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Light filth method on semolina and pasta

Daria P. Locatelli*, Sara Savoldelli, Emilio Moroni, Lidia Limonta
DeFENS, Department of Food, Environmental and Nutritional Sciences, Università degli Studi di Milano, Milan, Italy
**Corresponding author e-mail: daria.locatelli@unimi.it*

Abstract: Samples of semolina and pasta were collected from one mill and one pasta plant in Italy for six and four years respectively. They were analyzed by AOAC light filth method (225 g). Altogether, 195 semolina were collected from 2007 to 2012. The mean number of insect fragments detected during this period was 4.9, and each year, a mean of one first instar larva of *Stegobium paniceum* (L.) was found. A single mite was detected in only one sample. A total of 156 samples of pasta were analyzed during the period 2009 to 2012 and the mean number of fragments in these samples was 10.1. Mandibles of *Sitophilus oryzae* (L.) and *Tribolium* spp. were the most identified filths. Fragments were mainly derived from infestation prior to milling, both in semolina and pasta samples. In fact, fragment size was lower than the granulometry of semolina. Rodent hair was found in few samples.

Key words: Light filth method, insect fragments, pasta, semolina

Introduction

In storage facilities and during processing operations, low grain quality (insect-infested grain) and poor insect-pest infestation prevention practices are responsible for pest infestation in semolina and pasta (Locatelli & Codevilli, 1986).

Various mills and pasta plants are present in Italy. These differ in their dimensions or in the type of production plants. Old production plants that work efficiently still exist but they have wooden parts that harbor pests, especially stored-product beetles.

Until recently mills and pasta plants were fumigated once or twice a year using methyl bromide, and new outbreaks were treated using contact insecticide. The phase out of methyl bromide necessitated a strict adoption of integrated pest management (IPM) strategies (Savoldelli & Panzeri, 2008; Süss & Savoldelli, 2008). Sanitation involving daily removal residual of food and spilled feed from plants is now practiced. In the past, cleaning operations were restricted to easily accessible and clearly visible areas. Nowadays plants are inspected more frequently, and debris and spider and moth webbing are promptly removed. Additionally, walls and floors are varnished in order to eliminate roughness and old machines where pests can hide are being replaced. Regulatory requirement for employee training has certainly contributed to limiting risks of infestation.

Thorough visual observation of production areas and the use of traps is now common practice. Trap placement has also improved significantly.

The present survey was carried out in a mill and a pasta plant, where IPM practices have been adopted and pests are carefully monitored inside and outside the buildings. Samples were analyzed by filth method to detect the presence of fragments or bodies of insects in the products.

Material and methods

During the period 2007-2012, 195 semolina samples were collected; in the period 2009-2012, 156 pasta (macaroni) samples were collected. Every month, 2 to 5 samples of semolina and a similar number of pasta samples were received for examination. Semolina samples were collected from silos, after which they were mixed to form a 1 kg sample. The same method was used for pasta samples. The mill grinds italian durum wheat; grain is used within the year of harvest. The pasta plant processes semolina coming from different mills and the semolina is usually stored for a maximum of one year.

Samples of semolina and pasta were analyzed by AOAC (18^{th} 2005) light filth method involving 225g samples. Insects were identified and counted microscopically at 30X magnification. Fragments were referred to body parts and to the species when possible. Rodent hairs and mites were also counted.

Data were submitted to One-way ANOVA and Duncan's multiple range test (SPSS 19).

Results

Semolina

The number of semolina samples analyzed each year increased from seventeen in 2007 to fifty in 2012. The mean number of fragments observed in the different years varied from 3.3 to 8.3 in 225g samples. The highest mean number of fragments (8.3) was observed in 2007 (Table 1).

Table 1. Mean number of insect fragments in semolina samples (AOAC, 18^{th}2005).

Year	Number of samples	Mean ± S.E.	Min-max
2007	17	8.3 ± 1.51a	1-22
2008	42	5.1 ± 0.51b	0-12
2009	32	5.0 ± 0.62b	0-13
2010	32	3.3 ± 0.56b	0-11
2011	28	4.0 ± 0.73b	0-17
2012	50	5.1 ± 1.02b	0-40

One-way Anova: $F_{9,125} = 2.519$, $P \leq 0.05$; means followed by different letters are significantly different by Duncan's multiple range test.

Figure 1 shows the percentages of samples with specified numbers of fragments (fragment size classes) for the period 2007-2012. The most frequent class found was 1 to 5 fragments. During the period 2008-2012, some samples were without fragments. A few samples had more than 21 fragments in 2007 and 2012.

Mandibles were the most frequently encountered type of fragment each year. Table 2 shows the percentages of the total number of fragments found in samples that were mandibles and the percentages of mandibles from *Sitophilus* spp., *Tribolium* spp. and *Rhyzopertha dominica*. Except in 2008, where *Tribolium* spp. mandibles were the most common type of

mandibles found, mandibles from genus *Sitophilus* were the most common type found in other years. Low numbers (< 10%) of *R. dominica* mandibles were found in 2009, 2010 and 2012.

In semolina, a single larva of *Stegobium paniceum* (L.), (Coleoptera, Anobiidae) was found in only one sample in 2008 to 2011; in 2012, larvae were found in two out of fifty samples. One mite was found in a sample in 2011.

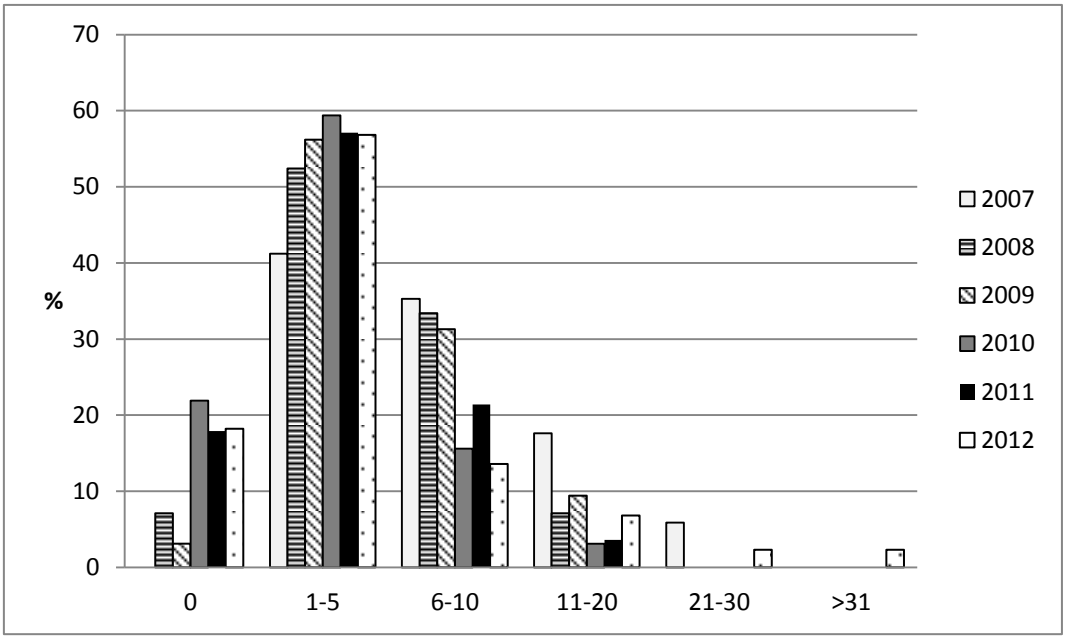

Figure 1. Percentages of semolina samples with specified numbers of fragments (fragment size classes) for the period 2007 to 2012.

Table 2. Percentages of the total number of fragments that were mandibles and percentages of mandible fragments in semolina that originated from *Sitophilus* spp. (Coleoptera: Curculionidae), *Tribolium* spp. (Coleoptera: Tenebrionidae), and *Rhyzopertha dominica* (F.) (Coleoptera: Bostrichidae).

Year	**Percentage of mandibles in fragments (%).**	**Percentage of mandible fragments (%)**		
		***Sitophilus* spp.**	***Tribolium* spp.**	***Rhyzopertha dominica***
2007	12.1	64.7	35.3	0.0
2008	1.4	33.3	66.6	0.0
2009	8.1	76.9	15.4	7.7
2010	16.2	82.3	11.8	5.9
2011	17.7	55.0	45.0	0.0
2012	11.8	73.4	23.3	3.3

Pasta (macaroni)

Mean numbers of fragments found in macaroni samples were no more than 20. Mean numbers of fragments in pasta samples that were recorded in different years varied from 4.7 to 18.6 (Table 3). The highest number of fragments (18.6) was observed in 2009. A decrease in the mean number of insect fragments was registered in subsequent years (Table 3).

Table 3. Mean numbers of insect fragments found and percentages of fragments identified in pasta (AOAC 969.41) (225 g).

Year	Number of samples	Mean ± S.E.	Min-max
2009	39	18.6 ± 2.42a	4-74
2010	37	9.4 ± 0.81b	2-28
2011	39	8.0 ± 0.71bc	0-21
2012	41	4.7 ± 0.76c	0-30

One-way Anova: $F_{3,152} = 18.85$, $P \leq 0.05$; means followed by different letters are significantly different by Duncan's multiple range test.

Some pasta samples were fragment-free in 2011 and 2012 (Figure 2). Samples with > 31 fragments were found in 2009.

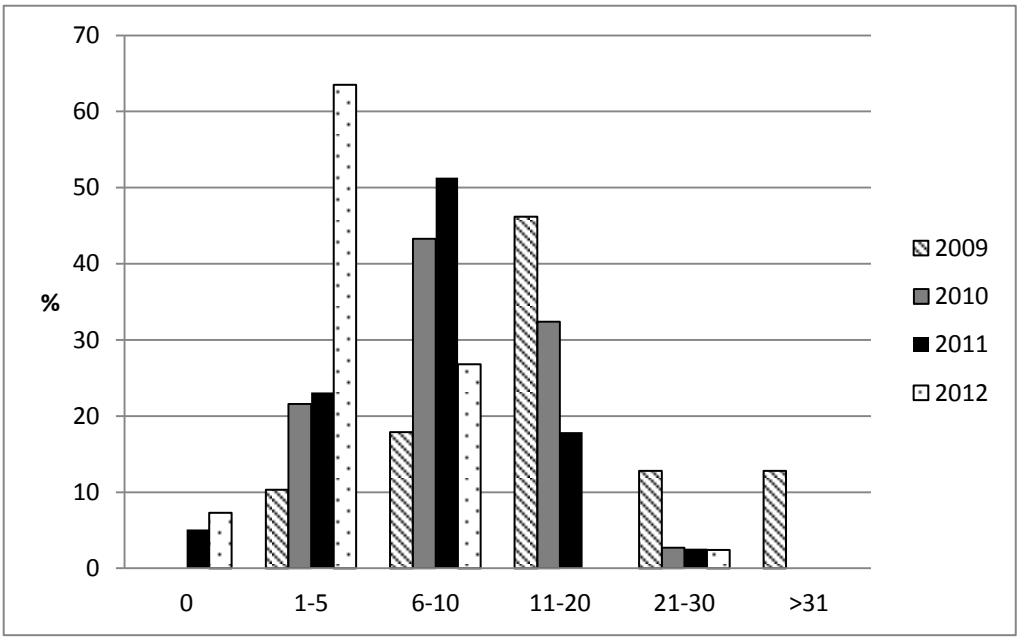

Figure 2. Percentages of pasta samples with specified numbers of fragments (fragment size classes) for the period 2009 to 2012.

Table 4. Percentages of the total number of fragments that were mandibles and percentages of mandible fragments in pasta that originated from *Sitophilus* spp., *Tribolium* spp., and *Rhyzopertha dominica.*

Year	Percentage of mandibles in fragments (%)	Percentage of mandible fragments (%)		
		***Sitophilus* spp.**	***Tribolium* spp.**	***Rhyzopertha dominica***
2009	20.4	62.2	35.1	2.7
2010	13.8	62.5	35.4	2.1
2011	15.7	65.3	32.6	2.1
2012	16.6	71.9	28.1	0

Like in semolina, the highest percentages of mandible fragments were from to *Sitophilus* (60-70%) and moderately high percentages from *Tribolium* (28.1-35.1). The percentages of mandibles from *R. dominica* were very low.

Whole insects of different stages were never found in pasta. In one sample a human hair was found.

In semolina and pasta, legs of aphids and whole aphids were found in one or two samples a year. Rodent hair was also found in semolina and pasta samples. It was only in 2009 when rodent hair was not found in semolina, in the other years the number of samples with rodent hair was one or two every year. In the case of pasta, six samples with one rodent hair in each were found in 2012. In other years, three samples with rodent hair were found each year.

Conclusions

The number of fragments in samples of semolina and pasta, detected by light filth method, was always below the FDA threshold. Most of the samples analyzed had between one and twenty fragments per 225g sample. The low number of fragments in semolina and pasta was probably due to the fact that raw material was processed quickly, within a year. Previous light filth test surveys in Italy have reported a low number of fragments (Rotundo *et al*., 1995; Trematerra & Catalano, 2009; Trematerra *et al.*, 2011).

Italy has an official method for analyzing cereal products (1994) but it has no acceptability thresholds. Therefore, each food processing industry sets the number of acceptable fragments for their processed food product. In most cases, FDA thresholds have been adopted; in some cases, a more restricted number is fixed, for example 20 fragments per 50 g. Other industries have chosen thresholds similar to those fixed by Canadian law that makes a distinction between field insects and stored products insects.

Fragments found were mainly parts of the thorax and abdomen, but lacked features useful for the identification of the species the fragments were from. Mandibles, due to their hardness and to the little dimension, retain their identification characteristics. For both semolina and pasta, the percentage of mandibles that came from *R. dominica* was lower than percentages from *Tribolium* and *Sitophilus*, and in some years they were not found. It is important to point out that *R. dominica* requires higher temperatures to thrive than *Sitophilus*. Additionally, durum wheat ground in the mill is cleaned before storage in warehouses and this practice decreases the infestation of *Tribolium* and *R. dominica* but it has a limited efficacy on *Sitophilus* that lay eggs inside the kernel.

Terms of contract for pasta industries presents threshold limits for the number of insect fragments, and this fact enhances grains quality control and implementation of good insect pest control practice in the processing mills (Trematerra & Catalano, 2010). Monitoring of cereals with probe trap is required and pheromone trap are placed both inside and outside the buildings. Warehouses and silos have to be and need to be sampled monthly.

Rodent hair was found in both semolina and pasta samples, but the percentage was higher in the pasta samples indicating that rodent prevention needs to be improved.

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