EXPLOITATION OF CRACKED CHICKEN EGGS BY SCUTTLE FLIES (DIPTERA: PHORIDAE): THE FIRST RECORD FROM MALAYSIA

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ABSTRACT

Poultry farm eggs, mainly chicken eggs, are one of the most widely used livestock products in Malaysia. For the past four years, Malaysians consumed more than 10 billion eggs annually with yearly record of more than 300 eggs per individual consumption. The demand for 'designer eggs' that are low in cholesterol and high in omega-3 fatty acids from the consumers was also increasing at retail stores but the presence of pests in these products was rarely known. This article reports the contamination of marketed designer chicken eggs by *Megaselia scalaris* (Loew) (Diptera: Phoridae) and *Megaselia spiracularis* Schmitz, two scuttle fly species of medical and forensic importance. Data were obtained from four chicken eggs delivered by a consumer to Forensic Entomology Laboratory, Forensic Science Programme, Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia (UKM). Upon inspection, only one of the eggs was found cracked, containing dipterous larvae. Larvae were reared on the cracked eggs in a sealed container in the laboratory (23.0–27.0°C, 69.0–70.0% RH) until adult stage to facilitate species identification of phorids. The discovery of larvae of both species feeding on cracked, commercialized chicken eggs highlighted the risk of contamination on poultry products by scuttle flies. For economic and medical reasons, these findings could be useful to properly assess quality management in the production of designer chicken eggs, as scuttle flies have been previously recorded as pests and agents of myiasis through contaminated food ingestion.

Key words: Poultry products, rotten eggs, contamination, *Megaselia*

ABSTRAK

Telur ayam adalah salah satu daripada produk ternakan yang paling banyak digunakan di Malaysia. Sejak empat tahun yang lalu, rakyat Malaysia telah menggunakan lebih 10 bilion telur ayam dengan rekod penggunaan lebih 300 biji telur per individu. Permintaan pengguna

terhadap ‘telur direkabentuk’ yang rendah kolesterol dan tinggi asid lemak omega-3 juga semakin meningkat di pusat jualan tetapi kehadiran serangga perosak pada produk berkenaan jarang diketahui. Artikel ini melaporkan kes pencemaran telur ayam oleh dua lalat mencalai berkepentingan perubatan dan forensik di Malaysia, *Megaselia scalaris* (Loew) (Diptera: Phoridae) and *Megaselia spiracularis* Schmitz. Data diperoleh daripada empat telur ayam dihantar oleh pengguna ke Makmal Entomologi Forensik, Program Sains Forensik, Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia (UKM). Pemeriksaan mendapati salah satu telur didapati retak dan mengandungi larva Diptera. Larva dipelihara pada telur di dalam bekas yang ditutup di dalam makmal (23.0–27.0°C, 69.0–70.0% RH) sehingga mencapai peringkat dewasa untuk pengenalpastian spesies phorid berkenaan. Penemuan larva kedua-dua spesies ini yang memakan telur ayam komersil yang retak menunjukkan risiko kontaminasi terhadap produk ayam itik oleh lalat mencalai. Bagi tujuan ekonomik dan perubatan, penemuan ini boleh digunakan untuk menilai pengurusan kualiti dalam penghasilan telur ayam direkabentuk kerana lalat mencalai sebelum ini pernah direkodkan sebagai serangga perosak dan agen penyebab miasis melalui pengambilan makanan tercemar.

Kata kunci: Produk ayam itik, telur rosak, pencemaran, *Megaselia*

INTRODUCTION

Scuttle flies (Diptera: Phoridae) are the most diversify group of flies with broad spectrum of larval feeding habits (Zuha & Disney 2017). Larvae generally feed on various decomposing organic matters and they are also known to be predators, parasitoids and parasites, mainly on other invertebrates (Disney 1994). Majority of those are from the giant genus *Megaselia* with great economic importance and has vital roles in medical and forensic investigations (Disney 2008).

Megaselia scalaris (Loew) and *Megaselia spiracularis* Schmitz are two forensically important scuttle flies commonly found indoors and in concealed environments (Greenberg & Wells 1998; Kumara et al. 2012; Thevan et al. 2010). Their small size enables them to penetrate through small openings to arrive on decomposing organic materials earlier than other sarcosaprophagous flies such as the Calliphoridae and Sarcophagidae (Catts & Goff 1992). In forensic entomology, scuttle flies can be primary source of reference to estimate minimum post mortem interval (mPMI) when other sarcosaprophagous flies are absent (Campobasso et al. 2004; Reibe & Madea 2010). These two species were also medically important as agent of myiasis in humans and animals through wound infestation and food ingestion (Ghavami & Djalilvand, 2015; Komori et al. 1978; Singh & Rana 1989; Vanin et al. 2013).

Although they could bring serious impact to human health and able to feed on vast spectrum of organic materials, *M. scalaris* and *M. spiracularis* were rarely reported contaminating livestock products. In this article, we report the first case of both species contaminating commercialized chicken eggs from Malaysia including information on their bionomics and life history.

METHODOLOGY

A total of 15 ‘designer eggs’, categorized as L size, packed in a single plastic carton were purchased by the complainant from a local departmental store in Bangi, Malaysia on 2 September 2019. During unpackaging, the complainant discovered live maggots on the surface of at least four eggs. On the next day, all four eggs that were kept in a sealed plastic container,

were brought to Forensic Entomology Laboratory, Forensic Science Programme, Universiti Kebangsaan Malaysia, Bangi, for further analysis.

In laboratory, inspection was made on each egg and we confirmed that only one egg was found cracked and rotten (Figure 1). Larvae that were observed crawling on all eggs were suspected as post feeding larvae (Figure 2), presumably from the family Phoridae. This presumption was made based on the morphology of fly egg casing (Figure 3) and early form puparia found on the cracked chicken eggs. We also observed larvae actively feeding the rotten egg (Figure 4). Active feeding larvae, post feeding larvae and pupae were kept in a plastic container sealed with paper towel to allow air flow and to prevent contamination from other insects. They were reared in the laboratory at room temperature (23.0–27.0°C) and relative humidity (69.0–70.0%) until adult stage to facilitate species confirmation. On 16 September 2019, all adults were formed from the rearing process. The newly emerged adults were then killed and preserved in 70% ethanol. Subsequent analysis was performed by dissecting the specimens to identify the species (Disney 2001). By using taxonomic keys (Borgmeier 1967; Disney & Sinclair 2008), the specimens were identified up to species.

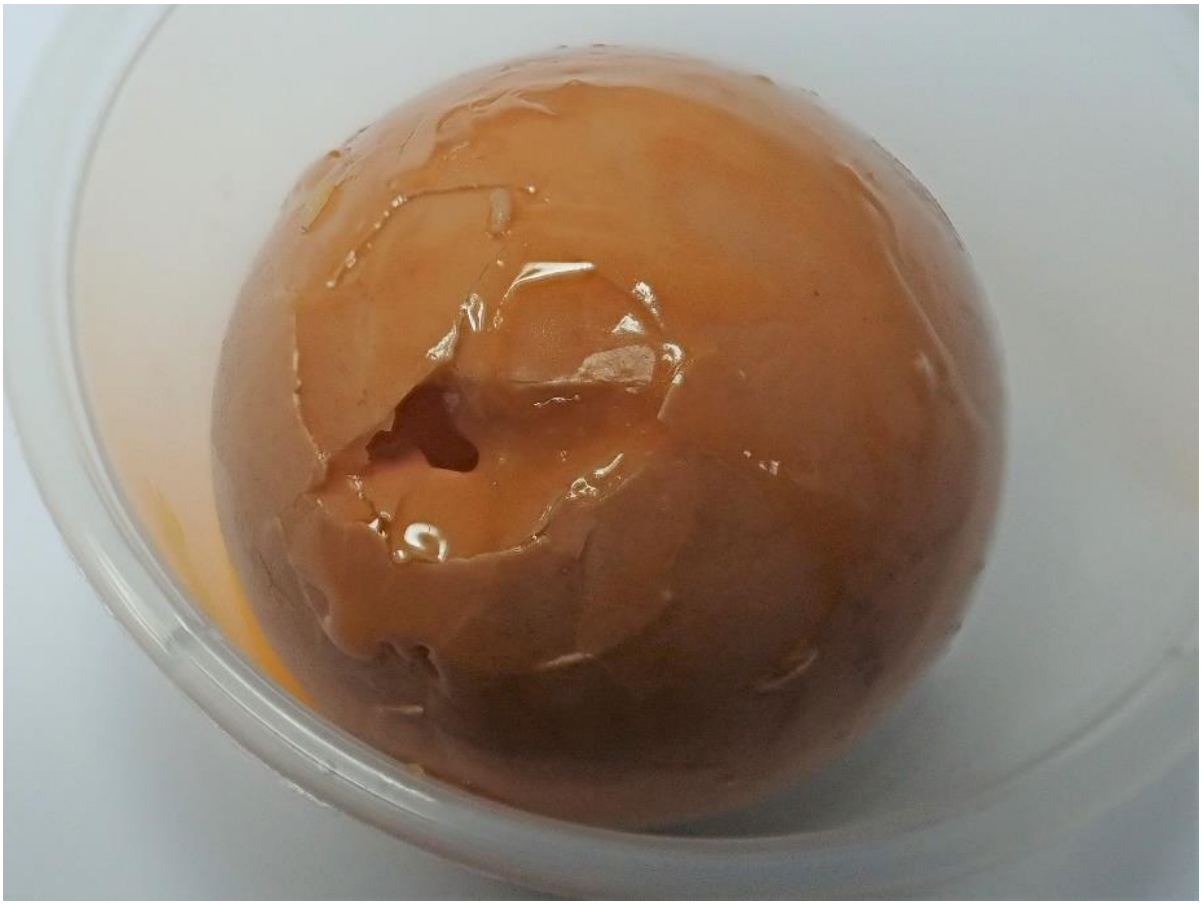

Figure 1 The condition of cracked chicken egg with larval infestation.

Figure 2. Post feeding larva on the outer surface of a cracked chicken egg.

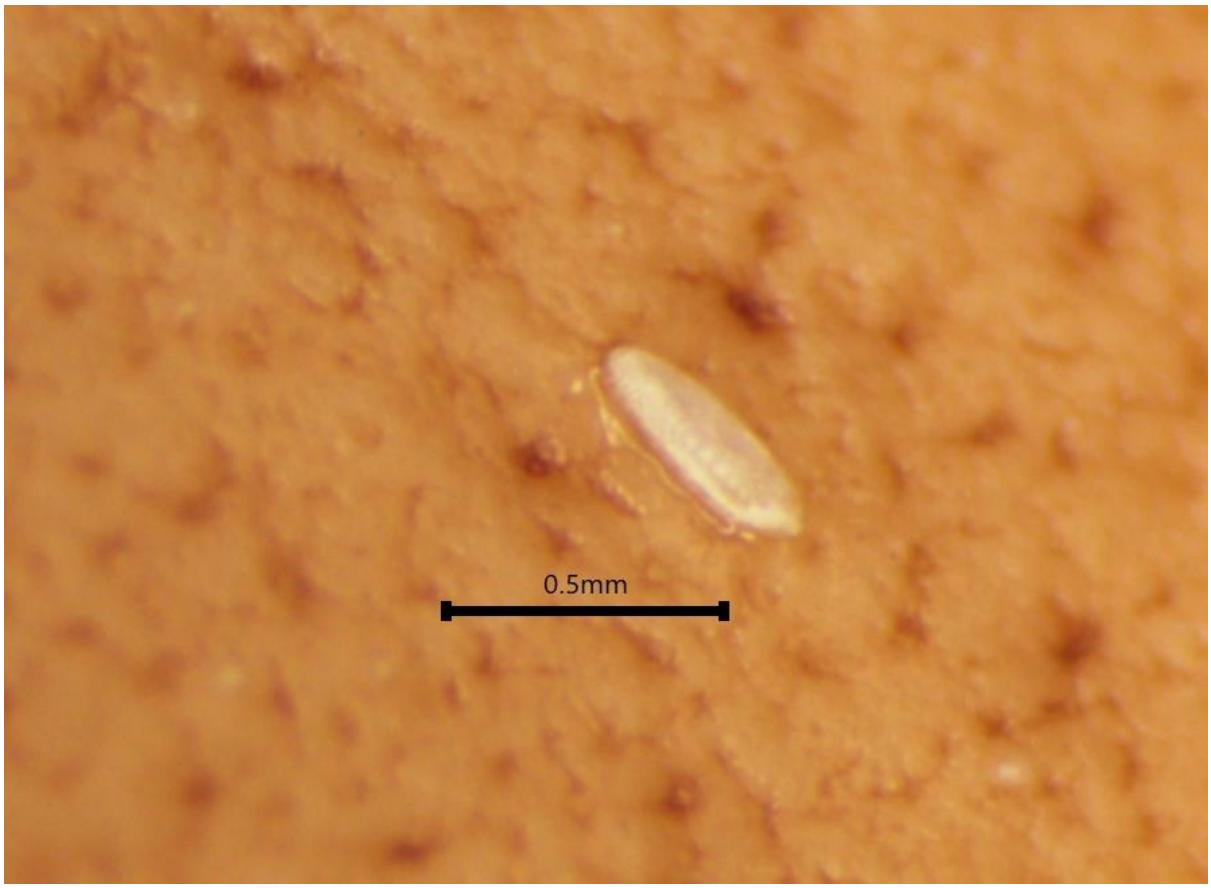

Figure 3. A phorid egg casing found on the outer surface of the cracked chicken egg.

Figure 4. Phorid larvae that were observed feeding on the rotten egg.

RESULTS AND DISCUSSIONS

The phorids were confirmed as *M. scalaris* (♀=3, ♂=2) and *M. spiracularis* (♀=4, ♂=2). Borgmeier (1967) discerned the adult morphological characteristics of these two species and they were further explained by Brown and Oliver (2007). *Megaselia spiracularis* can be distinguished from *M. scalaris* by having hairy mesothorax and male *M. spiracularis* has distinctively large abdominal spiracle and specific male genitalia (Disney & Sinclair 2008). Recently, Zuha et al. (unpublished) discovered sexual dimorphism based on wing venation of the two species by using geometric morphometric analysis. Information on larval and pupal morphology, however, still scarce (Disney 1994).

Developmental rates of *M. scalaris* from tropical region have been established at various range of temperatures, from 23℃ to 36℃ (Idris et al. 2001; Tumrasvin et al. 1977; Zuha et al. 2012; Zuha & Omar 2014). Based on present case, and assuming that development took place at room temperatures (23-27ºC), *M. scalaris* could complete post feeding stage in 4-5 days (Zuha & Omar 2014). The growth information of *M. spiracularis*, on the other hand, is scarce and currently limited to pupal development (Feng & Liu 2013).

This is a new record for *M. spiracularis* larvae found feeding and completed their development to adult stage in a rotten egg. Previously, *M. scalaris* has been previously recorded in extreme case of contamination via transportation of cracked chicken eggs to Antartica (Nickolls & Disney 2001) and in New Zealand "century eggs" (Brown & Oliver 2007). In food, this species has been found contaminating packed vermicelli, spaghetti, dates, soya flour, cheese and dried fish (Disney 1994). Larvae of *M. scalaris* have also been reported developing in ripe bananas (Karunaweera et al. 2002).

Megaselia scalaris contaminated laboratory rearing of ticks (Andreotti et al. 2003), triatomine bugs (Costa et al. 2007), mantids (Mongiardino Koch et al. 2013) and had caused serious contamination in mycological studies by infesting potato dextrose agar (Zuha et al. 2018). In forensic entomology laboratory settings, *M. scalaris* and *M. spiracularis* had been found contaminating *Chrysomya megacephala* (Fabricius) (Diptera: Calliphoridae) larval colony (Zuha et al. 2015).

Both species are equally important in medical and forensic investigations. *Megaselia scalaris* has been reported causing urinary myiasis (Wakid 2008), intestinal myiasis (Ogawa et al. 1959), nosocomial larval infestation of a wounded patient (Hira et al. 2004), including ocular and pulmonary myiasis in snakes (Diclaro II et al. 2011; Vanin et al. 2013). Other cases of possible myiasis caused by *M. scalaris* were vaginal and cutaneous myiasis (Biery et al. 1979). For *M. spiracularis*, the only medical case has been reported was of a pulmonary myiasis (Komori et al. 1978). In forensic investigation, both species has been found on decomposing human remains inside buildings (Kumara et al. 2012; Thevan et al. 2010). In the absence of other forensic dipterans such as Calliphoridae and Sarcophagidae, the phorids can be the main reference for mPMI estimation due to their small sizes that can penetrate through small gaps to reach decomposing corpses inside buildings (Zuha et al. 2016; Reibe & Madea 2010).

CONCLUSIONS

Based on the size and life duration of *M. scalaris* larvae found feeding on the cracked chicken egg, it was possible that the infestation began before purchasing. Retailers and consumers should be cautious as both scuttle fly species were able to take advantage of defective conditions in raw food commodities which subsequently could be transferred to human via ingestion. We also recommend any relevant authorities, chicken egg farmers and retailers to benefit from our findings by improving current regulations or standard operating procedures pertaining chicken egg marketing and handling.

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