INSECTS AS A SOURCE OF PROTEIN FOR ANIMAL FEED AND HUMAN NUTRITION: POTENTIAL FOR EXPOSURE TO DIOXINS?

Rose M[1]*, Fernandes A[1], Holland J[1], Petch S[1], Dickinson M[1], Fitches E[1], Wakefield M[1] and Charlton A[1]

[1] Food and Environment Research Agency, Sand Hutton, YORK. YO41 1LZ. UK

Introduction

Food security is a global challenge. As overall demand for food, particularly meat, increases there is an urgent need to increase supply of protein from sustainable sources. Currently more than 80% of the protein required for livestock rearing in the EU is imported from non-EU countries. The European Parliament has recently adopted an 'own initiative' resolution to address the EU's protein deficit, stating that urgent action is needed to replace imported protein crops with alternative European sources. It is also a European policy to reduce waste and to improve recycling wherever possible.

Insects, especially flies, have the potential to help meet this demand. As fly larvae are a natural component of the diet of fish, chicken and pig, the EU funded project PROteINSECT is focusing on rearing two species of fly and conducting feeding trials with these animals. Fly larvae grown on a range of organic wastes have the ability to reduce the volume of that waste by up to 60%, providing an additional benefit to waste management and the environment. PROteINSECT's research will evaluate the quality and safety of the larvae produced for incorporation into animal feed, as well as the taste and texture of the meat produced.

A comprehensive assessment of the quality and safety of insect derived extracts (both crude and processed) and suitability for incorporation into animal and fish feed will be undertaken as part of the project. The nutritional composition (e.g. amino acids), safety (chemical and microbiological), allergenicity and quality (e.g. taints) of insects and meat/fish produced from insects are all parameters that will be determined. We will also identify other high value products such as vitamins, minerals and chitin as byproducts of the protein production process.

A risk assessment framework will be constructed by leading food safety experts resulting in a prioritised testing matrix to generate the first substantial compositional dataset in relation to insects and insect products used for dietary purposes. This will adhere to food and feed safety guidelines according to EC Directive 2002/32. Testing will be performed both in state-of-the-art laboratory facilities and using industry standard testing protocols. Testing will be focussed on materials at their point of entry into the food chain, therefore whole insects, insect extracts and meat/fish from feeding trials will be assessed. Measurements will be diverse, but will include an evaluation of the most likely safety threats to successful adoption of insect protein use in animal feed. Significant risks that will need to be managed include:

- Environmental contaminants such as: heavy metals, dioxins, PCB & PAHs
- Viruses and other human pathogens.
- Chemical residues (e.g. pesticides, veterinary medicines).
- Allergens
- Taints

This paper presents results for dioxins and PCBs in some initial samples produced from this project.

Materials and methods

Figure 1: The process of turning waste into high protein animal feed; and selling insects for human consumption.

Figure 1 shows the process of producing animal feed from insects. Table 1 in the Results section gives details of the larvae samples. All larvae were reared on chicken manure except for one sample which was reared on abattoir waste (marked in the table as 'meat fed'). All harvested larvae were in the mature development state and drying was by boiling (UK samples) or drying in the sun (remainder). Approximately 500g of dried insect larvae were taken for all samples, they were milled in bulk and a 25g larvae powder aliquot was sub-sampled for analysis.

Each sample was fortified with known amounts of surrogate ($^{13}C_{12}$-labelled) analogues of target analytes and exhaustively extracted using mixed organic solvents. Extracts were purified by adsorption chromatography and methodology has previously been reported in detail.[1,2] Final determination was by high resolution gas chromatography with high resolution mass spectrometric detection. The set of samples was analysed alongside a reference material and a full reagent blank. The contribution from the batch blank was found to be negligible. The analytical performance of the laboratory in international inter-comparison studies that included PBDEs, dioxins and PCBs using essentially the same method, was shown to be in good agreement with consensus data.

Results and discussion

The results are shown below in Table 1.

Sample Details:	**Musca domestica**	**Calliphora vicina (meat fed)**	**Musca domestica**	**Calliphora vicina LARVAE**	**Musca domestica**
Country of production	UK	UK	China	UK	Ghana
WHO TEQ 2005 ng/kg whole					
Dioxin	0.18	0.44	0.14	0.39	0.30
non ortho-PCB	0.07	0.03	0.10	0.04	0.31
ortho-PCB	0.01	<0.01	<0.01	<0.01	0.02
Sum of WHO TEQs (upper)	**0.26**	**0.48**	**0.25**	**0.44**	**0.63**
WHO TEQ 2005 ng/kg Fat					
Dioxin	0.59	1.35	0.57	1.18	1.42
non ortho-PCB	0.21	0.10	0.43	0.11	1.54
ortho-PCB	0.02	<0.01	<0.01	0.01	0.09
Sum of WHO TEQs (upper)	**0.82**	**1.45**	**1.01**	**1.30**	**3.05**

These initial results suggest that animal feed derived from insects is likely to be below the range of limits that have been set for other types of animal feed. The lowest of these current limits is 0.75 ng WHO-PCDD/F-TEQ/kg relative to a feed with a moisture content of 12%. The limits are higher when PCBs are also included.

Acknowledgements

Funding for this project was through the EU project 'PROteINSECT'.

PROteINSECT
INSECTS AS SUSTAINABLE SOURCES OF PROTEIN

http://www.proteinsect.eu/

References:

1. Fernandes A, White S, D'Silva K and Rose M. (2004) *Talanta* 63 (5) 1147-1155
2. Fernandes A, Rose M, Mortimer D, Carr M, Panton S, Smith F. (2011) *Journal of Chromatography A*. 1218 9279-9287.