



**HAL**  
open science

## Emerging risk of infestation and contamination of dried fruits by mites in the Czech Republic

Jan Hubert, Vaclav Stejskal, Tomas Erban, Marta Nesvorna

► **To cite this version:**

Jan Hubert, Vaclav Stejskal, Tomas Erban, Marta Nesvorna. Emerging risk of infestation and contamination of dried fruits by mites in the Czech Republic. Food Additives and Contaminants, 2011, pp.1. 10.1080/19440049.2011.584911 . hal-00721229

**HAL Id: hal-00721229**

**<https://hal.science/hal-00721229>**

Submitted on 27 Jul 2012

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



**Emerging risk of infestation and contamination of dried fruits by mites in the Czech Republic**

Journal:	<i>Food Additives and Contaminants</i>
Manuscript ID:	TFAC-2011-057.R1
Manuscript Type:	Original Research Paper
Date Submitted by the Author:	20-Apr-2011
Complete List of Authors:	Hubert, Jan; Research Institute of Crop Production, Stored Product Pests Control and Food safety Stejskal, Vaclav; Crop Research Institute, Stored Product Pest Control and Food safety Erban, Tomas; Crop Research Institute, Stored Product Pest Control and Food safety Nesvorna, Marta; Crop Research Institute, Stored Product Pest Control and Food safety
Methods/Techniques:	Health significance, Exposure, Bioassay
Additives/Contaminants:	Additives general, Packaging
Food Types:	Dried fruit
Abstract:	The introduction of live insects into human food has been rare in developed countries. This work documents, for the first time, an emerging risk that exists from dried fruit in Central Europe. Recently, massive and frequent infestation of dried fruit imported from the Mediterranean region by the mite <i>Carpoglyphus lactis</i> L. (Acarina: Carpoglyphidae) has been found. In 180 analyzed samples taken from supermarkets, 13% were contaminated; the contamination levels ranged from 0 to 660 mites per g of dried fruit. The contamination was found in dried apricots, figs, plums and raisins. To estimate the risks and food preferences of <i>C. lactis</i> , its growth rate was examined under laboratory conditions. Starting with a hypothetical population of 10 mites per g of dried fruit, the risk level of 1,000 mites per g of dried fruit is reached at 42 days for dried figs, 49 days for dried pineapple and 63 days for dried

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

	<p>apricots, dates and plums at 25 °C and 85% of relative humidity following exposures of 21 days. The experiment found that mites are able to enter to every dried fruit packing material tested, including polypropylene and aluminum foils. This indicates that mites can disperse from package to package in supermarkets. Mites are known as allergen producers and vectors of mycotoxin-producing fungi. These findings indicate that an increased risk of <i>C. lactis</i> contamination exists in dried fruit.</p>

For Peer Review Only

SCHOLARONE™  
Manuscripts

1  
2  
3 **1 Emerging risk of infestation and contamination of dried fruits**  
4 **2 by mites in the Czech Republic**  
5  
6  
7  
8  
9  
10  
11

12 5 Jan Hubert, Tomas Erban, Marta Nesvorna and Vaclav Stejskal  
13  
14  
15  
16

17 7 Department of Stored Product Pest Control and Food Safety, Crop Research  
18 Institute, Drnovska 507, Praha 6 - Ruzyne, CZ -16106, Czech Republic  
19  
20  
21  
22  
23  
24

25 10  
26  
27 11 Corresponding author:  
28

29 12 Jan Hubert  
30  
31

32 13 Crop Research Institute  
33  
34

35 14 Drnovska 507,  
36  
37

38 15 Praha 6 - Ruzyne, CZ -16106,  
39  
40

41 16 Czech Republic,  
42  
43

44 17 e-mail: hubert@vurv.cz  
45  
46

47 18 tel: +420233022265  
48  
49

50 19 fax: +420233310636  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 20 **Abstract**  
4

5 21 The introduction of live insects into human food is rare in developed countries.  
6  
7 22 However we report, for the first time, an emerging risk that exists from dried fruit in  
8  
9 23 Central Europe. Recently, massive and frequent infestation of dried fruit imported  
10  
11 24 from the Mediterranean region by the mite *Carpoglyphus lactis* L. (Acarina:  
12  
13 25 Carpglyphidae) has been found. In 180 samples taken from supermarkets, 13%  
14  
15 26 were contaminated; the contamination levels ranged from 0 to 660 mites per g of  
16  
17 27 dried fruit. The contamination was found in dried apricots, figs, plums and raisins. To  
18  
19 28 estimate the risks and food preferences of *C. lactis*, its growth rate was examined  
20  
21 29 under laboratory conditions. Starting with a hypothetical population of 10 mites per g  
22  
23 30 of dried fruit, the risk level of 1,000 mites per g of dried fruit is reached at 42 days for  
24  
25 31 dried figs, 49 days for dried pineapple and 63 days for dried apricots, dates and  
26  
27 32 plums at 25 °C and 85% of relative humidity following exposures of 21 days. We  
28  
29 33 found that mites are able to enter every dried fruit packing material tested, including  
30  
31 34 polypropylene and aluminum foils. This indicates that mites can move from package  
32  
33 35 to package in supermarkets. Mites are known as allergen producers and vectors of  
34  
35 36 mycotoxin-producing fungi. These findings indicate that an increased risk of *C. lactis*  
36  
37 37 contamination exists in dried fruit.  
38

39 **Key words:** *Carpoglyphus lactis*, dried fruits, contamination, allergy  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## 40 Introduction

41 The presence of insects and mite contaminants in food is unacceptable not only  
42 for esthetic but also for health reasons. The pre-harvest infestation of fruits in the field  
43 has been widely documented. Several arthropods can become serious post-harvest  
44 pests in contaminated dried fruit. Among them, the *Plodia interpunctella* (Hubner)  
45 moth, *Carpophilus hemipterus* (L.) beetles, *Oryzaephilus surinamensis* (L.) and the  
46 dried food mite *Carpoglyphus lactis* L. are concerns in food production (Johnson et al  
47 2000). Dried apricots are especially sensitive to mite contaminations; the highest  
48 reported contamination is 15,000 mites per kg (Cobanoglu 2009). However, little data  
49 is available on the direct infestation of finished food products in supermarkets. One  
50 reason for this is that most food production companies and marketing chains  
51 consider data on pest infestation of finished products market-sensitive and therefore  
52 strictly confidential. The second reason is that, in the past three decades, the direct  
53 introduction of live arthropods in dried fruit marketed for human food has been  
54 considered rare due to the fact that most fruits have been preventively treated prior to  
55 export using the multispectral fumigant methyl-bromide. However, this fumigant has  
56 been banned for environmental reasons by the Montreal protocol treaty with no  
57 effective and reliable acting substitute for it (Fields and White 2002). Consequently,  
58 this may be the cause of a newly emerging risk from dried fruit in Central Europe. In  
59 fact, a high level of contamination of dried fruit has recently been found in products in  
60 Czech markets. For example in 2007, nine out of 76 RAFF (the rapid alert system for  
61 food and feed) notifications given by the Czech Republic were caused by mites or  
62 insect pests in dried fruit (Anonymous 2008).

63 Saleh et al. (1987) suggested a consequence of arthropod contamination is a  
64 decrease in the nutritional values of the fruits. However, recently the risk of the

1  
2  
3 65 arthropod contamination is due to their health impact, being producers of allergens  
4  
5 66 and the vectors of microorganisms. Because mites are well-known allergen  
6  
7  
8 67 producers (Colloff 2009), house dust mites are a primary concern because of their  
9  
10 68 proximity to humans. However, recently, there has been an increasing number of  
11  
12 69 reports describing the sensitization of humans not only to *Dermatophagoides* mites  
13  
14 70 but also to stored-product mites (Fernandez-Caldas 1997). The consumption of pest  
15  
16 71 mites may cause allergic reaction and also direct infestation in the form of intestinal  
17  
18 72 acariasis (Li et al. 2003). Allergy risk is heightened by the limited options available for  
19  
20 73 effective mite chemical control using traditional pesticides (Hubert et al. 2007). The  
21  
22 74 second risk is associated with the vectoring of mycotoxin-producing fungi. The  
23  
24 75 association of mites and mycotoxin-producing fungi such as *Aspergillus* spp. and  
25  
26 76 *Penicillium* spp. has been reported (Aucamp 1969; Franzolin et al. 1999; Hubert et al.  
27  
28 77 2004). The contamination of dried fruit by aflatoxins and ochratoxin is a common  
29  
30 78 event (Trucksess and Scott 2008). During their migration, mites can disseminate the  
31  
32 79 fungal spores. The risks associated with *C. lactis* are possible allergen production  
33  
34 80 and vectoring of mycotoxin-producing fungi. Although there is no evidence of this for  
35  
36 81 *C. lactis*, evidence does exist for related species of mites. The contamination of dried  
37  
38 82 fruit is directly correlated with the risk of direct consumption of hazardous mites.  
39  
40  
41  
42  
43  
44

45 83 In this study, we analyzed the mite contamination of 180 samples of dried fruit  
46  
47 84 obtained in Czech markets. To compare the risks of contamination of the fruit, we  
48  
49 85 analyzed in laboratory the growth rate of the mites on various dried fruit. This  
50  
51 86 analysis of growth rate simulates the risk of contamination of dried fruit in  
52  
53 87 supermarkets or in consumers' kitchens. This study is part of a broader pest-risk  
54  
55 88 study related to arthropod contamination of stored food and commodities in the  
56  
57  
58  
59  
60

1  
2  
3 89 Central Europe (Stejskal and Hubert, 2008; Hubert et al. 2009; Trematerra et al.  
4  
5 90 2011).  
6  
7  
8 91

## 92 **Material and Methods**

### 93 *Contamination of dried food*

94 The analyses of 180 samples of dried fruit included apricots, pineapple, plums,  
95 figs, raisins and dates. The samples were obtained in supermarkets from January to  
96 June 2010; three samples of each type of dried fruit were obtained from each market  
97 inspected (if available). Altogether we visited 5 different trade networks including 10  
98 markets. The samples were transferred to the laboratory and analyzed immediately.  
99 The dried fruits were weighed, and the mite infestation (all visible developmental  
100 stadia) was counted on a STEMI 2000 C dissection microscope (C. Zeiss, Jena,  
101 Germany). The mite infestation was recalculated per g of dried fruit. The mites were  
102 sorted out, preserved and mounted on microscopic slides for species determination.  
103 Mites were preserved in Oudemans solution (70% ethanol (87 ml); acetic acid (8 ml),  
104 glycerol (5ml)) and microscopic slides were done for their determination (Žďárková  
105 1967). Zuzana Kucerova (Crop Research Institute, Prague) determined mites. The  
106 specimens are stored in the collection of "Small organisms and microorganisms" at  
107 Crop Research Institute Prague, Czech R.  
108

### 109 *Risk analyses of mite growth on dried fruit.*

110 *Carpoglyphus lactis* (Linnaeus 1758) originated from laboratory stock cultures  
111 stored in the Crop Research Institute in Prague. The mites were reared at the plastic  
112 chambers derived from IWAKI tissue cell cultures with filter cap plugs (P-Lab, Praha,  
113 Czech Republic/CZ). The mites were reared from a fish food-derived diet composed



1  
2  
3 114 of dog food (Ontario-pet, Placek, Podebrady, CZ), wheat germ, Aqua-tropic dried fish  
4  
5 115 food (LonBio, Aqua Tropic Lonsky, Praha, CZ), Pangamin and gelatin (Serva  
6  
7 116 Electrophoresis GmbH, Heidelberg, Germany) (10:10:3:2:1 w/w). The diet was  
8  
9  
10 117 powdered using blender and sieved. The size of opening of the sieves was 0.5 mm.  
11  
12 118 After sieving the diet was heated to 70 °C for 0.5 h, then powdered and sieved again.  
13  
14  
15 119 The chambers were placed into Secodar desiccators (P-Lab) at 85% r.h. and kept at  
16  
17 120 25 °C in darkness.

18  
19  
20 121 The risk analyses included samples of dried apricots, pineapple, raisins, apples,  
21  
22 122 figs, and dates. The dried fruit samples were observed and no visible contamination  
23  
24 123 was found. To confirm that the dried fruit used had no hidden infestation, we  
25  
26 124 incubated the fruits without mites. In all cases we did not observe any mite infestation  
27  
28 125 after 21 days. The experiments were carried in IWAKI tissue cell cultures with filter  
29  
30 126 cap plugs (P-Lab). At the beginning of the experiment, pieces of dried fruit were  
31  
32 127 placed in the chamber and 10 unsexed mite adults were added. The chambers were  
33  
34 128 incubated in Secodar desiccators at 85% r. h. and 25 °C, in the dark for 21 days. The  
35  
36 129 experiment was terminated by the addition of 10 mL of 80% ethanol to the chambers.  
37  
38 130 Mites were directly counted under a dissection microscope. In the experimental  
39  
40 131 design, 12 or 24 replicates per type of dried fruit were performed.

41  
42  
43 132 As only the initial and the final mite population densities were known, we assumed  
44  
45 133 that the populations grew exponentially (McCallum 2000). The differential density-  
46  
47 134 independent model ( $N_t = N_0 e^{rt}$ ) was used to estimate growth rate  $r$ . In this equation ,  
48  
49 135  $N_0$  is the initial density of mites (=10),  $N_t$  is the final mite density, and  $t$  is the duration  
50  
51 136 of the experiment (21 days). Data showed normal distribution and were analyzed  
52  
53 137 using analysis of variance (ANOVA) with Tukey's honest significant differences  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 138 (HSD). Analyses were performed in XLSTAT 2007 (Addinsoft USA, New York, NY,  
4  
5 139 USA).

6  
7  
8 140

9  
10 141 *The penetration of mite into dried fruit packing*

11  
12 142 Mite transfer in dried fruits and other commodities in supermarkets has been  
13  
14  
15 143 simulated under laboratory conditions. Therefore, it is important to show that packing  
16  
17 144 materials used are mite proof. To test the various packing materials, we obtained 16  
18  
19 145 packages of each fruit type, at the same time from a single supermarket. We  
20  
21 146 examined four packages and if there was any infestation, we assumed that the rest of  
22  
23 147 the twelve packages were also without contamination and used them for subsequent  
24  
25 148 experiments. The closed packages (200 - 400 g) of dried apricots were placed in  
26  
27 149 plastic containers. Four different packing types of dried apricots were compared: (1)  
28  
29 150 Plastic bag; (2) Polypropylene bag; (3) Polypropylene bag with aluminum foil and (4)  
30  
31 151 Cellophane sac. One container contained 12 packs of one type of packaging  
32  
33 152 including one contaminated package. The contaminated package contained dried  
34  
35 153 plums and contamination had to be visible without opening the package. The  
36  
37 154 containers were incubated in laboratory conditions ( $25\pm 10$  °C) for 6 months. After  
38  
39 155 one, three and six months, four packages were randomly selected per container. The  
40  
41 156 mite infestation of dried apricot was analyzed as was described above. The presence  
42  
43 157 of mites on the surface of the bags was also verified. We inspected four packs at the  
44  
45 158 beginning of experiments to confirm that they are free of mites.  
46  
47  
48  
49  
50  
51  
52

53 159

54  
55 160 **Results**

56  
57 161 *Levels of contamination of dried fruit in the markets*  
58  
59  
60

1  
2  
3 162 The contamination of dried fruits was caused by the presence of *C. lactis* mites in  
4  
5 163 stored products (Figure 1). The level of contamination ranged from 0 to 660  
6  
7  
8 164 individuals per g of dried fruit (Table 1). The highest frequency of contamination  
9  
10 165 occurrence was found in apricots, followed by a lower infestation in plums, figs and  
11  
12 166 raisins. With the exception of apricots and one plum sample, the maxima were lower  
13  
14  
15 167 than 100 contaminants per g of dried fruit. We did not find any contamination in dates  
16  
17 168 and dried pineapples. The infested fruits were produced and imported from Turkey  
18  
19 169 (apricots, figs), Greece (figs, raisins) and Moldova (plums).  
20  
21

22 170  
23

#### 24 171 *Growth of mites under laboratory conditions*

25  
26  
27 172 All types of dried fruit were suitable for *C. lactis* population growth. The growth of  
28  
29 173 mites was influenced by the type of dried fruit ( $F_{(5,114)} = 63$ ;  $P < 0.0001$ ). Dried figs  
30  
31 174 were the most suitable for mite growth, followed by dried pineapples, dates, plums  
32  
33 175 and apricots; raisins were the least suitable for mite growth (Table 2). For simulation  
34  
35 176 according to the formula ( $N_t = N_0 e^{rt}$ ),  $N_t$  values were calculated from observed growth  
36  
37 177 rate ( $r$ ) (Table 2) and a hypothetical population of 10 mites ( $N_0$ ) in dried fruits for the  
38  
39 178 periods ( $t = 21, 28, 35, 42, 49, 56, 63, 70, 77, 84$  and 91 days) (Figure 2). The  
40  
41 179 simulation illustrated that the increase in contamination was influenced by the type of  
42  
43 180 dried fruit. The hypothetical increase is approximately 200,000 contaminants on dried  
44  
45 181 figs; followed by 50,000 contaminants on dried pineapple; 8,000 on dried apricots,  
46  
47 182 plums and dates; and 3,000 on raisins.  
48  
49  
50  
51

52 183  
53

#### 54 184 *Infestation of dried apricot in bags under laboratory conditions*

55  
56  
57 185 Mites were found on the exterior of the packing during inspection, which indicates  
58  
59 186 that they migrated from the inside of the infested packing to the surface. The packing  
60

1  
2  
3 187 differed in its protection to the mite infestation and decreased from polypropylene  
4  
5 188 back with aluminum foil, cellophane sac, polypropylene bag to plastic bag. However,  
6  
7  
8 189 after six months, the mites penetrated into all types of packing. The highest numbers  
9  
10 190 of mites were observed in plastic bags packing (see Table 3).  
11

12 191

## 13 192 **Discussion**

14  
15  
16  
17 193 Public health inspectors in the Czech Republic discovered dried fruit mite  
18  
19 194 infestation and reported the risk to the European food alert system (see reports  
20  
21  
22 195 RAFS - cf. Anonymous 2008) via Czech food safety focal points and the Scientific  
23  
24 196 Committee on Phytosanitary and Environment (Stejskal and Tlustoš 2009).  
25  
26  
27 197 Consequently, we conducted this study with the aim of documenting the extent of  
28  
29 198 mite population density and contamination of dried fruits for human consumption in  
30  
31 199 Czech hypermarkets. The data obtained illustrated the alarming high contamination  
32  
33  
34 200 of imported dried fruits by *C. lactis*. With the exception of apricots and dates, we  
35  
36 201 found infestation in plums, raisins and figs. Although we found contamination in 16%  
37  
38 202 of samples (n= 180), it is difficult to estimate the size and frequency of contamination  
39  
40  
41 203 because the study is not a definite survey and sampling was not random.

42  
43 204 To date, only a few reports have described the direct mite contamination of food  
44  
45 205 for human consumption. For instance, Thind and Clarke (2001) reported the  
46  
47 206 occurrence of mites in several ready-to-use cereal-based foods that included baby  
48  
49  
50 207 food, biscuits and breakfast cereals, among others. Aygun et al. (2007) reported  
51  
52 208 *Tyrophagus putrescentiae* contamination in 10% of samples of traditional Turkish  
53  
54 209 cheese Surk. Quintero and Acevedo (1991) found *C. lactis* contamination in 33 and  
55  
56  
57 210 12% of traditional fermented liquid samples of pulpe and tepache, respectively. Our  
58  
59 211 results confirmed previous findings (Thind and Clarke 2001), that there is an

1  
2  
3 212 opportunity to ingest mites in food. These findings are considered unsavory and  
4  
5 213 undesirable and do not conform to the known medical importance of mites. In  
6  
7  
8 214 medical literature, reports of mite oral anaphylaxes after ingestion of mite-  
9  
10 215 contaminated food were described (Sanchez-Machin et al. 2010, Iglesias-Souto et al.  
11  
12 216 2009; Sanchez-Borges et al. 2005). The levels of mites in such contaminated food,  
13  
14  
15 217 which provokes anaphylaxes, started from 1,000 individuals per g of food (Sanchez-  
16  
17 218 Machin et al. 2010).

18  
19  
20 219 Compared to insects, the stored product *C. lactis* mites have a short  
21  
22 220 developmental time, which is approximately 19 days (Chmielski 1971) under optimal  
23  
24 221 conditions (relative humidity 85% and 25 °C). Such conditions represent the usual  
25  
26 222 microclimate for dried fruit storage in hypermarkets or in consumers' kitchens.  
27  
28  
29 223 Therefore, we suggest that during the storage of these products in supermarkets or  
30  
31 224 consumers' homes, the mites are able to migrate from one contaminated commodity  
32  
33  
34 225 into another. If the food that is secondarily infested is suitable for mite population  
35  
36 226 growth the resulting mite multiplication and food contamination is extremely rapid.  
37  
38 227 Acaridid mites are known to thrive on a variety of food products present in household  
39  
40 228 pantries and stores, including dried yeasts, milk products, fruit and honey (Hughes  
41  
42 229 1975).

43  
44  
45 230 Our field data from supermarkets showed a contamination density with a  
46  
47 231 maximum of 650 individuals per g of dried food. The simulation model indicates that  
48  
49 232 such levels of contamination can be reached quickly during storage of contaminated  
50  
51 233 dried fruit in supermarkets or consumers' kitchens. From a hypothetical initial mite  
52  
53 234 population of 10 individuals, the risk level observed in supermarkets (650 individuals)  
54  
55  
56 235 is reached very quickly: 42 days of population multiplication on dried figs, 49 days on  
57  
58  
59  
60

1  
2  
3 236 dried pineapple and 63 days on dried apricots, dates and plums (Figure 2) in  
4  
5 237 hypothetical temperature 25 °C.  
6  
7

8 238 The labeled time for consumption is half a year or longer; however, mites are not  
9  
10 239 detected by buyers, consumers, or inspectors in this time frame because the mites  
11  
12 240 are not visible to the human eye due to their small size. Similar observations have  
13  
14 241 been made in grain stores, in which farmers seriously underrated the risk of  
15  
16 242 infestation by mites and psocids (Stejskal and Hubert 2008) because mite  
17  
18 243 contamination was not visible due to the microscopic size of the mites.  
19  
20  
21

22 244 In the hypermarkets, mites are able to infest other packages of dried fruit as was  
23  
24 245 simulated in our experiment. We found that mites are able to penetrate every  
25  
26 246 packaging material for dried fruit that was tested, including polypropylene and  
27  
28 247 aluminum foils. In addition, they are able to develop in them (see Table 3).  
29  
30

31 248 Insect and mite presence is traditionally considered an aesthetic rather than a  
32  
33 249 health problem (Thind and Clarke 2001). Codex alimentarius recommended that  
34  
35 250 “dried fruit be prevent by insect and mite contamination“ (CAC/RCP 3-1969).  
36  
37 251 Fumigation is required to be used as a preventive treatment. The mites are sensitive  
38  
39 252 to magnesium phosphide treatment (Meyvaci et al. 2010). However, the limitation of  
40  
41 253 fumigation is due to *C. lactis* forming hyppopus stadia with almost zero physiological  
42  
43 254 and breathing activity, which enables them to survive fumigation. Manipulation of  
44  
45 255 temperature and relative humidity is not practical because hyppopus mite  
46  
47 256 developmental stage can survive unfavorable moisture and temperature conditions  
48  
49 257 (Chmielski 1967; 1973). Among the promising control methods of physiologically  
50  
51 258 active stadia are extreme physical conditions or long-term exposure to modified  
52  
53 259 atmospheres (Emeck et al. 2004). Zdarkova and Voracek (1993) found that mite  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 260 exposure to extremely low temperature (-15 °C) or low barometric (95mm Hg for 96  
4  
5  
6 261 hours) pressure completely kills the mites in 80 hours.

7  
8 262 A recent study by Thind and Clarke (2001) documented a high risk of mite  
9  
10 263 contamination of cereal-based foods, including sensitive baby food in Great Britain.  
11  
12 264 However *C. lactis* is not present in cereal product and has not been reported. In  
13  
14 265 addition *C. lactis* has never been subjected to the immunological analyze and the  
15  
16 266 information about production of allergens are missing. *C. lactis* is reported as the pest  
17  
18 267 on the Swedish farm, when the farmers showed allergy symptoms to the mites (van-  
19  
20 268 Hage-Hamsten et al. 1991). In the website for the systematic allergen nomenclature  
21  
22 269 that is approved by the World Health Organization and International Union of  
23  
24 270 Immunological Societies (WHO/IUIS) Allergen Nomenclature Sub-committee new  
25  
26 271 description of allergens in stored product mites appears in those, which has been  
27  
28 272 previously described in house dust mites.

29  
30  
31  
32  
33  
34 273 Our study has showed the elevated risk of *C. lactis* to the final consumer of dried  
35  
36 274 fruits in Central Europe. We have reviewed all storage mite management options and  
37  
38 275 shown that effective *C. lactis* detection and control tools are missing. An unanswered  
39  
40 276 question remains what was the reason for the increased infestation and  
41  
42 277 contamination of imported dried fruits to Czech republic from Turkey, Greece and  
43  
44 278 Moldova. It should be interesting to tests hypotheses whether this new mite risk  
45  
46 279 could be some how associated with the worldwide deregistration of the most powerful  
47  
48 280 quarantine fumigant methyl bromide in 2006. We also recommend that large-scale  
49  
50 281 surveys for infestation of packaged dried fruit by *C. lactis* should be established and  
51  
52 282 conducted in other European countries where no data exist in order to evaluate the  
53  
54 283 overall risk of this mite to potential consumers in the EU market.  
55  
56  
57  
58  
59  
60

1  
2  
3 285 **Acknowledgment**  
4

5 286 This study was supported by project No. 0002700604 provided by the Czech Ministry  
6  
7  
8 287 of Agriculture. The authors thank Zuzana Kučerová for her review of an earlier draft  
9  
10 288 of this manuscript and for confirming the identification of *Carpoglyphus lactis* and  
11  
12 289 Tereza Michnova and Sarka Tuckova for their technical assistance. The authors are  
13  
14  
15 290 obligated to the anonymous referees for valuable comments.  
16

17 291

18  
19  
20 292 **References**  
21

- 22 293 Anonymoous, 2008. [Report on activites of the rapid alert system for food and feed  
23  
24 294 for 2007]. Czech Ministry of Agriculture, Prague,33 pp. (in Czech language)  
25  
26 295 Aygun O, Yaman M,Durmazc H, 2007. A survey on occurrence of *Tyrophagus*  
27  
28 296 *putrescentiae* (Acari: Acaridae) in Surk, a traditional Turkish dairy product. J Food  
29  
30 297 Eng 78(3): 878-881.  
31  
32 298 Aucamp JL, 1969. The role of mite vectors in the development of aflatoxin in  
33  
34 299 groundnuts. J. Stored. Prod. Res. 5(3): 254-249.  
35  
36 300 CAC/RCP 3-1969. Recommended international code of hygienic practice for dried  
37  
38 301 fruit (CAC/RCP 3-1969) -  
39  
40 302 [www.codexalimentarius.net/download/standards/263/CXP\\_003e.pdf](http://www.codexalimentarius.net/download/standards/263/CXP_003e.pdf)  
41  
42 303 Chmielewski V, 1967. [Stadium hypopus *Carpoglyphus lactis* (L., 1758)  
43  
44 304 (Glycyphagidae, Acarina)]. Prace naukowe Instytutu ochrony roslin 9(2): 161-173.  
45  
46 305 (in Polish lang.)  
47  
48 306 Chmielewski V, 1971. [Morphology, biology and ecology of *Carpoglyphus lactis* (L.,  
49  
50 307 1758) (Glycyphagidae, Acarina)]. Prace naukowe IOR, Poznan 12(2): 1-166. (in  
51  
52 308 Polish lang.)  
53  
54  
55  
56  
57  
58  
59  
60



- 1  
2  
3 309 Chmielewski V, 1973. A study on the influence of some ecological factors on the  
4  
5 310 hypopus formation of stored mites. In Proceedings of the 3rd International  
6  
7  
8 311 Congress of Acarology, Prague, M. Daniel and B. Rosicky. W. Junk(eds), pp. 357-  
9  
10 312 363. 31 August-6 September 1971. The Hague, Netherlands.
- 11  
12 313 Cobanoglu S, 2009. Mite population density analysis of stored dried apricots in  
14  
15 314 Turkey. Intl J Acarol 35(1): 67-75.
- 16  
17 315 Colloff MJ, 2009. Dust mites. CSIRO Publishing, Collingwood, Victoria, Australia,  
18  
19 316 Emekci M; Ferizli AG; Tutuncu S; Navarro S, 2004. The efficacy of modified  
20  
21 317 atmosphere applications against dried fruit pests in Turkey. Bulletin OILB/SROP.  
22  
23 318 27(9): 227-231.
- 24  
25  
26 319 Fernández-Caldas E. 1997. Mite species of allergologic importance in Europe.  
27  
28 320 Allergy 52(4):383-387.
- 29  
30 321 Fields PG, White NDG. 2002. Alternatives to methyl bromide treatments for stored  
31  
32 322 product and quarantine insects. An Rev Entomol 47:331-359.
- 33  
34 323 Franzolin MR, Gambale W, Cuero RG, Correa B, 1999. Interaction between toxigenic  
35  
36 324 *Apergillus flavus* Link and mites (*Tyrophagus putrescentiae* Schrank) on maize  
37  
38 325 grains: effects on fungal growth and aflatoxin production. J Stored Prod Res  
39  
40 326 35(3): 215-224.
- 41  
42  
43 327 Hage-Hamsten-van M. Johansson E, Wiren A, Johansson SGO. 1991. Storage  
44  
45 328 mites dominate the fauna in Swedish barn dust. Allergy 46(2):142-146.
- 46  
47  
48 329 Hubert J, Stejskal V, Munzbergová Z, Kubátová A, Vánová M, Zd'árková E. 2004.  
49  
50 330 Mites and fungi in heavily infested stores in the Czech Republic. J Econom  
51  
52 331 Entomol 97(6): 2144-53.
- 53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 332 Hubert J, Stejskal V, Munzbergova Z, Hajslova J, Arthur FH, 2007. Toxicity and  
4  
5 333 efficacy of selected pesticides and new acaricides to stored product mites (Acari:  
6  
7 334 Acaridida). *Exp Appl Acarol* 42(4):283-290.  
8  
9  
10 335 Hubert J, Kucerova Z, Aulicky R, Nesvorna M, Stejskal V, 2009. Differential levels of  
11  
12 336 mite infestation of wheat and barley in Czech grain stores. *Insect Sci* 16(3): 255–  
13  
14 337 262.  
15  
16  
17 338 Hughes AM, 1975. The mites of stored food and houses, Minist. Agric. Fish. and  
18  
19 339 Food, London, UK. 400 pp.  
20  
21  
22 340 Iglesias-Souto J, Sánchez-Machín I, Iraola V, Poza P, González R, Matheu V. 2009.  
23  
24 341 Oral mite anaphylaxis by *Thyreophagus entomophagus* in a child: a case report.  
25  
26 342 *Clin Mol Allergy*. 25(7):10.  
27  
28  
29 343 Johnson, JA, Valero, KA, Hannel, MM, Gill, RF 2000. Seasonal occurrence of  
30  
31 344 postharvest dried fruit insect and their parasitods in a culled fig warehouse. *J*  
32  
33 345 *Econom Entomol* 93(4): 1380-1390.  
34  
35  
36 346 Li CP, Cui YB, Wang J, Yang QG, Tian Y, 2003. Acaroid mite, intestinal and urinary  
37  
38 347 acariasis *World J Gastroenterol* 9(4): 874-877.  
39  
40  
41 348 McCallum H. 2000. Population Parameters. Estimation for Ecological Models.  
42  
43 349 Blackwell Science. Oxford.  
44  
45  
46 350 Meyvaci KB, Sen F, Aksoy U, 2010. Optimization of magnesium phosphide treatment  
47  
48 351 used to control major dried fig storage pests. *Horticulture, Environ Biotechnol*  
49  
50 352 51(1): 33-38.  
51  
52  
53 353 Quintero MT, Acevedo HA, 1991. Mites of fermented liquid foods in Mexico. In: <sup>§</sup>  
54  
55 354 *Modern Acarology*, F. Dusbabek and V. Bukva (eds.), Vol. 1, pp. 611-614.  
56  
57 355 *Academia: Prague and SPB Academic Publishing, The Hague.*  
58  
59  
60

- 1  
2  
3 356 Saleh SM, Yacout GA, El-Sadek MM, 1987. Comparative studies on sound and  
4  
5 357 infested dried fig with *Carpoglyphus lactis* (Linne). Alexandria J Agricult Res  
6  
7 358 32(3): 409-418.  
8  
9  
10 359 Sánchez-Borges M, Suárez-Chacón R, Capriles-Hulett A, Caballero-Fonseca F,  
11  
12 360 2005. An update on oral anaphylaxis from mite ingestion. Ann Allergy Asthma  
13  
14 361 Immunol 94(2): 216-220.  
15  
16  
17 362 Sánchez-Machín I, Glez-Paloma Poza R, Iglesias-Souto J, Iraola V, Matheu V, 2010.  
18  
19 363 Oral mite anaphylaxis. Allergy 65(10): 1345–1347.  
20  
21  
22 364 Stejskal V, Hubert J, 2008. Risk of occupational allergy to stored grain arthropods  
23  
24 365 and false pest-risk perception in Czech grain stores. Ann Agric Environ Med  
25  
26 366 15(1): 29-35.  
27  
28  
29 367 Stejskal V, Tlustoš P, 2009. Introduction of scientific committee on phytosanitary and  
30  
31 368 environment. Plant. Soil Environ 55(9): 411-412  
32  
33  
34 369 Thind BB, Clarke PG, 2001. The occurrence of mites in cereal-based foods destined  
35  
36 370 for human consumption and possible consequences of infestation. Exp Appl  
37  
38 371 Acarol 25(3): 203-215.  
39  
40  
41 372 Trematerra P, Stejskal V, Hubert J 2011. The monitoring of semolina contamination  
42  
43 373 by insect fragments using the light filth method in an Italian mill. Food Cont 22(7):  
44  
45 374 1021-1026.  
46  
47  
48 375 Trucksess MW, Scott PM, 2008. Mycotoxins in botanicals and dried fruits: a review.  
49  
50 376 Food Addit Contam Part A 25(2): 181-192.  
51  
52  
53 377 Zdarkova E., 1967. Stored food mites in Czechoslovakia. J. Stored Prod. Res. 3:  
54  
55 378 155-175.  
56  
57  
58 379 Zdarkova E; Voracek V, 1993. The effects of physical factors on survival of stored  
59  
60 380 food mites. Exp Apl Acarol 17(3): 197-204.

1  
2  
3 381 **Figures**  
4

5 382 **Figures 1.** Massive infestation of dried apricot by *Carpoglyphus lactis*.  
6  
7

8 383

9  
10 384 **Figure 2.** Simulation of the contamination/population growth of *Carpoglyphus lactis*  
11  
12 on dried fruit from a hypothetical initial number of 10 pest individuals.  
13  
14

15 386

16 387  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

For Peer Review Only

**Table 1.** The only contaminant was *Carpoglyphus lactis* in samples of dried fruit obtained in Czech supermarkets. Legend: nd. – not determined, n –number of samples analyzed.

Dried fruit	n	Number of contaminated sample	N total (individuals)	N (individuals.g <sup>-1</sup> )		
				mean±std.dev.	maximum	minimum
Apricot	30	18	93,440	104±176	650	0
Dates	30	0	nd.	nd.	nd.	nd.
Figs	30	6	2,926	28±40	0	89
Plum	30	8	23,163	100±228	663	0
Pine apple	30	1	57	3	nd.	nd.
Raisins	30	3	6	0±0.003	0	0

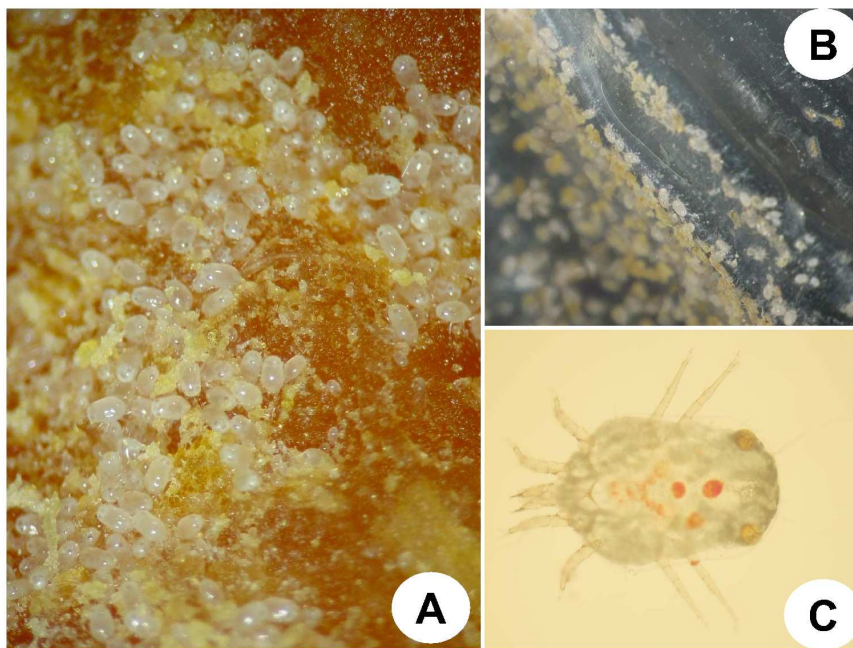
**Table 2.** Multiplication of *Carpoglyphus lactis* on various dried fruit under laboratory conditions. The starting population was 10 individuals; final numbers of contaminants N (means  $\pm$  standard deviation) and growth rate r are shown, n is the number of replicates; \* - indicates that the rearing diet data was not included in ANOVA test. . The letters indicate differences among the groups based on Tukey's honest significant difference.

Dried fruit	n	r	N
Appricots	24	0.071 $\pm$ 0.014b	46 $\pm$ 13
Dates	24	0.076 $\pm$ 0.006b	50 $\pm$ 6
Figs	12	0.109 $\pm$ 0.004d	100 $\pm$ 8
Pine apples	12	0.093 $\pm$ 0.004c	71 $\pm$ 6
Plums	24	0.072 $\pm$ 0.007b	46 $\pm$ 7
Raisins	24	0.064 $\pm$ 0.007a	39 $\pm$ 6
Rearing diet*	10	0.103 $\pm$ 0.019	93 $\pm$ 32

**Table 3.** Effects of type of dried fruit packaging material and exposure period on infestation of packages by *Carpoglyphus lactis* under laboratory experiment. The packages of fruit without mites were stored in containers together with one contaminated package. At different exposure periods, the number of mites in packages was counted. Four packages were used to determine the mean number of mites infesting a particular type of packaging material during each exposure period.

Product name	Time (month)	N (individuals.g <sup>-1</sup> )	Non contaminated sample
Plastic bag	1	0	0
	3	0.04±0.02	4
	6	0.14±0.09	4
Polypropylene bag	1	0.04±0.04	4
	3	1.46±1.41	4
	6	1.68±1.53	4
Cellophane sac	1	0	0
	3	0	0
	6	0.02±0.01	4
Polypropylene bag with aluminum foil	1	0	0
	3	0.01±0.01	2
	6	0.02±0.01	3

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

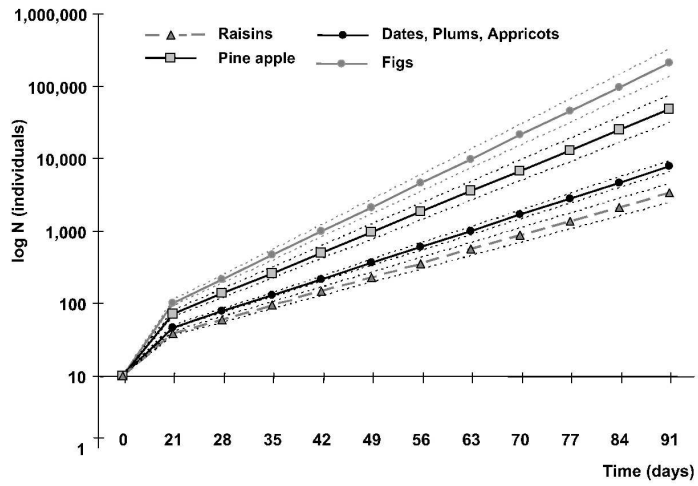


297x209mm (600 x 600 DPI)

view Only



1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



297x209mm (600 x 600 DPI)

view Only