eggs per 5 g of samples among positive ones was 23.73. In 36 of 38 MPS, the numbers of adult mites were fewer than twenty and the highest number of mites was 29 in one MPS, which were in different developmental stages excluding eggs.

There are few studies concerning surveying mites infestation in cheese (Tigün & Özer, 1971; Umur, 1995; Yaman, Sevinç, Altınöz, & Uslu, 2000). Tigün and Özer (1971) investigated the mites in Turkish Kashar cheese and found two species of mites, *Acarus siro* and *Caloglyphus rhizoglyphoides*, but they did not provide any information on the prevalence of the mites in cheese samples. In the

Table 1
The number of *T. putrescentiae* at different developmental stages found in MPS of Surk cheese

	Total number	Mean $\pm$ SD	Minimum	Maximum	% of MPS
Eggs	306	15.04 $\pm$ 12.44	2	42	4.66 (21 of 450)
Larval mites	186	14.30 $\pm$ 7.07	1	24	2.88 (13 of 450)
Nymphal mites	247	19.00 $\pm$ 7.17	2	26	2.88 (13 of 450)
Adult mites	469 (♀365, ♂104)	12.34 $\pm$ 6.12	1	29	8.44 (38 of 450)

study carried out by Umur (1995), the prevalence of *A. siro* was 73.3% in old Turkish Kashar cheese samples. Yaman et al. (2000) reported prevalences of *A. siro* infestation as 10.34% and 3.27% in mouldy cheese and Tulum cheese, two traditional Turkish cheeses, respectively.

The analysis of moisture and salt contents were carried out and pH was measured for only 50 Surk cheese samples randomly selected from total 450 samples. The summary of the analyses are given in Table 2. Durmaz, Tarakçı, Sağun, and Aygün (2004) found higher moisture content (50.28%) in Surk samples than that in our study, while the salt content and pH were comparable. Leitao (1988) suggested that the fungi associated with stored grains are induced to proliferate at moisture contents greater than 13.5%, above which growth of mites is favored. Mites need a moist environment, which, in turn, induce the growth of fungi and yeast and the mites feed on both the fungi and yeasts (Hill, 2002). Consistently, the moisture content of Surk samples in the present investigation was 44.59% (Table 2), which favors the growth of moulds and mites in Surk. Woertz et al. (2002) reported that the mold mites are able to reproduce most readily in nutrient media of a pH 4 in 9–10 weeks. In consistent with the report given above, the pH value of the samples in our study was 5.3, which is close to the value stated. To our knowledge, there is no study carried out about effects of salt content of food products on growth of storage mites.

It is also suggested that mites are carriers and distributors of toxigenic fungi in stored grain kept under warm and moist conditions (Armitage & George, 1986; Franzolin, Gambale, Cuero, & Correa, 1999). Miller (1995) pointed out that the fungi in storage environments have been documented as mycotoxin producers which may endanger human health after consumption of contaminated food. Consistently, the poor storage conditions of foods may be resulted in serious mite infestations from food products (Hill, 2002). This author suggested a number of methods for avoiding from storage mites in stored food products: maintaining relative humidity at 60% in the environment, a moisture content less than 13.4% in stored food products, gamma radiation, hermetic storage, and modified atmosphere. Refrigeration could also be a way to suppress the growth of storage mites, as Matsumoto and Satoh (2004).

Olsen (1998) suggested that less than 75 mites per 100 g of canned mushrooms or 15 g of dried mushrooms are harmless and unavoidable in non-sensitive people to mite allergens, which is consistent with FDA guidance. In this study, the mean number of storage mites in infested

mouldy Surk cheese samples was 23.73 per 5 g Surk, which is comparable to the critical level stated above. There are no statutory limits concerning the number of mites that could be present in foods in Turkey. However currently, safety margin for avoiding sensitization or reaction to allergenic mites in food is unknown. But it has to be noted that extremely sensitive people to mite allergens may be at risk from any level of mite contaminations, considering that *T. putrescentiae* is known to induce IgE-mediated reactions in people (Olsen, 1998; Tee, 1994).

In conclusion, the mouldy Surk is a favorable product for the mites. Therefore, we suggest that the manufacturing, packaging, marketing and especially storage of Surk cheese should be carried out under hygienic and right environmental conditions and it should be consumed freshly. Further studies are needed to uncover the relationship between storage mites and moulds on the Surk cheese and to demonstrate if the storage mites in the poorly stored Surk cheese could be cause of human disorder.

References

- Anonymous, 1978. Cheese—Determination of Chloride Content. TS 3043, the Institute of Turkish Standards, Ankara (in Turkish).
- Armentia, A., Fernandez, A., Perez-Santos, C., de la Fuente, R., Sanchez, D., Sanchis, F., et al. (1994). Occupational allergy to mites in salty ham, chorizo and cheese. *Allergologia et Immunopathologia*, 22(4), 152–154.
- Armitage, D. M., & George, C. L. (1986). The effect of three species of mites upon fungal growth on wheat. *Experimental and Applied Acarology*, 2, 111–124.
- Durmaz, H., Tarakçı, Z., Sağun, E., & Aygün, O. (2004). Chemical and sensorial characteristics of Surks. *Firat Üniversitesi Sağlık Bilimleri Dergisi*, 18(2), 91–95 (in Turkish).
- Franzolin, M. R., Gambale, W., Cuero, R. G., & Correa, B. (1999). Interaction between toxigenic *Aspergillus flavus* link and mites (*Tyrophagus putrescentiae* Schrank) on maize grains: effects on fungal growth and aflatoxin production. *Journal of Stored Products Research*, 35, 215–224.
- Güler, M. B. (2000). The additives used in the production of Surk. In M. Demirci (Ed.), *Microbiology of milk and additives* (pp. 443–449). Istanbul: Rebel Yayıncılık (in Turkish).
- Hill, D. S. (2002). *Pests of stored foodstuffs and their control*. New York: Kluwer Academic Publishers.
- Hughes, A. M. (1976). *The mites of stored food and houses. Technical Bulletin of the Ministry of Agriculture, Fisheries and Food* (9). London: Her Majesty's Stationery Office.
- Lee, W. K., & Choi, W. Y. (1980). Studies on the mites (Order Acarina) in Korea. *The Korean Journal of Parasitology*, 18(2), 119–144.
- Leitao, M. F. (1988). Microbiologia de alimentos. In I. Roitman, L. R. Travassos, & J. L. Azevedo (Eds.), *Tratado de Microbiologia* (pp. 1–81). Sao Paulo: Manole.
- Li, C. P., Cui, Y. B., Wang, J., Yang, Q. G., & Tian, Y. (2003a). Acaroid mite, intestinal and urinary acariasis. *World Journal of Gastroenterology*, 9(4), 874–877.
- Li, C. P., Cui, Y. B., Wang, J., Yang, Q. G., & Tian, Y. (2003b). Diarrhea and acaroid mites: A clinical study. *World Journal of Gastroenterology*, 9(7), 1621–1624.
- Matsumoto, T., Hisano, T., Hamaguchi, M., & Miike, T. (1996). Systemic anaphylaxis after eating storage-mite-contaminated food. *International Archives of Allergy and Immunology*, 109, 197–200.
- Matsumoto, T., & Satoh, A. (2004). The occurrence of mite-containing wheat flour. *Pediatric Allergy and Immunology*, 15, 469–471.

Table 2
The chemical characteristics of Surk cheese (n = 50)

	Mean ± SD	Minimum	Maximum
pH	5.31 ± 0.74	4.24	6.42
Salt (%)	5.88 ± 1.74	3.43	8.60
Moisture (%)	44.59 ± 7.34	31.76	56.93

- Miller, J. D. (1995). Fungi and mycotoxins in grain: implications for stored product research. *Journal of Stored Products Research*, 31, 1–16.
- Olsen, A. R. (1998). Regulatory action criteria for filth and other extraneous materials. II. Alergenic Mites: An emerging food safety issue. *Regulatory Toxicology and Pharmacology*, 28, 190–198.
- Sloss, M. W., Kemp, R. L., & Zajac, A. M. (1994). *Veterinary clinical parasitology* (sixth ed.). Ames: Iowa State University Press.
- Tee, R. D. (1994). Allergy to storage mites. *Clinical and Experimental Allergy*, 24, 636–640.
- Thind, B. B., & Clarke, P. G. (2001). The occurrence of mites in cereal-based foods destined for human consumption and possible consequences of infestation. *Experimental and Applied Acarology*, 25(3), 203–215.
- Tiğın, Y., & Özer, Y. (1971). The mites of Turkish Kashar cheese. *Ankara Üniversitesi Veteriner Fakültesi Dergisi*, 18(3–4), 418–431 (in Turkish).
- Umur, S. , (1995). The incidence of the *Acarus siro* in Turkish Kashar cheese in Kars province. *Türkiye Parazitoloji Dergisi*, 19(4), 576–582 (in Turkish).
- Woertz, J. R., Kinney, K. A., Kraakman, N. J. R., Van Heiningen, W. N. M., Van Eekert, M. H. A., & Van Groenestijn, J. W. (2002). Mite growth on fungus under various environmental conditions and its potential application to biofilters. *Experimental and Applied Acarology*, 27, 265–276.
- Yaman, M., Sevinç, F., Altunöz, F., & Uslu, U. (2000). Research on *Acarus siro* in mouldy cheese and cheese in a skin. *Türkiye Parazitoloji Dergisi*, 24(3), 313–316 (in Turkish).