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SHORT COMMUNICATION

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Calliphora vicina larvae grow at different rates on different body tissues.

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Abstract Compared with the rate on pig's liver, larval growth of the blowfly, *Calliphora vicina* is significantly faster by as much as 2 days on lung, kidney, heart or brain tissue. Potentially this has major implications when laboratory growth rates of larvae fed on one food substrate (often liver) are used to calculate the amount of development, and therefore the postmortem interval in a forensic case.

Keywords Development rates · Postmortem interval · Forensic entomology

Introduction

On a corpse, a range of tissues and organs are available as food sources for colonising blowfly larvae. Some, particularly softer tissues (e.g. lungs and brain), are frequently attacked first and are consumed more quickly than others. In published accounts of studies of growth rates of blowfly larvae it is usual for a single food substrate to be used and although these data are utilised by practising forensic entomologists, there is no consistency among authors or any consideration as to the applicability of data of these types to actual corpse decay scenarios. Liver, either beef (e.g. (Levot et al. 1979; Byrd & Butler 1996; Grassberger & Reiter 2001, 2002; Grassberger et al. 2003), pork (Ames & Turner 2003) or lamb/sheep (Wall et al. 1992; Davies 1998), beef (Greenberg & Tantawi 1993) or pork muscle (Byrd & Butler 1996; Byrd & Castner 2001), fish (Nuorteva 1977) or artificial diets (Mandeville 1988, but see Byrd & Castner 2001), have all been used or suggested in larval growth studies. Yet when such data are collected together in review articles the feeding substrates are not recorded or considered relevant (e.g. Smith 1986; Greenberg 1991; Higley & Haskell 2001; Greenberg & Kunich 2002). Additionally the effects of drugs on larval blowfly growth (e.g. O'Brien & Turner 2004; Pien et al. 2004) may be affected by the choice of tissues used by the feeding larvae.

This begs an important question; to what extent do such growth studies correctly model what happens on different tissues and if they do not, then what potential is there for inaccurate postmortem interval (PMI) determination? Can the growth of larvae taken from the cranial cavity or thoracic region of a corpse be compared with laboratory growth rates on one of these standard substrates? This paper describes some simple experiments to explore variability of growth rates on different tissues from the same animal.

Methods

Small groups of larvae of the common urban blowfly, *Calliphora vicina*, were grown on either liver, brain, heart muscle, lung or kidney tissue from pigs at a constant temperature of 20°C. These tis-

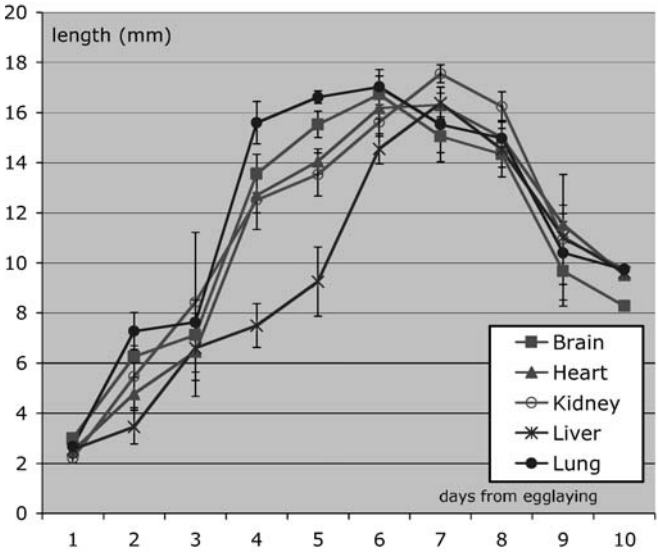

Fig. 1 Larval growth, in terms of length, of *Calliphora vicina* on different food substrates. *Error bars* are ±1 standard deviation

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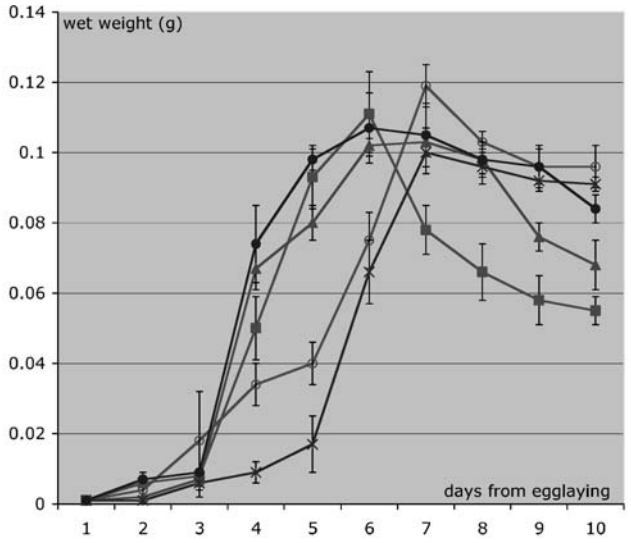


Fig. 2 Larval growth, in terms of wet weight, of *Calliphora vicina* on different food substrates. *Error bars* are ±1 standard deviation (key to substrates as in Fig. 1)

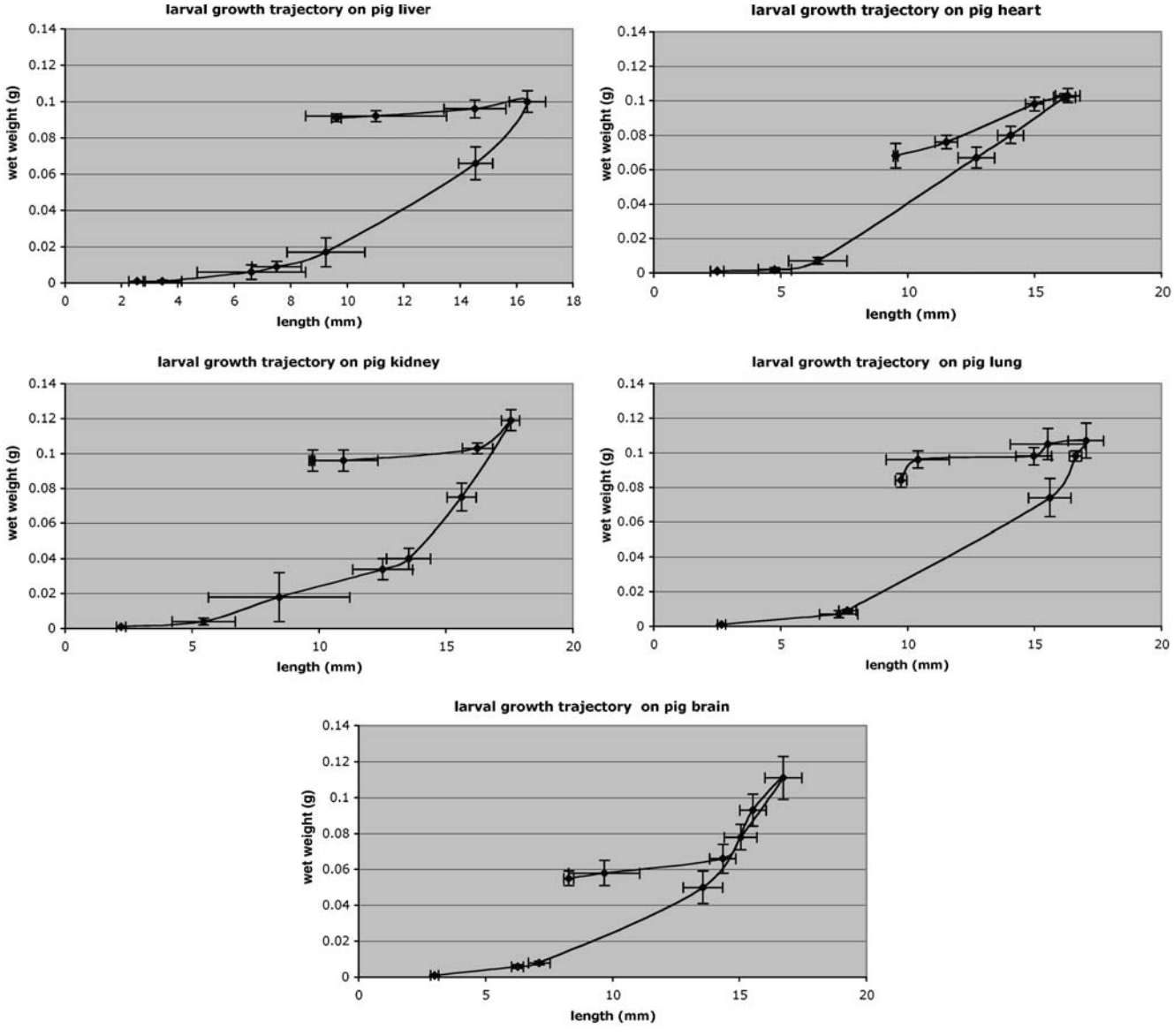
sues, which were either purchased from a butcher or obtained from a local abattoir, were stored frozen prior to being thawed and used in approximately 30 g pieces, on which groups of 10 larvae were reared. On a daily basis, batches of 10 larvae from each tissue substrate were washed in distilled water, dried on paper towels, individually weighed, killed in hot water and measured from 1st instar to pupariation (between 9 and 10 days from oviposition) in 3 replicated experiments.

All statistical analyses were carried out using the SAS package StatView v 5.

Results

There was no significant difference between any of the 3 replicates (ANOVA for wet weight F=0.496, p=0.609; for length F=0.435, p=0.648) on the same substrate and so the replicates were pooled (n=30 for each day/substrate combination).

Fig. 3 Weight:length growth trajectories of *Calliphora vicina* larval development on different food substrates. *Error bars* are ±1 standard deviation



Larval development, measured either as wet weight (Fig. 1) or length (Fig. 2), varied significantly between the different substrates (ANOVA for weight F=494.4, p<0.0001, length F=220.9, p<0.0001, n=1350 in both, Scheffé's post hoc test for difference between pairs of substrates p<0.02 for all combinations). In particular the growth rates on all the other substrates were higher than on liver during the first 6 days. For mid-sized larvae (approx. 10 mm or 0.06 g) the size/weight differences between pig liver and the other tissue substrates can be equivalent to 2 days of development (Figs. 1, 2).

During the post-feeding stage, when both weight and length decline, there was a considerable variability in weight change but little length variation between larvae grown on different substrates. Growth trajectories for *C. vicina* larvae on different substrates (Fig. 3) differed substantially, with larvae fed on brain or heart showing a marked wet weight loss during the post-feeding stage, leading to puparia of reduced weight and size.

Conclusions

Substrate does appear to matter when considering the rate of blowfly larval development and therefore it is important to know where on a corpse larval material has come from. It is also important that laboratory growth models, which form the foundation of PMI estimation using blowfly size or weight, are realistic and not carried out using substrates selected on the basis of convenience or low odour (Byrd & Castner 2001). Ideally, comparative growth models for different tissues should be developed otherwise errors of up to 2 days are possible in postmortem interval calculations.

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