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The occurrence of arthropods in processed rice products in Malaysia

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ABSTRACT

Objective: To determine distribution of arthropods in processed rice products such as rice flour and rice cereal-based infant food. **Methods:** Random samples of rice flour and rice cereal-based infant food purchased from commercial outlets were examined for the presence of arthropods using a modified Berlese Tullgren Funnel Method. Mites were mounted prior to identification and weevils were directly identified. **Results:** For non-expired products, infestation was found in 6.7% of rice flour and none was found in rice cereal-based infant food samples. The arthropods found in the flour samples were *Cheyletus* spp., *Suidasia pontifica* (*S. pontifica*), *Tarsonemus* spp., *Tyrophagus putrescentiae* (*T. putrescentiae*), *Sitophilus granarius* (*S. granarius*) and *Sitophilus oryzae* (*S. oryzae*). Others which cannot be identified were *Oribatid* and *Prostigmatid* mites. The most common mites in rice flour were *Tarsonemus* spp. (69.1%), followed by *S. pontifica* (18.2%). For expired products, only one sample of rice cereal-based infant food was infested and the infestation was by mites of the family *Tydeidae*. **Conclusions:** This study demonstrates the presence of 4 allergenic species of *S. pontifica, T. putrescentiae, S. granarius* and *S. oryzae* in rice flour. These arthropods can contribute to the incidence of anaphylaxis upon consumption by atopic individuals. There was no infestation of arthropods in rice cereal-based infant food surveyed except for an expired product in a moderate rusty tin container.

1. Introduction

Infestation of processed food products by arthropods is a common problem world-wide[1-3]. Ingestion of foods infested with arthropods may cause anaphylaxis[4-8]. The arthropods may originate from the field or infest foods during storage. Increase in the percent of infested samples following storage of cereal-based foods in a domestic situation in United Kingdom suggested that the domestic environment is an important factor in development of infestation by mites[2]. This study is to determine distribution of arthropods in two processed rice products, i.e. rice flour and rice cereal-based infant food, which were purchased from various commercial outlets in Klang Valley and Selangor.

2. Materials and methods

One hundred and fifty 500 g plastic packages of rice flour (10 each of 15 brands) were randomly purchased and screened for arthropods. The flour were weighed and sealed in plastic at the factories. There was no difference in the packaging material. Besides rice flour, 150 samples of rice cereals were also purchased and screened. Rice cereals were either placed in sealed aluminum foil bag before packed in cardboard box or tin, or directly packed in Bi-axially Oriented Polypropylene (BOPP) film laminated bag. Four common brands of rice cereals were tested. Forty-two samples of expired products, dented or rusty tin containers and damp or dirty board box packages of rice cereals found in market were also purchased during the study period.

Extraction of mites was done according to a modified Berlese Tullgren Funnel Method[9]. A random sub-sample of 50 g of each sample was placed in a 12 cm diameter sieve with a 1 mm mesh size that was placed approximately 7 cm below a lighted 60 watts frosted light bulb. A 14 cm diameter Petri dish containing concentrated lactic acid was placed directly below the sieve to collect arthropods displaced from the rice flour or rice cereal. The lighted bulbs were switched on for three continuous days or sooner if no more arthropods were found. Petri dishes were checked for arthropods twice a day.

The techniques for preparation of mites for identification followed those used by Ho & Nadchatram[10]. The collected

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mites in Petri dish containing lactic acid were then heated with constant stirring. The heat source was removed as soon as the suspension began to bubble. The suspension was left to cool, then a small volume at a time was transferred to a Petri dish and examined under 20 × magnification. Whole mites and mite fragments were picked up with a sharpened applicator stick and were mounted in Hoyer's medium. Mounted slides were dried in an oven at 40 ℃ for 10–12 days before the mites were identified. Weevils were picked up manually and identified at 20 × magnification.

3. Results

3.1. Distribution of arthropods in rice flour

Infestation occurred in 6.7% of the samples examined. Mites were more abundant (90.2%) compared to weevils (9.8%). Number of mites recovered from infested samples ranged from 1–38 mites per 50 g of flour (Table 1). The most abundant species recovered was *Tarsonemus* spp. (69.1%) followed by *Suidasia pontifica* (*S. pontifica*) (18.2%). Other mites were *Cheyletus* spp. (1.8%), *Oribatid* mites (1.8%), *Tyrophagus putrescentiae* (*T. putrescentiae*) (1.8%) and *Prostigmatid* mites (3.6%). Weevils were found only in 20% of the infested samples, comprising two species, *Sitophilus granarius (S. granarius)* (83.3%) and *Sitophilus oryzae (S. oryzae)* (16.7%).

3.2. Distribution of arthropods in rice cereals

No samples of rice cereal–based infant food were found to be infested. This probably is due to the thick, tough materials and well sealed packaging that can help to deter entry of arthropods. Furthermore, infestation prior to packing is unlikely to occur as the products went through a sterilization process.

3.3. Distribution of arthropods in expired or damaged packages of products

Only 1 tin of expired rice cereal mixed with soya infant food was infested. The infestation was by 2 nymphal mites of the family *Tydeidae*. No infestation by weevils was found. The tin container was moderately rusty, dented and had expired for 1 month. Further checking under a microscope showed no breakage at the rusted area of the container that could allow entry of mites. However, it is possible that a minute breakage occurred before the advent of the rust that ultimately covered the breakage.

Table 1.
Arthropods found in 50 g of infested rice flour samples [*n* (%)].

Sample #	No. ectoparasites found*		Total ectoparasites	Species identified*	
	Mites	Weevils		Mites	Weevils
1	38 (88.4)	5 (11.6)	43	*Tarsonemus* spp. (69.1)	*S. granarius* (50.0) *S. oryzae* (16.7)
2	2 (66.7)	1 (33.3)	3	*S. pontifica* (1.8) *Oribatid* (1.8)	*S. granarius* (33.3)
3	1 (100.0)	0(0.0)	1	*Cheyletus* spp. (1.8)	–
4	1 (100.0)	0(0.0)	1	*S. pontifica* (1.8)	–
5	6 (100.0)	0(0.0)	6	*S. pontifica* (11.0)	–
6	1 (100.0)	0(0.0)	1	*T. putrescentiae* (1.8)	–
7	2 (100.0)	0(0.0)	2	Specimen distorted (3.6)	–
8	1 (100.0)	0(0.0)	1	Specimen distorted (1.8)	–
9	2 (100.0)	0(0.0)	2	*S. pontifica* (3.6)	–
10	1 (100.0)	0(0.0)	1	Prostigmatid (3.6)	–

* Percentage in parentheses

4. Discussion

Although mites extracted from rice flour are commonly known to infest storage food[5,11,12], there are no reports on local infestation rate of arthropods (mites and weevils) in the flour. This study showed a higher infestation rate compared to a rate of 1.7% of wheat flour from retail outlets in Japan[13]. The recovered mites, *Suidasia* spp. and *T. putrescentiae* have been shown to cause anaphylaxis by ingesting mite–infested foods[4]. Sensitization to *S. pontifica* and *T. putrescentiae* in Malaysians has also been reported[14,15]. The possibility of mite allergy after ingestion of infested flour should not therefore be underestimated. Besides these mites, the two weevils found also have allergenic properties [16].

It is recommended to purchase flour in small packages that can be consumed in a short time without prolonged storage periods of a month or more. Before use, it is a good practice to sift the flour for isolating arthropods, especially weevils. Most of the eggs, immature stages and adults of mites can be removed if flour is sifted through a No. 64 wire screen [17]. For killing mites, it is a good practice to heat the flour before use as mites are destroyed by temperature of above 50 ℃[18]. Once a package is opened, it is advisable to keep flour in the refrigerator as there were no mites found in refrigerated flour[13].

One of the possible source of infestation of mites in an expired rice cereal infant food sample were presence of eggs that were already in the product during packaging and / or storage process and that escaped damage during any pre–

packing sterilization process. This is because there was no possibility of contamination during extraction of mites from the samples as each set of the apparatus used was soak and rinse several times with hot water detergent and tap water, respectively. It was then dried in an oven at 40 ℃ until further used.

There was also no infestation of mites from damp cardboard box of rice cereal samples as only the outer layer of packaging were affected. Dampness of the boxes invited attacked of mold and fungal that made appearance of the boxes dirty. This however did not affect the products sealed in aluminium foil bag that provides barrier properties from arthropods. It is not known whether eggs of *Tydeid* mites were as resistant as other mites. This explained how mites can survive in milk powder packaging[12]. It would be interesting to know which type of the three cereal packaging was the most prone to mite infestation. Therefore, a further study needs to be carried out in order to determine the answer.

The relatively high infestation rate in rice flour recovered is a cause for concern. This study demonstrates the occurrence of 4 allergenic species of arthropods i.e. *S. pontifica*, *T. putrescentiae*, *S. granarius* and *S. oryzae* in rice flour that can contribute to the incidence of anaphylaxis upon consumption by sensitized individuals. This study also has shown that there is no infestation of arthropods in rice cereal-based infant food surveyed except for an expired product in a moderate rusty tin container that was still intact. It is advisable to be certain that the containers of rice cereals are not broken, damaged or unsealed before purchasing.

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Conflict of interest statement

We declare that we have no conflict of interest.

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