IPIFF
Guide on
Good Hygiene Practices

for European Union (EU) producers of insects as food and feed

December 2020
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The industry to farm insects as food and feed started only about a decade ago. In tropical countries eating insects was based on harvesting from nature. Sometimes that occurred at a very large scale such as the harvesting, processing and marketing of the mopane caterpillar in southern Africa. However, efforts to rear or farm edible insects in large numbers was never the case, although there were examples of semi-domestication by indigenous people such as providing egg laying sites for aquatic Hemiptera in lakes of Mexico, manipulating the habitat to increase edible caterpillars in Africa, and cutting palm trees deliberately to encourage palm weevils to lay their eggs in South America. There are only sporadic examples that insects were used as feed, such as luring termites to devices which were then emptied to feed the chicks.

Rearing of insects at a large scale occurred in pest management. The Sterile Insect Technique needed enormous numbers of reared sterile insects to be released into the wild to control fruit flies or flesh-eating screwworms. Biological control needed large numbers of predators and parasitoids to be released to control pests. Edible insects were reared but mainly for customers with house pets like reptiles and amphibians. When the idea of using insects for food or feed emerged, some of those insect rearing companies set up special production lines to rear mealworms, crickets and locusts for human consumption. Those special production lines were necessary because it was realised that society needed safeguards with respect to food safety. Strict hygienic measures and track and tracing systems were self-imposed. The knowledge that insect consumption could trigger allergic reactions prompted the industry to put warnings on the label. However, because it was all new, the insect industry was not sure how to deal legally with all food safety issues.

During the last ten years, the worldwide interest in using insects as food and feed surged, both in the public and private domain. Hundreds of start-ups in the world are now engaging in this activity. Some very large industrial insect rearing companies have emerged capable of producing tons of insects a day. The interest of the academic world in this topic is growing exponentially, especially during the last three years. The environmental benefits of using insects as food and feed by the public media is often highlighted. National and international authorities are becoming increasingly supportive as they also discover the benefits of this new agricultural sector. But how to ensure food and feed safety?

I happened to be present at the first meeting in 2013 of the European Union (EU) insect producing companies in Brussels when the International Platform of Insects for Food and Feed (IPIFF) was created. The main concern was legislation. Since then IPIFF has done a tremendous job of promoting edible insects towards the European Union. This Guide shows that the association also wants to support its members in the effective implementation of EU food and feed safety legislation. As such, the Guide contributes to underline the critical importance of food and feed safety (procedures) in insect production activities as concluded by the European Food Safety Authority (EFSA) in recent opinion dealing with risks associated with insects as food and feed and acknowledged by EU public authorities (e.g. European Commission, Directorate-General for Health and Food Safety). This Guide by IPIFF is an excellent guideline for everyone engaging in the business of how to produce, process and market insects safe for human consumption and for animals to feed. It is very complete and gives a profound overview of all relevant EU regulations and how to deal with it.

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GENERAL INTRODUCTION

An initiative by the International Platform of Insects for Food and Feed (IPIFF)

The International Platform of Insects for Food and Feed (IPIFF) is a not-for-profit organisation which represents the interests of the insect production sector. With over 72 members from 23 different countries across Europe and worldwide, IPIFF is the voice of European insect producers towards the European Union and the wider public.

The prime objective of the European insect production sector is to produce safe products suitable for both human consumption and animal feed. Against this background, in November 2016, the IPIFF members decided to launch a Task Force on ‘Good Hygiene Principles’ aimed at preparing and developing a Guide on Good Hygiene Practices (GHP) for insect production (hereafter referred to as ‘the Guide’).

Objectives of the Guide:

The overarching objective of the Guide is to help operators producing insects for food and/or animal feed purposes (hereafter referred to as ‘insect producers’) to achieve a high level of consumer protection and animal health through the production of safe products. To this end, the Guide provides guidance to insect producers to effectively apply EU food and feed safety legislation and other related EU requirements (e.g. food and feed labelling requirements, EU animal-by-products and TSE legislations), while providing an incentive for them to develop a robust food and feed safety management system.

In addition, this Guide specifies requirements enabling to:

1. ensure that insect producers conform to their stated food and feed safety policy and demonstrate their commitments in this regard;
2. help the insect producers to effectively communicate food and feed safety issues to the national competent authorities, and when needed, to their suppliers, customers and relevant interested parties (i.e. consumers) in the food and feed chain.

To achieve the above objectives, the Guide has drawn on the skills and expertise of companies directly involved in the production of insects, either for human consumption or for animal feed purposes. Annex III lists all insect producing companies that have been active in the development of the present document.

Furthermore, IPIFF has consulted several European representative organisations of the food and feed business sectors and other interested parties – i.e. the Members of the Advisory Group on the Food Chain and Animal and Plant Health - during the preparation of the present Guide. The consulted organisations are listed in Annex IV.

Scope of the Guide and legal framework

The Guide covers the production of insects destined for human consumption or animal feed (i.e. including feed for food producing animals, pet food and fur animals) and encompasses all production steps, from the feeding of the insects, their breeding, the killing and other processing steps, storage, transport or retail activities, to the final delivery of the product to consumers, feed manufacturers or farmers.

Yet, it does not address the specific steps and/or measures to be applied by operators when handling of insects/ insect products and/or their by-products (e.g. insect frass) which are intended for ‘technical uses’ (i.e. non-food and/or feed use) (e.g. use of insect fat as biofuel, valorisation of insect frass as organic fertiliser).
Insect products destined for human consumption include the followings:

- killed whole insects which have been subject to post treatment steps i.e. steps which do not change the nature of the primary product (e.g. drying, freezing step);
- ground and further processed insects (e.g. insect meals, including when incorporated into processed products, or parts of insects and their derived products).

N.B: At the time of the present document's writing, the above products are not authorised for marketing as human food on the EU territory, due to the absence of approval by the European Commission. Indeed, insects as food in the EU require pre market authorisation, based on novel food applications, pursuant to Regulation (EU) 2015/2283. As of this writing, several novel food applications have been submitted to the European Commission and are currently being assessed by the European Food Safety Authority1.

Different types of products may be commercialised for animal feed. The related production steps are addressed in this document. These concern the followings:

- live farmed insects. The Guide does not however specifically address the steps and/or measures which should be applied by operators following the breeding/growing phase of the live insects intended for animal feed (the latter being covered through chapter 3 & 4);
- killed whole insects if subject to post treatment steps, i.e. steps which do not change the nature of the primary product (e.g. drying, freezing);
- ground and further processed insects (e.g. insect-derived hydrolysates, oils or processed insect proteins such as in the form of fat meals, defatted or partially defatted meals).


In respect of the above activities, insect producers must comply with the same safety requirements and Good Hygiene Practices (GHP) as food or feed business operators that are active in other food or feed sectors. Thus, the present Guide covers:

1. the operations referred to in article 4.1 and 4.2 of Regulation (EC) No 852/2004, concerning respectively primary production (and associated operations), processing and distribution of food.
2. the operations referred to in article 5.1 and 5.2 of Regulation (EC) No 183/2005 which concern respectively primary production of feed and other activities.
3. the general obligations referred to in article 4.2 of Regulation (EC) No 183/2005 which apply to the feeding of food producing animals.

Therefore, it follows that the recommendations provided for in Annex I (primary production) and II (processing and distribution) of Regulation (EC) No 852/2004 and of Regulation (EC) No 183/2005 concerning the control of hazards in primary production of both food (and associated operations) and feed products. It is also in line with the guidelines provided in annex III of Regulation (EC) No 183/2005 concerning good animal feeding practice.

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1 For further details, see IPIFF briefing paper on novel food (link)
The guidelines provided in the Guide revolve around good hygiene practices including prerequisite programs and procedures based on the HACCP principles, when applicable.

Furthermore, the Guide identifies the elements that require particular attention from insect producers, as previously identified by the European Food Safety Authority (i.e. ‘the specific production methods, substrates used, stage of harvest, insect species and development stage and methods for further processing, environmental effects’), in order to achieve compliance with food and feed objectives, as defined in the applicable EU Regulations.

To this end, it makes a series of concrete recommendations aimed at addressing and managing safety hazards identified along the production chain, including on the application of Hazard Analysis and Critical Control Points (HACCP) principles, whenever applicable (for more details, see chapter 7 - ‘Implementation of HACCP principles by insect producers’). Notably, HACCP principles do not apply to primary production and associated activities.

The development of such sector specific hygiene guides is encouraged by the above-mentioned Regulations. Yet, its use and effective implementation by insect producers remains voluntary and is based on their full self-responsibility. Furthermore, the Guide does not aim to substitute these Regulations nor to replace national regulatory provisions which may apply to their activities: therefore, for legal compliance purposes, operators should always refer to applicable regulatory requirements.

In addition to the above-mentioned requirements, several insect producers may have to comply with standards as set out in framework of food and/or feed assurance systems (e.g. see section 2.6.2. regarding ‘microbiological limits’). Such schemes may serve as a point of reference for IPIFF and its members to complement and update, in the future, the recommendations that are provided in this Guide.

Similarly, the present Guide may serve as a point of reference for establishing supplementary guides or for developing food and/or feed assurance schemes that apply to insect production activities. Yet, it should not serve the purpose of establishing standards falling subject to third party certification.

Furthermore, it may be consulted as a useful reference for production activities taking place outside the EU, without prejudice to the applicable legislative standards in these countries.

Notably, the recommendations contained in the document should be used by third country operators intending to sell their products on the EU market: compliance with EU requirements is indeed mandatory for imported insect products intended as food or feed.

- In the case of import of insect food products, only third countries that are listed in Regulation (EU) No 2019/626 (i.e. Canada, Switzerland, South Korea and Thailand at the time of writing of this document) can legally import such products into the EU, while each consignment shall be accompanied by an official certificate in accordance with Regulation (EU) No 2019/628.
- The import in the EU of processed insect, ‘treated’ but not ‘processed’ (in view of their use as feed) allowed, only if originating from countries listed in Part I of Annex II to Regulation (EU) No 206/2010 (List of third countries, territories and parts thereof authorised for import of fresh meat into the EU) and accompanied by a health certificate, in line with the model health certificate laid down in Chapter I of Annex XV to Regulation (EU) No 142/2011.

The Guide also applies to subsequent activities (e.g. packaging, transport, retail) if they take place in the European Union, from the EU importer up to the final distribution stage.

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2 EFSA scientific opinion ‘Risk Profile related to production and consumption of insects as food and feed’ (8 October 2015).
3 Pursuant to the ‘non-territorial effect’ of EU provisions, these operations do not fall within the scope of EU food and feed safety requirements.
4 Imports would be only possible on the approval of the product as a novel food, for further information please refer to the information note on imports of insects as food.
5 At the time of the document’s writing, the use of processed insects’ proteins in animal feed for food producing animals is ‘only’ possible for farmed fish. Yet, EU discussions are underway with the view to authorising these products in swine and poultry feed.
Applicable EU Regulations and other reference texts

Besides the General EU food and feed hygiene regulations - Regulation (EC) No 852/2004 on the hygiene of foodstuffs and Regulation (EC) No 183/2005 laying down requirements for feed hygiene and the EFSA’s scientific opinion from 8 October 2015, insect producers may refer, for compliance with EU food and feed safety objectives, to the following EU legal acts:

1. Regulation (EC) No 178/2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety (better known as ‘General Food Law’ Regulation);

2. Guidance on the implementation of articles 11, 12, 14, 17, 18, 19 and 20 of Regulation (EC) No 178/2002 on General Food Law;

3. Regulation (EU) No 2017/625 on official controls and other official activities performed to ensure the application of food and feed law, rules on animal health and welfare, plant health and plant protection products;

4. Regulation (EU) No 2019/625 on supplementing Regulation (EU) No 2017/625 of with regard to requirements for the entry into the Union of consignments of certain animals and goods intended for human consumption;


10. Regulation (EU) No 1169/2011 on the provision of food information to consumers;


13. Regulation (EC) No 999/2001 laying down rules for the prevention, control and eradication of certain transmissible spongiform encephalopathies;


17. Regulation (EU) No 68/2013 on the catalogue of feed materials

The following documents may also be regarded as essential tools for insect producers to ensure compliance with General Food Law Principles.

1. European Food Safety scientific opinion ‘risk profile related to production and consumption of insects as food and feed’ (8 October 2015);
2. Report on ‘novel foods’: a risk profile opinion for the house cricket (Acheta domesticus)’ by the Swedish University of Agricultural Sciences (EFSA funded report, adopted on 6 July 2018);
3. Commission Notice – Guidelines for the feed use of food no longer intended for human consumption (OJEU, 16 April 2018);
4. Commission notice – Guidance document on the implementation of certain provisions of Regulation (EC) No 183/2005 laying down requirements for feed hygiene (OJEU, 5 July 2019);
5. Hazard Analysis and Critical Control Points (HACCP) system and Guidelines for its application (Codex Alimentarius);
6. EN ISO 22000:2018 on Food Safety management systems;
7. The Codex code of practice on good animal feeding;
8. Strategy safety concept for Insects as Feed (Updated);
9. IPIFF Policy priorities towards 2025 (IPIFF’s Regulatory Brochure) (20 May 2020);

**Overall structure of the document**

The Guide is divided into seven parts:

Chapter 1: Food and feed safety management systems: general principles and EU requirements
Chapter 2: Prerequisite programs: infrastructures and general conditions of production
Chapter 3: Prerequisite programs: management of insects’ substrates
Chapter 4: Prerequisite programs: insect rearing activities
Chapter 5: Overview of processing methods applied to insects intended for human consumption and animal nutrition
Chapter 6: Prerequisite programs: storage, packaging, labelling and transport operations
Chapter 7: Implementation of HACCP principles by insect producers
Each chapter sets out a series of recommendations aimed at addressing and managing safety hazards identified along the entire production chain. Referred to as ‘recommended practices’ - see the last subchapter at the end of each chapter - and/or encapsulated in summary frames, these recommendations are presented with references to applicable EU regulatory provisions or illustrations whenever deemed appropriate.

These recommendations are applicable to insect production activities for both food or feed purposes, with the exception of Chapter 5 which contain elements specific to these operative branches6.

The Guide is complemented by the following four annexes:

- **Annex I** contains a glossary of definitions, mainly extracted from EU regulatory provisions;
- **Annex II** provides the list of insect species authorised for use as processed proteins in feed for aquaculture animals within the EU;
- **Annex III** lists all insect producing companies who contributed to the development of the present document – i.e. the Members of the IPIFF Task Force on ‘Good Hygiene Principles’;
- **Annex IV** lists the European representative organisations of food and feed business sectors and other interested parties – i.e. members of the Advisory Group on the Food Chain and Animal and Plant Health – who were consulted during the development of the present Guide.

**Future updates**

Any future change(s) to the current Guide will be made by IPIFF in consultation with stakeholders. The Guide is currently pending the official endorsement by the Standing Committee on Plants, Animals, Food and Feed. The Guide will be reviewed as required to take into account technological or scientific advances, as well as legislative developments on the topic of safe insect production. The current version of the Guide was updated in December 2020 (initial release on February 2019, update December 2019).

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6 However, insect food producers should refer to section 5.1., section 5.2. (killing methods) and 5.2.3. (post killing methods) as those practices and/or techniques reflect, to a large extent, the standards being followed by those operators, similarly to insect feed producers. As EU standards may differ as result of the ‘first’ novel food authorisations covering insects as food, and owing to potential future updates of EU hygiene standards in this field (e.g. setting of specific microbiological criteria for processed insects for human consumption). Applicable legislative requirements insects as food, will have to be complemented accordingly.
1.1. Introduction

The purpose of this Guide is to ensure the achievement of EU food and feed safety standards by insect producers. To this end, food and feed safety management systems must be established, documented, implemented and maintained.

The structure of the systems must include policies, requirements and documented procedures that reflect best practices.

Furthermore, insect producers should implement the necessary good hygiene practices, traceability systems and recall requirements. These operators should also be aware of hazards that might adversely affect the safety of insect products along the production chain. Whenever feasible and/or applicable (e.g. at insect processing stage) hazard analysis must be carried out in accordance with HACCP principles (see Chapter 7 for more details).

This chapter contains general recommendations which should be followed by any insect producer - before starting their activities – in the setting up of the above systems. Whenever relevant, references to EU food and feed hygiene requirements are indicated.

1.2. Applicable EU Regulations

1.2.1. ‘General’ EU food and feed hygiene requirements

Regulation (EC) No 178/2002 (i.e. ‘General Food Law’), Regulation (EC) No 852/2004 (Food Hygiene) and Regulation (EC) No 183/2005 (Feed Hygiene) apply to all insect producers rearing, processing, handling (e.g. transport, storage) or distributing insects along the food or feed chain. In practice, the requirements contained in Regulation (EC) No 852/2004 and Regulation (EC) No 183/2005 for producing insects for food and feed are closely related in particular as regards ‘primary production’ activities. Due to the nature of insect production activities which remain very similar regardless of insect products intended use (food or feed), the recommendations contained in the present Guide therefore combine both production activities (except for operations subsequent to processing - see Chapter 5).

However, these production activities should be registered respectively to the competent authorities.

As a general rule, operators active in the rearing of insects, and/or in other handling operations that are directly associated with these activities (including storage at the rearing plant and transport from the rearing plant) are considered as ‘primary producers’, according to EU Food and Feed Hygiene legislation:

7 According to article 3 f. of Regulation (EC) No 183/2005, ‘primary production of feed’ means the production of agricultural products, including in particular growing, harvesting, milking, rearing of animals (prior to their slaughter) or fishing resulting exclusively in products which do not undergo any other operation following their harvest, collection or capture, apart from simple physical treatment (Chapter 1, article 4, point f). Insect breeding can therefore be considered as primary production within the meaning of the EU feed hygiene legislation. Likewise, pursuant to article 3 17. of Regulation (EC) No 178/2002 which defines ‘primary production’ similarly to article 3. f. of Regulation (EC) No 183/2005 the breeding of insects intended for human consumption should be regarded as ‘primary production’ activities.
1. Operators producing insects for animal feed must be registered\(^8\) before the national competent authorities - pursuant to article 9 of Regulation (EC) No 183/2005 - and comply with the general requirements contained in Annex I, Part A of the text. Part B of the same annex includes several recommendations for the development of guides to good practices covering primary production activities, while Annex III describes general practices regarding the feeding of their insects (including storage and distribution operations);

2. Operators rearing insects for human consumption must register and notify national competent authorities of operations under their control - pursuant to article 6.2 of Regulation (EC) No 852/2004 - including the handling operations directly - in view of their registration, and comply with general requirements contained in Annex I, Part A of the text. Part B of the same Regulation specifies recommendations for the development of Guides to good practices covering the above activities\(^9\).

The killing of insects and other processing activities - including handling operations directly associated with these activities - are not considered ‘primary production’, even if carried out in the same rearing plant, since these steps lead to a change in the nature of the primary product. Thus, those fall subject to different hygiene requirements, under EU food feed hygiene and fall subject to the ‘EU Animal By-Products (ABP) Regulations’ (i.e. Regulation (EC) No 1069/2009 and Regulation (EU) No 142/2011) in case of insect products intended for animal feed.

1. Whenever processing\(^10\) killed insects (e.g. in view of producing processed insect proteins), insect producers processed animal proteins must be approved\(^11\) before national competent authorities in accordance with Regulation (EC) No 1069/2009 (article 24 1. a) (see chapter 4.1.2).

2. Operators producing insects for animal feed, at ‘other stages than primary production’ - i.e. from the killing stage up to further processing stages - must comply with specific hygiene requirements laid down in Annex II of Regulation (EC) No 183/2005 (these requirements concern the facilities and equipment, personnel, storage and transport operations, compulsory sampling plans, record keeping measures, complaints and product recall);

3. Operators producing insects for human consumption, at ‘other stages than primary production’ - i.e. from the killing stage up to further processing stages including distribution - shall also refer to Annex II of Regulation (EC) No 852/2004, which contains specific hygiene requirements applying to these activities (these concern facilities and equipment, personnel, storage and transport operations, compulsory sampling plans, record keeping measures, complaints and product recall).

The handling of insect by-products generated through the production process (e.g. processing of insect frass as organic fertiliser) is subject to ‘separate’ hygiene standards in accordance with Regulation (EC) No 1069/2009 (e.g. new categorisation as foreseen by article 9, and approval procedure before national competent authority under article 24 1 a)\(^12\).

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\(^8\) Registration involves the placing of establishments on a list which will be used to develop a programme of official controls. Approval requires a prior inspection visit by the national competent authorities before a feed business operator is allowed to carry out its production activities.

\(^9\) This requirement applies without prejudice to the obligations of insects producers to obtain or benefit from a novel food authorisation in order to produce and market their products, pursuant to Regulation(EU) 2015/2283 on novel foods (see Introduction for more details).

\(^10\) Processing does not include treatment steps such drying or freezing.

\(^11\) The approval procedure is defined in article 44 1. of Regulation (EC) No 1069/2009 as the procedure by which the national competent authority shall approve establishments or plants only where an on site visit, prior to start-up of any activity, has demonstrated that they meet the relevant requirements of the animal by-products legislation.

\(^12\) As previously indicated, these activities are not directly covered in this Guide.
Stages of production covered

General principles, main obligations and legislative requirements for insect producing activities: overview of main EU provisions in the areas of food and feed safety

Applicable EU legislative provisions

<table>
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<tr>
<th>Producers of insects for human consumption</th>
<th>Producers of insects for animal feed</th>
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<tr>
<td>Regulation (EC) No 178/2002 (‘General Food Law’) lays down the general principles governing food and feed safety. The most relevant provisions include article 6 (‘risk analysis’), article 14 (‘food safety requirements’), article 15 (‘food safety requirements’), article 17 (‘responsibilities’), article 18 (‘traceability’), article 19 (‘responsibilities for food: food business operators’) and article 20 (‘responsibilities for feed: feed business operators’).</td>
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Considered as ‘primary production’ activities

| Are not required to implement HACCP based procedures (article 5.3 of Regulation (EC) No 852/2004). | Are not required to implement HACCP based procedures (article 6.1 of Regulation (EC) No 183/2005). Yet, insect breeders are no longer considered as ‘primary producers’ when using additives or premixtures of additives (article 5.2 of Regulation (EC) No 183/2005) and must consequently implement a HACCP plan (in accordance with article 291 (a) of Regulation (EC) No 1069/2009) |

Operators must ‘register’ their activities

| Must comply with Annex I, Part A. of Regulation (EC) No 852/2004 (contains requirements for operators active in primary production of food, incl. hygiene provisions and record keeping). Insect frass being considered as a by-product pursuant to Regulation (EC) No 1069/2009, insect producers fall subject to the requirements of the above legislation when it comes to the management of these materials (e.g. sorting obligations, approval before national competent authorities in accordance with article 4 and article 24 of Reg. 1069/2009 and compliance with processing methods defined in Reg. 142/2011). Yet, these steps fall outside the scope of the present Guide. | Must comply with Annex I part A of Regulation (EC) No 183/2005 (contains requirements for operators active in primary production of feed incl. hygiene provisions and record keeping). Must comply with Annex III of Regulation (EC) No 183/2005, which refers to ‘good animal feeding practices’ (contains requirements regarding feeding equipment, feeding practices, water and personnel). Insect frass being considered as a by-product pursuant to Regulation (EC) No 1069/2009, insect producers fall subject to the requirements of the above legislation when it comes to the management of these materials (e.g. sorting obligations, approval before national competent authorities in accordance with article 4 and article 24 of Regulation (EC) No 1069/2009 and compliance with processing methods defined in Regulation (EU) No 142/2011). Yet, these steps fall outside the scope of the present Guide. |

Applicable hygiene requirements

<p>| Supply of substrates and rearing of insects for food and feed – chapter 3 and 4 of the Guide |  |</p>
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<th>Producers of insects for animal feed</th>
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Being considered as ‘non-primary production’ activities (e.g. processing), operators must comply with HACCP based procedures with specific hygiene requirements.

Article 5 of Regulation (EC) No 852/2004 requires that food business operators ‘shall put in place, implement and maintain a permanent procedure or procedures based on the HACCP principles’.

Insect producers shall comply with Annex II of Regulation (EC) No 852/2004 (i.e. contains requirements regarding all food premises, transport, equipment requirement, food activities subject to ‘registration’).


Activities subject to ‘approval’ and ‘registration’


Approval as ‘establishment handling animal by products’ and complying with processing methods as required under article 24. of Regulation (EC) No 1069/2009 (including for the manufacture of pet and other activities such as the processing of insect frass).

‘Terrestrial invertebrates’ are classified category 3 materials (article art. 10 (l) of Regulation (EC) No 1069/2009). Therefore, insect-derived ingredients intended for animal (e.g. insect processed protein, insect fat, hydrolysed proteins, gelatine) must be treated in accordance with validated processing methods (article 31 1. (b) of Regulation).

13 See notably article 9 and 21 of Regulation (EU) No 142/2011 and relevant Annexes referred thereof.
Regulation (EC) No 852/2004:
- Operator must be registered as a ‘food business establishment’ (Art. 6.2);
- No compulsory implementation of HACCP based procedures (Art. 5.3);

Regulation (EC) No 852/2004 on food hygiene:
- Operator must be registered as a ‘food business establishment’ (Art. 6.2);

Regulation (EC) No 853/2004:
- Operator must be registered as a ‘feed business establishment’ (Art. 9);
- Must comply with hygiene provisions and record keeping (Annex I, Part A);
- Exception: insect breeders are no longer considered as ‘primary producers’ when using additives or premixtures of additives (Art. 5.2) and must then implement a HACCP plan (Art. 29(1)(a) of Regulation (EC) No 1069/2009);

Regulation (EC) No 1069/2009:
- Compulsory implementation of HACCP based procedures (Art. 5);
- Operator should be approved as ‘establishment processing animal by products’ (Art. 24 (1) (a));
- Insect derived ingredients intended for animal feed must have validated processing methods (Art 31);

Insects as food and feed operators involved in ‘Management of insect frass’ - EU Animal by product legislation applies

Regulation (EU) No 142/2011:
- Compliance with processing methods as defined

Regulation (EC) No 1069/2009:
- Sorting obligations – Art. 4
- Approval before national competent authorities – Art. 24 (1) (g)
- Implementation of a HACCP plan - Art. 29(1)(a) and (c) on primary production activities

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1.2.2. Requirements on substrates as feed for insects

Introduction

Insects reared within the European Union fall within the category of ‘farmed animals’ as defined the EU Animal By-Products’ legislation (i.e. article 3 6. of Regulation (EC) 1069/2009). Consequently, these animals may only be fed with materials which are eligible for the above, which include:

- Feed materials of **vegetal origin**;
- Feed materials of **animal origin**, provided that they have not been expressly prohibited by the EU legislator for use as feed for farmed animals (including therefore farmed insects).

As article 3.6 of Regulation (EC) No 1069/2009 defines ‘farmed animals’ very broadly\(^ {14} \), the abovementioned limitations apply, no matter the destination of the insect derived products, including if those are intended e.g. as feed for pet food, fur animal or for technical uses (e.g. biofuel production, cosmetic, biochemistry).

The only exception applies to **maggots and worms intended for fishing bait**, which may notably be fed with catering waste or with animal manure (category 2 materials), if authorised by the national competent authority of the EU country where the product is being commercialised, pursuant to article 18 of Regulation (EC) No 1069/2009.

The present chapter aims to provide a comprehensive overview of the **EU restrictions applying to the feeding of insects with products of animal origin**. Furthermore, it outlines the specific EU requirements relating to the **presence of contaminants** in the selected substrate (of vegetal or animal origin) and the EU requirements applying to the use of **feed additives** (see below section ‘where to find the applicable EU requirements’).

Yet, requirements relating to **feed suppliers’ obligations** (e.g. compliance with HACCP standards, registration obligations) are being addressed in chapter 3.1.2 of the present Guide.

For ease of reading and in order to better illustrate the above-mentioned regulatory possibilities, this chapter also includes examples of substrates/ types of substrates which may well be used by insect producers vs. those that are expressly prohibited (see section ‘Authorised and non-authorised substrates for insects: a few examples’\(^ {15} \)). Yet, for legal compliance purposes, operators should always refer to applicable regulatory requirements.

Where to find the applicable EU requirements?

Applicable EU rules revolve around the following products or sets of legislation:

- Those **feed materials that are expressly prohibited in animal feed** (including for pet food and fur animals or for food and feed producing animals only) pursuant to the provisions contained in the EU ‘Feed Marketing’ and in the ABP Regulations;
- Restrictions applying under the EU ‘TSE Regulation’ (or ‘feed ban’ rules);
- Different types of **former foodstuffs** containing products of animal origin that are authorised under the EU animal by-products legislation and,
- **EU contaminants** residue limits applying to feed materials and applicable requirements for **feed additives** when used as substrate for insects.

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\(^{14}\) Article 3.6 of Regulation (EC) No 1069/2009 defines ‘farmed animal’ as any animal that is kept, fattened or bred by humans and used for the production of food, wool, fur, feathers, hide, hides and skins, or any other product obtained from animals or from other farming practices.

\(^{15}\) This list is purely informative and inspired by answers provided to an internal questionnaire addressed to the IPIFF Members on 9 March 2018 (27 answers collected) as well as numerous requests (i.e. request for legal clarification) addressed to the IPIFF Secretariat.
N.B: the EU Catalogue of feed materials contained in Commission Regulation (EU) No 68/2013 provides a comprehensive list (above 1000 entries) of feed materials (together with a product description) which are being commonly used on the EU market. Yet, the mere fact that a product is listed in this Catalogue or in the accompanying register of feed materials does not necessarily mean that the product is authorised in feed for insects. Indeed, the Catalogue of feed materials remains a ‘non-exhaustive’ instrument while the name and/or description provided for each feed material does not specify whether the feed is intended for food and feed production animals or for pet food or fur animals (bearing in mind that the feed materials allowed for these respective target species may sometimes largely differ).

Prohibited materials as substrate for insects

Annex III to Regulation (EC) No 767/2009 (‘the Feed Marketing Regulation’) prohibits the use of the following substances for use as animal feed:
- Faeces and separated digestive tract content;
- hide treated with tanning substances;
- seeds and other plant-propagating materials (treated with plant protection products);
- wood and their derived products;
- waste derived from urban, domestic and industrial waste treatment;
- packaging from agri-food products and parts thereof;
- protein products obtained from yeasts of the Candida variety cultivated on n-alkanes.

The EU ABP legislation prohibits the use of certain materials of animal origin, including notably:
- manure (being classified as ‘category 2’ material under article 9 (a) of Regulation (EC) No 1069/2009, manure is therefore not eligible for use as feed material – see article 13 of the above-mentioned Regulation);
- catering waste (article 11 1. (b) of Regulation (EC) No 1069/2009 prohibits its use as feed for food and feed producing animals).

Restrictions stemming from the EU ‘TSE’ Regulation

According to the ABP legislation, processed animal proteins (PAPs) (i.e. protein entirely derived from ‘category 3’ materials, as listed in article 10 of Regulation (EC) No 1069/2009 – see annex I 5. of Regulation (EU) No 142/2011) are authorised for use in animal feed, including for food and feed producing animals, if complying with the requirements (e.g. processing methods) provided in section 1 of Chapter II of Annex X to Regulation (EU) No 142/2011.

Nevertheless, the possibilities for using such PAPs as feed materials for farmed animals have been reduced to large extent by the EU legislator at the beginning of the year 2000. Indeed, the ‘TSE’ Regulation (i.e. Regulation (EC) No 999/2001) prohibits their use as feed for ruminants and non-ruminant farmed animals (excluding fur animals but including insects), except in the case of fishmeal (and compound feed containing fish meal)16.

Furthermore, the TSE Regulation prohibits to feed insects (and other non-ruminant farmed animals) with blood products, collagen and gelatine as well as with hydrolysed proteins of animal origin and derived from ruminants (annex IV, chapter I to Regulation (EC) No 999/2001).

N.B: A contrario, the use of hydrolysed proteins, collagen and gelatine or blood products derived from non-ruminants (or parts of non-ruminants)17 is allowed. The same possibilities apply for hydrolysed proteins from ruminant hide and skins as well as for di and tricalcium phosphate (including compound feed containing such products)18, pursuant to annex IV, chapter II b. of Regulation (EC) No 999/2001.

16 Provided that it has been produced and placed on the market in accordance with the specific conditions laid down in section A of Chapter IV to annex IV of Regulation (EC) No 999/2001.
17 Provided that it has been produced and placed on the market in accordance with the specific conditions laid down in section C of Chapter IV to annex IV of Regulation (EC) No 999/2001.
18 Provided that it has been produced and placed on the market in accordance with the general conditions laid down in Chapter III and the specific conditions laid down in section B of Chapter IV to annex IV of Regulation (EC) No 999/2001.
Furthermore, the TSE legislation does not prevent to feed farmed animals (therefore including farmed insects) with rendered fat (including from ruminant) as well as with milk, eggs and their derived products.

**Former foodstuffs of animal origin**

Article 10(f) of Regulation (EC) No 1069/2009 refers to ‘products of animal origin, or foodstuffs containing products of animal origin, which are no longer intended for human consumption for commercial reasons or due to problems of manufacturing or packaging defects or other defects from which no risk to public or animal health arise’. Being more often associated with the more commonly known category of ‘former foodstuffs’ the concept of ‘former foodstuffs’ encompasses both products of animal and vegetal origin as defined in Regulation (EU) No 68/2013 (recital 3), these notably comprise unsold products from supermarkets or discarded products from agri-food industries.

Most importantly, the latter Regulation distinguishes these products from catering reflux/ catering waste, which covers both post-consumer and pre-consumer waste, according to EU legislation.

Annex X, chapter II, section 10 of Regulation (EU) No 142/2011 (Regulation implementing Regulation (EC) No 1069/2009) restricts the possibilities for using these materials in feed for food producing animals to ‘non-containing meat or fish’ former foodstuffs products. ‘Only’ the products containing the following ingredients (of animal origin) are authorised as feed for insects.

- eggs and egg products;
- milk, milk based-products and milk-derived products;
- honey;
- rendered fat;
- collagen;
- gelatine.

Moreover, these products must have been previously processed (either prior their intended use as food product or after being requalified as animal by product) and comply with microbiological criteria as defined in annex X (chapter 1) of Regulation (EU) No 142/2011 (e.g. tresholds are set for enterobacteria, salmonella). Moreover, the latter annex (section 10) provides that ‘all precautions must have been taken to prevent the contamination of the material’.

Finally, these products must be free from packaging residues, in accordance with Regulation (EC) No 767/2009 (annex III, chapter 1).

Consequences:

- Only products which have been previously pasteurized (e.g. milk) or cooked (e.g. eggs) are today eligible as feed for food producing animals (including farmed insects);
- unwrapped products or products with ‘apparent’ moulds (or any ‘similar’ defects) would most probably not be ‘accepted’ as feed for food producing materials.

**EU residue limits for contaminants and requirements applying to feed additives**

The ‘Feed Marketing Regulation’ (i.e. Regulation (EC) No 767/2009) provides that animals (including therefore insects) bred in the EU may be only be fed with safe feed.

The Undesirable Substances Directive (i.e. Directive 2002/32/EC) establishes maximum levels of undesirable substances in feed materials and compound feed, while Regulation (EC) No 396/2005 sets out maximum residue levels of pesticides in feed.

Feed materials and compound feed for insects therefore have to comply with the limits established in the above pieces of legislation.

Only feed additives approved in the EU (in accordance with Regulation (EC) No 1831/2003) can be used in feed for insects: the list of authorised additives is provided within the EU Register of Feed Additives. Since (at the time of drafting this Guide) no feed additive has been specifically approved for used as feed.

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19 Annex I 22. to Regulation (EU) No 142/2011 defines catering waste as ‘all waste food, including used cooking oil originating in restaurants, catering facilities and kitchens, including central kitchens and household kitchens’.
for insects yet, only the feed additives which are authorised for all animal species may be used as feed ingredient for farmed insects.

Authorised and non-authorised substrates as feed for insects: a few examples

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**Non-exhaustive list of substrates /substrates categories commonly used by EU insect producers**

1. Cereal-based materials (e.g. wheat bran, chaff bran, bruised rye, oatmeal, grass, brewery/distillery grains);

2. Fruits and vegetables and their derived products;

3. Commercial feed authorised for all animal species\(^2\);\(^2\)

4. Unsold products from supermarkets, food industry or bakery establishments\(^2\) if composed of ingredients vegetal origin, (cooked) eggs and/or pasteurised milk and provided that the product has been previously unpacked;

5. Fat derived from the processing/rendering of parts of slaughtered animals.

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**Non-authorised substrates**

1. Livestock manure and/or slurry or other products derived from animal digestive tract content;

2. Human excrements;

3. Water treatment (e.g. industrial sludges) or solid waste (urban industrial or domestic) streams;

4. Aquaculture sludges;

5. Products containing packaging residues (plastic, PET, paper);

6. Animal by-products originating from slaughterhouses or rendering establishments, excepted those that are expressly authorised, (see above);

7. Food waste originating from restaurants, catering establishments, household and international transport;

8. Unsold products from supermarkets or food producing establishment containing meat or fish products and/or residues of packaging materials.

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\(^2\) When using commercial compound feed, insect producers must comply with applicable restrictions and/or prohibitions – e.g. insect producers must ask guarantees to their suppliers as to the absence of feed additives whose use for insect feed is prohibited – e.g. coccidiostat.

\(^2\) Products defined as ‘former foodstuffs’ under EU legislation (see above section ‘where to find the applicable requirements’) for insects yet, only the feed additives which are authorised for all animal species may be used as feed ingredient for farmed insects.
1.2.3. Overview of the EU regulatory possibilities for using insect products as food and feed

**General remarks**

As general recommendation, EU insect producers should be well aware of the applicable EU requirements since the possibilities for commercialising insects and insect products for food or feed purposes vary largely, depending on the type of product (e.g. whole insects, processed animal proteins) and the market segment considered (e.g. food vs. feed). Notably, these operators should be aware about the currently applicable EU restrictions (e.g. restrictions applying to processed animal proteins or whole insects as feed) and/or of the position of their belonging EU country, whenever the subject falls under EU Member States’ competence (e.g. use of live insects as animal feed, production of whole insects as food).

N.B: This chapter does not address the subject of producing insects for technical uses (e.g. biofuel production, cosmetic, biochemistry) since these activities do not fall within the scope of the present Guide (see introduction). As general rule, whenever authorised for animal feed in accordance with the EU ABP legislation, animal by-products derived from insects (e.g. insect PAPs, hydrolysed proteins, rendered fat), may be commercialised for those uses provided that applicable requirements of the ABP legislation (i.e. Regulation (EC) No 1069/2009 and Regulation (EU) No 142/2011) or specific legislations concerning these uses (when they exist) are being complied with by insect producers.

**Use of insects for human consumption**

Producers of insects and products thereof that are intended for human consumption must comply with the ‘general’ requirements contained in Regulation (EC) No 178/2002 which lays down the general principles and requirements of ‘Food Law’ and of Regulation (EC) No 852/2004 on the hygiene of foodstuffs.

However, the commercialisation of insects and their derived products on the EU market remains today prohibited, pending the novel food authorisations to be granted pursuant to Regulation (EU) 2015/2283. Commission Implementing Regulation (EU) 2017/2470 establishing the Union list of novel foods will further define the conditions under which these products may be commercialised on the EU market22.

Meanwhile, these products are being legally authorised in several EU Member States national level in accordance with EU Law. This possibility indeed results from the implementation of the transitional measure foreseen in article 35.2 of Regulation (EU) No 2283/201523.

**Use of insects as animal feed**

**Where to find the applicable EU requirements?**

Several pieces of EU legislation regulate the conditions for producing and placing insects and derived feed products on the EU market. These include notably:

- The EU Catalogue of feed materials enumerates insects in their various forms, which may be used as animal feed;
- the TSE Regulation (or ‘feed ban’ rules) sets out several restrictions for using processed animal proteins derived from insects in animal feed;

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22 See IPIFF briefing paper (pg 18) on novel food for more details
23 See IPIFF briefing paper (pg 31) on novel food for more details
The ABP legislation elaborates on the contours for live and whole (dead, ‘untreated’ and ‘treated’) insects be used in animal feed;

Finally, specific methods for the processing of animal by products derived from insects are included in Regulation (EU) No 142/2011 (these provisions are further described in chapter 1.4.1).

Provisions of the EU Catalogue of feed materials

Terrestrial invertebrates are listed in the EU Catalogue of feed materials (i.e. Regulation (EU) No 68/2013) under entry 9.16.1. (i.e. ‘terrestrial invertebrates live’) and 9.16.2 (‘terrestrial invertebrates, dead’), thereby encompassing live insects and whole insects (untreated or treated but not processed/ground-into insect meal). Entries 9.4.1 titled ‘Processed animal proteins’ and 9.2.1 ‘animal fat’ also include invertebrates (‘other than species pathogenic to humans and animals’) in their description. So, insect processed animal proteins (insect PAPs) and fat or oil derived from insects may also possibly be used in animal feed.

The fact that such feed materials are listed in the EU Catalogue or in the accompanying Register of feed materials does not mean that the product is authorised for all animal species (see chapter 2.1.1 for more details). Notably a distinction must be drawn between insect products intended for food producing animals, other farmed animals (i.e. fur animals) pet food and other feeding purposes (e.g. feed for birds of prey, reptiles or zoo animals).

Indeed, the EU ABP and TSE legislations further define those ‘targeted species’ to which feed materials derived from farmed animals (including therefore farmed insects) may be intended. The ‘TSE’ legislation also defines the list of authorised insect species when used as processed animal product for aquaculture animals (see sub sections below for more details).

Limitations imposed under the EU TSE Regulation

A clear distinction must be made between insects PAPs which are prohibited for use in feed for farmed animals from other ingredients derived from insects (e.g. fat) and whole insects (either live, dead, with or without treatment). The latter products (with the exception of hydrolysed proteins, collagen or gelatine) do not indeed fall within the scope of the TSE legislation (see below for further details).

Restrictions are imposed to insect PAPs when used as feed for food producing animals:

Processed animal proteins are defined in Annex I of Regulation (EU) No 142/2011 as ‘animal protein derived entirely from Category 3 material, which have been treated in accordance with Section 1 of Chapter II of Annex X of the present Regulation (including blood meal and fishmeal) so as to render them suitable for direct use as feed material or for any other use in feeding stuffs, including pet food, or for use in organic fertilisers or soil improvers’. These therefore include meal/proteins derived from insects.

However, as general rule (as laid in Article 7 and Annex IV of Regulation (EC) No 999/2001), the TSE legislation prohibits the use of any PAP when intended as feed for non-ruminant farmed animals (excluding fur animals). This ban also applies to insect PAPs. However, this ban was lifted on 1st July 2017 in the case of insects PAPs intended for aquaculture animals (see below for more details).

Today insect PAP are ‘only’ allowed for use as aqua feed, pet food, fur animals and other non-food producing animals (e.g. reptiles, birds of prey, zoo and circus animals) as defined in article 18 of Regulation (EC) No 1069/2009.

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24 For more details about the objectives and content of the Catalogue of feed materials, see previous section.
The authorisation of insect PAPs in aqua feed materialised through the adoption of Regulation (EU) 2017/893. This text introduced a specific section for insects and insect products in the EU - Annex IV section F of Regulation (EC) No 999/2001. This revision allowed insect-producers ‘to make use of the same authorisation’ as the one benefiting to those producing and processing proteins derived from other non-ruminant animals (i.e. pigs and poultry) for feeding aquaculture animals (back in 2013)25.

In order to benefit from the above authorisation, killed insect (insect by-products) must be processed in establishments that are specifically approved and dedicated for the production of insect PAPs (e.g. these establishments may not be dedicated to the production of other animals species) in accordance with article 24 1 a. of Regulation (EC) No 1069/2009 (thereby complying with annex X, chap II, section 1 to Regulation (EU) No 142/2011)26. Regulation (EU) No 142/2011 (AnnexX, chapter II, section 1 b. 2.) requires operators to follow one of the processing methods (1 to 5 or 7) as described in Chapter III of Annex IV of that Regulation. The accompanying commercial document and the label shall clearly bear the following indication “processed insect protein - shall not be used in feed for farmed animals except aquaculture and fur animals”.

The authorisation for using insect PAPs in aqua feed is limited to seven insect species (see Chapter II of Annex X to Regulation (EU) No 142/2011), namely to the followings: black soldier fly (Hermetia illucens), house fly (Musca domestica), yellow mealworm (Tenebrio molitor), lesser mealworm (Alphitobius diaperinus), house cricket (Acheta domesticus), banded cricket (Gryllodes sigillatus) and field cricket (Gryllus Assimilis).

Such restrictions do not however apply to insect PAPs intended for pet food animals, fur animals or other non-food producing animals, which means that any species that is not pathogenic to humans or animals may be used as feed for such animals, provided that the requirements of Regulation (EC) No 1069/2009 (e.g. approval required under article 24 1 b., compliance with processing methods laid down in article 14 d (iii) and adherence to an HACCP plan as provided under article 29) and hygiene and processing requirements foreseen in Regulation (EU) No 142/2011 (i.e. annexes X and annex XIII for pet food) are being respected. See chapter 4.14 for more details.

- Yet, fat /oil and other products derived from insects fall outside the scope of the TSE legislation, a specific regime is applicable in the case of hydrolysed proteins

Defined in Annex I (definition 14) to Regulation (EU) No 142/2011 as ‘polypeptides, peptides and amino acids, and mixtures thereof, obtained by the hydrolysis of animal by-products’, hydrolysed proteins are specifically authorised (under annex IV to Reg. 999/2001) for use as feed for non-ruminant and ruminant animals.

On the other hand, the TSE rules (i.e. Regulation (EC) No 999/2001) do not apply to fats and oil derived from insects, nor to gelatine and collagen: listed respectively in section 3, section 5 and section 8 of chapter II to annex X of Regulation (EU) No 142/2011, these products may therefore be fed to non-ruminant farmed species (e.g. poultry, pig animals)27 as well as to pet food and other non-food producing animals (incl. fur animals and other animals listed in article 18 of Reg. 1069/2009 – see above for further details).

Furthermore, there is no ‘positive list’ of ‘authorised insects’ species’ (see sub section above) in the case of whole, live insects, fat, hydrolysed proteins and other derived ingredients derived from insects (as listed in the sub section above).

25 With this revision, the EU legislator also created, for the first time, ‘EU dedicated standards’ for insect production intended as animal feed. These standards complement the other pieces of legislation whose ‘general’ provisions are also applicable to insects as food and/or feed (e.g. Reg. 178/2002, Reg. 852/2004, Reg. 183/2005, Reg. 1069/2009 and Reg. 999/2001 etc listed in the previous section).

26 The same obligation applies for compound feed producers using these products, which implies that their premises should exclusively dedicated to aqua feed production (unless derogation applies).

27 Article 7 of Reg. 999/2001 prohibits to use ruminant animals with any product of animal origin.
Specific hygiene requirements and processing standards applying to the above-mentioned feed materials derived from insects are provided in Regulation (EU) No 142/2011 (i.e. in annex X, chapter II of Reg. 142/2011). These are described in chapter 4.1.4 regarding hygiene and processing methods required.

- **The TSE rules do not apply to whole (e.g. dried) and live insects**

  As Regulation (EU) No 999/2001 only covers derived products from animals, the feed ban rules do **not apply to whole insects** nor to live insects (except in case those products are intended for ruminants\(^\text{28}\)).

- **Regulatory status of whole and live insects under the EU ABP legislation**

  Nevertheless, the above-mentioned products are being regulated under the EU ABP legislation (in the case of whole insects) or at Member State level (which is the case for both whole insects and live insects).

- **Killed and ‘untreated’ or ‘treated’ (but ‘unprocessed’ insects) insects must be looked at under the ABP legislation**

  Referred to in entry 9.16.2 (i.e. 'Terrestrial invertebrates, dead') of the EU Catalogue of feed materials (Regulation (EU) 68/2013) ‘whole insects’ used as feeding ingredient must undergo ‘light’ treatment (e.g. freeze-drying), but are not being processed to the extent of altering the physical characteristics of the product (e.g. not ground into meal or oil)\(^\text{29}\).

With respect to the ABP rules, both killed whole insects (without any further treatment) and killed whole ‘treated’ (e.g. dry frozen insects’ insects) but not ‘processed’ according to Regulation (EC) No 1069/2009 **may not be used as feed for food producing animals**. Indeed, article 14 of Regulation 1069/2011 requires operators to ‘process dead insects (i.e. processing methods defined in Regulation (EU) No 142/2011) in that particular case.

Yet, whole ‘treated’ insects may be used as feed for **pet food** (under the condition that the company is approved in accordance with article 24 1 e and article 35 of Regulation (EC) 1069/2009\(^\text{30}\)) or for **technical uses**.

The above products are also allowed for other feeding purposes as provided in Article 18 of Regulation (EC) 1069/2009 (including zoo and circus animals, reptile, birds of prey, wild animals and fur animals, as well as for fishing bait) if **approved by the national competent authority** of the country where the product is being commercialised\(^\text{31}\).

- **Live insects are excluded from the scope of Reg. 1069/2009**

  As live insects are not considered as animal-by products, they fall outside the scope of Regulation (EC) No 1069/2009 and thus no conditions for their use as animal feed are laid down at EU level.

Consequently, their **possible use in animal feed remains at the discretion of EU Member States**. These EU countries may therefore allow their use as feed for farmed non-ruminant animals (see sub section above ‘limits imposed under the TSE legislation’), pet food as well as other feeding purposes (as listed in article 18 of Reg. 1069/2009 – see above).

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\(^{28}\) Article 7(1) of Regulation (EC) No 999/2001 prohibits the use of any animal proteins in feed for ruminants.

\(^{29}\) These products are commonly used for specialised pet shops, notably to feed ‘exotic’ animals (e.g. reptiles) or domestic birds. Yet, these also present numerous advantages when used as feed for livestock (e.g. used as environmental enrichment in poultry husbandry, feed complement, beneficial effects for farmed animals’ health or welfare) or aquaculture animals.

\(^{30}\) Point 3(v) of Chapter II of Annex XIII to Regulation (EU) 142/2011 provides that the national competent authority may authorise a treatment such as drying or fermentation for the manufacturing of processed pet food provided that that the treatment ‘ensures no unacceptable risks to public or animal health’.

\(^{31}\) In accordance with the provisions of article 18 of Reg. 1069/2009, EU member States authorities may indeed authorise the use for such specific feeding purposes (i.e. feed for non-food animals) provided that the absence of health risks is guaranteed.
Even though these products fall outside the scope of the ABP legislation, these remains governed by feed safety legislation (incl. feed marketing or labelling and contaminants).

- Processing methods for insect products used in animal feed

*See Chapter 4.1.2 for more details*

### 1.2.4. Imports of insects and their derived ingredients

Different sets of Regulation are applicable in the case of insects intended as food and feed, this section is divided in two parts respectively:

#### Imports of insects as food

**General remarks**

The EU Official Controls Regulation (OCR) - Regulation (EU) 2017/625 provides the framework for the EU Member States (MS) to verify that Agri-food businesses comply with European food and feed safety standards. European food and feed safety standards also cover import conditions on animals and goods entering the EU from 'third countries' (countries outside the EU). As general rule, article 11 of Regulation (EC) No 178/2002 (‘General Food Law’) provides that ‘food and feed imported into the EU shall comply with the relevant requirements of food law or conditions recognised by the Community to be at least equivalent thereto’. Imports of insects intended for human consumption may only be of those products authorised under the Novel Food regulation (Regulation (EU) 2015/2283) and listed in the Union list of novel foods (Implementing Regulation (EU) 2017/2470). Furthermore the imported products must comply with conditions of use, additional specific labelling requirements, other requirements and specifications (e.g. Definition, Physical-chemical properties, heavy metal and microbiological criteria, etc.) as established in the Union list of novel foods (Annex, Table 1)

**Rules Applicable for insects and their derived products intended for human consumption.**

- Regulation (EU) 2019/625 ( Article 3, a) foresees that imported insects as food must comply with EU requirements for food and food safety.
- Regulation (EU) 2019/628 (Article 25) establishes a model official certificate (Annex III, Part XIII) for insects as food imported into the EU.
- Regulation (EU) 2019/626 (Article 20) draws a list of third countries (ANNEX III a) authorised to export insects into the EU. EU Member States benefiting from the so-called ‘novel food transitional measure and allowing imports of insects (as food) from EU third countries, will only permit authorised and listed countries to do so. Currently (December 2020) imports of insects as food are only authorised from Canada, South Korea, Switzerland and Thailand.

#### Imports of insects as feed

**General remarks**

As general rule, article 11 of Regulation (EC) No 178/2002 (‘General Food Law’) provides that ‘food and feed imported into the EU shall comply with the relevant requirements of food law or conditions recognised by the Community to be at least equivalent thereto’.

Most requirements applicable to animals and animal by products (therefore including insects) can be found in annex XIV and annex XV of Regulation (EU) No 142/2011

**Rules applicable to Processed insect proteins (insect PAP)**

*Where to find the applicable EU requirements?*

- Annex XIV, chapter I section 1 and section 2 to Regulation (EU) No 142/2011
• Annex XIV, chapter I, section 1, table 1 entry 1 which concerns processed animal proteins for farmed animals (see p 138)
• Annex XIV, chapter II, section 1, table 2 entry 14 which concerns animal by-products intended for processed pet food (see p 155)

Applicable health certificate models can be found in Annex XV to Regulation (EU) No 142/2011:
• Annex, XV chapter 1a for insect PAPs as feed for farmed animals (e.g. ‘only’ authorised for farmed fish today) - page 187 of Regulation (EU) No 142/2011
• Annex XV, Chapter 3(F) insect PAPs intended for processed pet food (e.g. dog, cat) – page 233 of Regulation (EU) No 142/2011
• Annex XV, Chapter 3(D) for insect PAPs intended for fur animals - page 222 of Regulation (EU) No 142/2011

Overview of main requirements
• The insect PAP must originate from a species authorised for use as insect PAP for aquafeed in the EU, namely back soldier fly, common house fly, yellow mealworm, lesser mealworm, house cricket, banded cricket and field cricket (annex XIV, Chapter I section 2 5. (a) of Regulation (EU) No 142/2011). N.B. this restriction only applies in the case the imported PAP is intended for use as feed for farmed animals (not applicable for pet food and fur animals) Regulation (EU) No 142/2011 requires that the insect PAP does not come from insects fed with feed materials which are not eligible as feed for farmed animals (e.g. manure, treated wood, catering waste, former containing meat and fish, etc) (annex XIV section 2 5. (b) of Regulation (EU) No 142/2011).
• The insect PAP must be produced in line with the requirements laid down in Regulation (EC) No 1069/2009 for category 3 materials (i.e. article 13 of Regulation (EC) No 1069/2009 requires that category 3 materials intended as feed for farmed animals or for the manufacturing of pet food are being processed) and notably of article 31 in case of PAPs to be placed on the EU market as feed for farmed animals (e.g. these must be processed according to method 1 to 7) and article 35 in the case of pet food.

• Only imports originating from the countries listed in Part I of Annex II to Regulation (EU) No 206/2010 are allowed.

• The processing plant in the third country must be approved in accordance with the requirements included in the ABP Regulation (see Traces system). The procedure to request such authorisation can be found through the following link (e.g. once the country is approved for export in the EU, following controls performed by the EU competent authorities, third country authorities are responsible for selecting the authorised establishments after ensuring these comply with EU requirements) whereas the list of non-EU countries authorised establishments may be accessed via the following link. See annex XIV section 1 (d) of Regulation (EU) No 142/2011 for more details

• The insect PAP consignment must undergo veterinary checks at a EU Border Inspection Post. To this end, the consignment must be accompanied by a health certificate delivered by the exporting country and in line with the model health certificate laid down in Chapter I of Annex XV to Regulation (EU) No 142/2011: N.B. in case of insect PAPs intended for farmed animal feed, third country authorities should use the model certificate provided in annex, XV chapter 1a whereas insect PAPs intended for processed pet food are covered through the model in Annex XV, Chapter 3(F) (and the one in Annex XV, Chapter 3(D) in the case of fur animals)

• Before free circulation into the EU market, the importer must ensure that each consignment is tested by light microscopy and/or PCR test, in line with the Standard Operating Procedure of the EURL for Animal Protein, to verify the absence of constituents of animal origin prohibited by EU feed ban rules (for more details see Section C of Chapter III of Annex IV to Regulation (EC) No 999/2001.

32 i.e. Argentina, Albania, Australia, Bosnia Herzegovina, Bahrain, Brazil, Botswana, Belarus, Belize, Canada, Switzerland, Chile, China, Colombia, Costa Rica, Cuba, Algeria, Ethiopia, Falkland Islands, Greenland, Guatemala, Hong Kong, Honduras, Iran, India, Iceland, Japan, Kenya, Morocco, Montenegro, Madagascar, The Republic of North Macedonia, Mauritius, Mexico, Namibia, New Caledonia, Nicaragua, New Zealand, Panama, Paraguay, Serbia, Russia, Singapore, Swaziland, Thailand, Tunisia, Turkey, Ukraine, United States, Uruguay, South Africa, Zimbabwe.
Import of whole (frozen or dried) insects

- Where to find the applicable requirements?

See Annex XIV, chapter II to Regulation (EU) No 142/2011

see annex XIV, chapter II, section 1, table 2 entry 14 which concerns animal by-products intended for processed pet food (see p 155)

The Model certificate is provided in Annex XV, Chapter 3(D in the case of processed pet food (page 222 of) Regulation (EU) No 142/2011

- Overview of main requirements

The import into the EU of treated (e.g. dried or frozen insects) but not ‘processed’ insects according to Regulation (EC) No 1069/2009 (meaning non PAPs) is currently allowed, but only for pet food (including for reptiles, birds of prey, circus or zoo animals) and if approved by the national competent authority in accordance with article 18 of Regulation (EC) No 1069/2009

The same general requirements apply as in the case of insect PAPs (e.g. come form the same list of authorised countries, come from an establishment which is approved by competent authority of the third country, consignment must be accompanied with a health certificate). Yet, no light microscopy and/or PCR test is required.

As producers of products intended as processed pet food, insect producers from third countries must use the model provided in Annex XV, Chapter 3(F) (and the model certificate provided in annex, XV chapter 3 (D) if intended as feed for fur animals.

If intended for pet food, the subsequent pet food manufacturer must be approved in accordance with article 24 e.1 of Regulation (EC) No 1069/2009.

Imports of non-treated (dead) insects (for pet food, reptiles, birds of prey, circus or zoo animals, etc) should also theoretically be possible - in accordance with article 18 of Regulation (EC) No 1069/2009 – if authorised at Member State level.

Import of insect fat as feed

Insect fats are not specifically regulated but should theoretically be allowed under the same conditions that for rendered fat intended as feed for farmed animals (see Annex XIV, chapter I section 1, table 1 entry 3 of Regulation (EU) No 142/2011) The same list of authorised countries as for PAPs and whole insects should therefore apply, while the model of health certificate provided in Annex XV, Chapter 10 (A) should be used.

1.2.5. Animal health and environmental requirements

The general requirements relating to animal health, apply to farmed insects since these are considered as ‘farmed animals’ (see section 1.1.2 for more details). Insect producers shall therefore, consider the following: they must comply with animal health and biosecurity measures on transmissible animal diseases, as foreseen in the Animal Health Law - i.e. Article 10 of Regulation (EU) 2016/429.

Insects and their derived products intended for food and feed purposes shall not:

1. be pathogenic or have other adverse effects on plant, animal or human health (requirements applicable to category 3 materials in accordance with the ABP legislation or for ‘terrestrial invertebrates’ in the EU Catalogue of feed materials - Regulation (EC) No 68/2013

2. be protected or defined as an invasive alien species in accordance with Regulation (EU) 1143/2014.

Insects are, however, exempted from the application of the EU animal welfare legislation, which only concerns vertebrate animals (see article 1 d. of Directive 98/58 concerning the protection of animals kept for farming purposes).
1.3. Management of responsibilities, organisational structure and employees

1.3.1. Food and feed safety management system responsibility

The Management of an insect producing undertaking shall set the objectives related to GHP and HACCP principles where applicable, for the operating staff, rearing, killing, processing, storage and transport operations as well as visitors and subcontractors.

The respective safety management system states the expectations management has on hygiene practices to ensure the safe production (primary production and processed products), storage and delivery of insects and related products.

The Management shall inform the operating staff about the hygiene practices and protocols practices being followed in the company and is committed to ensuring their implementation within the company.

The safety management system in place should be reviewed and updated, when necessary, based on the outcomes of the internal and external audits. Employees are kept informed accordingly.

1.3.2. Employees’ appointment and structure

Annex II of Regulation (EC) No 183/2005 on feed hygiene states that:
‘Where appropriate a qualified person responsible for quality control must be designated’.

Annex II, chapter XII of Regulation (EC) No 852/2004 on food hygiene provides:
‘Those responsible for the development and maintenance of (...) (HACCP based procedures) or for the operation of relevant guides have received adequate training in the application of the HACCP principles’.

The Management could appoint a qualified person responsible for supervising the quality control of the production and/or process lines, and ensuring product safety parameters. The responsible person could organise the work of the team and has the authority/responsibility to:

1. Develop and maintain GHP within the company;
2. Report to the Management about issues and to suggest appropriate measures to remediate or control problems when they occur;
3. Prepare for and train the Health, Safety, Environment and Quality (HSEQ) team, should it exist, in developing and maintaining the HACCP system and implementing GHP, and;
4. Train company employees in GHP.

The Management shall ensure that adequate communication channels are in place to inform the responsible person of significant changes in products or processes.
1.3.3. Employees’ skills

The operating staff is required to have the skills and the qualifications necessary for the manufacture of the products concerned.

Annex II of the Regulation (EC) No 183/2005 on feed hygiene states:

1. ‘Feed businesses must have sufficient staff possessing the skills and qualifications necessary for the manufacture of the products concerned. An organisation chart setting out the qualifications (e.g. diplomas, professional experience) and responsibilities of the supervisory staff must be drawn up and made available to the competent authorities responsible for inspection (…)’.

Annex II, Chapter XII of Regulation (EC) No 852/2004 states:

1. ‘Food business operators are to ensure (…) that food handlers are supervised and instructed and/or trained in food hygiene matters commensurate with their work activity’.

Among the minimal employees’ skills required for insect production activities are the following:

1. The behaviour of insects;
2. Ability to identify species of insects;
3. Farmed insect species life cycle;

1.4. Traceability and record keeping

1.4.1. General requirements

Traceability is a risk management instrument to be used to identify and contain a possible food and feed safety problem more easily and efficiently. Relying on the ‘one step back – one step forward’ approach as well as on record keeping measures, insect producers must have systems and procedures in place that enable them to send traceability information to the relevant authorities upon request. This ensures that product withdrawals and recalls are precise and targeted.

Such system should enable, at all times, to trace any raw materials, ingredients, additives and primary packaging materials backward (one step upstream in the food chain) and to trace any finished products that have left the manufacturer forwards (one step downstream in the food chain).

Article 18 of Regulation (EC) No 178/2002 specifies the main principles and obligations implied by traceability:
Furthermore, Regulation (EC) No 852/2004 as well as Regulation (EC) No 183/2005 recommend Guides on good hygiene practices to contain recommendations to ensure the traceability of food and feed products or of hazardous inputs such as plant protection, biocides, veterinary products or feed additives (e.g. Regulation (EC) No 852/2004 annex I, part B c., d. and e.).

Traceability is also ensured through the recording of all measures aimed at controlling hazards (e.g. Regulation 852/2004 annex I part A chapter III on ‘record keeping’).

1.4.2. Product traceability records

In accordance with EU legislation and/or national provisions, insect producers must record and keep the following information in order to ensure product traceability:

1. The name and address of the substrate (e.g. feed materials, compound feed products, suppliers, the batch number, the quantity and delivery date of the products, etc);

2. The name and address of the insect breeding flock providers, the main characteristics of the flock and its delivery date;

3. The nature, formulation and quantity of the products manufactured, along with their manufacturing date and batch number. Samples and records of each batch must be retained in accordance with EU food and feed hygiene Regulations;

4. Food allergens (e.g. gluten) which the substrate given to the insects may contain when the latter are intended for human consumption (and those made into semi-finished and finished products, including non-conforming products reprocessed to match treatment requirements or microbiologic criteria);

5. The name and address of the buyer(s) and of the site where the batch of semi-finished or finished products are delivered to.

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34 Regulation (EC) No 183/2005 Annex II, Quality Control.4. Documentation relating to the raw materials used in final products must be kept by the manufacturer in order to ensure traceability.
35 Regulation (EU) No 931/2011, Article 3, Traceability requirements
In addition, insect producers could keep records of the following information:

1. The point of loading and unloading of the products;

2. The transport company and the means of transport used, such as boats (in hold or tank), vehicles (with reference to the trailer), etc;

3. If relevant, the storage company and the means of storage used, such as warehouses, silos or tanks and the number or distinguishing mark of the store or silo;

4. Temperature levels, information on processing control points, origin, processing equipment used, heat and freezing treatment, the substrates used, sample results and staff involved in regard to each product batch;

5. All finished products should be labelled to ensure traceability of the batch (‘first in first out strategy’).

6. A system shall also be in place to deal with products that are rejected by customers for food safety reasons.

EU Regulations and/or national legislations state that documents should be retained to ensure traceability at least until it can be reasonably assumed that the food has been consumed. By default, a two-year period is recommended. Operators must have systems and procedures in place that allow the sharing of information with national food and feed safety authorities whenever deemed necessary.

1.5. External communication

External communication among the different parties of the value chain (the food or feed chain) and control authorities is key to ensure the safety of the food and feed products. To this end, 32 communication channels and efficient processes are established to ensure a smooth exchange of information.

1. All operators along the value chain should provide all relevant contact points/d details to their direct suppliers and customers (e.g. email address and phone number in order to ensure rapid and efficient communication during recall activities).

2. A procedure for notifying control authorities and operators both upstream and downstream, of any non-conformity with food and feed safety requirements and other specifications should be established. This procedure shall include provisions for the management of recalls when needed.

1.6. Emergency and product recall strategy

1.6.1. Background information

Crises are emergency situations and potential accidents which can be of very different natures (e.g. presence of unacceptable levels of contaminants, a break in the supply of raw materials, breakdowns or accidents, strikes by personnel, natural disasters, etc.). The aforementioned situations can affect the production process itself (such as delay in raw materials can halt the production line, delay in feeding .

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substrates for insects, perishable raw material could degrade over time on delayed delivery or use) or cause contamination in the product (contaminated raw materials, human or equipment error). Potentially, such crises could impact the product, compromising its safety and quality.

1.6.2. Recall obligations under EU legislation

**Article 19 of Regulation (EC) No 178/2002 on ‘General Food Law’ states**

**Responsibilities for food: food business operators**

‘1. If a food business operator considers or has reason to believe that a food which it has imported, produced, processed, manufactured or distributed is not in compliance with the food safety requirements, it shall immediately initiate procedures to withdraw the food in question from the market where the food has left the immediate control of that initial food business operator and inform the competent authorities thereof. Where the product may have reached the consumer, the operator shall effectively and accurately inform the consumers of the reason for its withdrawal, and if necessary, recall from consumers products already supplied to them when other measures are not sufficient to achieve a high level of health protection.’

**Regulation (EC) No 178/2002, Article 20 indicates:**

**Responsibilities for feed: feed business operators**

‘1. If a feed business operator considers or has reason to believe that a feed which it has imported, produced, processed, manufactured or distributed does not satisfy the feed safety requirements, it shall immediately initiate procedures to withdraw the feed in question from the market and inform the competent authorities thereof. In these circumstances or, in the case of Article 15(3), where the batch, lot or consignment does not satisfy the feed safety requirement, that feed shall be destroyed, unless the competent authority is satisfied otherwise. The operator shall effectively and accurately inform users of the feed of the reason for its withdrawal, and if necessary, recall from them products already supplied when other measures are not sufficient to achieve a high level of health protection.’

1.6.3. Recommended practices

Insect producers should formulate a definition of an ‘emergency’ situation. A clear strategy linked to the emergency should be defined by the operator, who should follow the proposed mentioned scheme in case of such situations.

A written crisis management procedure available in line with regulation EU 178/2002 should be established to assist the personnel confronted with emergency situations and potential accidents to act effectively and consistently, thereby avoiding improvisation.
Annex II of Regulation (EC) No 183/2005 on feed hygiene indicates:

Complaints and products recall

‘1. Feed business operators shall implement a system for registering and processing complaints.

2. They shall put in place, where this proves necessary, a system for the prompt recall of products in the distribution network. They shall define by means of written procedures the destination of any recalled products, and before such products are put back into circulation, they must undergo a quality-control reassessment.’

The procedure should include the following information and measures and should be tested beforehand:

- Contact details of relevant staff with allocated responsibilities for decision making;
- Contact details of external organisations (e.g. national competent authorities) as per the emergency plan;
- How to identify the product/area that is affected by the emergency situation such as fires, and potential contamination from the activities of the first responders (e.g. fire-fighter, rescue team);
- Handling procedures for potentially unsafe products (e.g. waste or allergen cross contamination);
- How to evaluate and restore the affected area through correction and corrective action processes. (e.g. allergen cross contamination in insect-based food products production line, evaluation on area of contamination in production line, potential cleaning protocols before restarting the production line).
CHAPTER 2 – PREREQUISITE PROGRAMS: INFRASTRUCTURES AND GENERAL CONDITIONS OF PRODUCTION

2.1. Introduction

This annex provides an overview of the main requirements or recommendations, which may serve as guidance to insect producers, in the designing and/or maintenance of their infrastructures (e.g. the premises, production equipment) and in the general management of their production operations.

2.2. Building and Premises

2.2.1. Building and premises location

Insect producers shall provide and maintain the resources (i.e. buildings, equipment, staff, infrastructure and facilities) that are adequate to the operations involved. When selecting the location for a new production site, at least the following shall be taken into consideration:

1. Availability of services, such as electricity, gas, potable water, drainage and waste collection;
2. The Site should be protected from:
   - neighbouring facilities and activities creating possible contamination sources, e.g. farms, heavy chemical industries, etc;
   - areas where waste cannot be removed effectively;
   - rivers, canals, ponds, marshes and other waterways;
   - areas subject to flooding;
   - areas prone to infestations of pests;
   - areas prone to excessive levels of airborne bacteria, yeasts and molds;
   - loud external noise that could disturb the rearing of specific insect species.

Ideally, the local authorities should be consulted from the planning stage.

2.2.2. Building and premises: design principles

*Annex II and relevant articles of Regulation (EC) No 183/2005 on feed hygiene indicate:*

‘2. The lay-out, design, construction and size of the facilities and equipment shall: (a) permit adequate cleaning and/or disinfection; (b) be such as to minimise the risk of error and to avoid contamination, cross-contamination and any adverse effects generally on the safety and quality of the products. Machinery coming into contact with feed shall be dried following any wet cleaning process.

4. Facilities must have adequate natural and/or artificial lighting.

9. Where necessary, ceilings and overhead fixtures must be designed, constructed and finished to prevent the accumulation of dirt and to reduce condensation, the growth of undesirable moulds and the shedding of particles that can affect the safety and quality of feed.’
The design and construction of the premises and the process flow shall take into account the relevant hygienic and safety standards. The purpose of a hygienic layout is to facilitate good hygienic practices, to avoid contamination and to enable effective cleaning. Zoning is a widely used principle in the hygienic lay-out of food businesses. Zoning of rooms and areas consists of visual and/or physical barriers that control the movement of staff, products, and utensils between the zones.

The layout, design, construction, siting, and size of the premises shall:

1. Permit adequate maintenance, cleaning and/or disinfection, avoid or minimise airborne contamination, and provide adequate working space to allow for the hygienic performance of all operations;
2. Protect goods from damage and contamination. Production units in which insects are reared must stay closed or fitted with nets or grids or any other appropriate means to exclude other pests, or the contamination with other insects, and prevent the presence of rodents. Premises should be built in order to avoid cross-contamination with and from other animal production premises;
3. Have adequate natural and/or artificial light and a controlled environment if necessary;
4. Windows and other openings must, where necessary, be proofed against pests. Doors must be close-fitting and proofed against pests when closed;
5. Sewage and waste shall be disposed of in a responsible manner, ensuring that the equipment as well as the safety and quality of food and feed is not affected;
6. The facility should be closed so that dust, rain water and pest invasion is controlled;
7. The premises are also designed to avoid accidental release of insects from the production facilities (e.g. the premises might be surrounded by a shallow moat);
8. Hazardous substances are kept away from rearing environments and from the storage facilities and only used when appropriate (e.g. cleaning process between two batches). Substances considered dangerous are labelled to prevent confusion and misuse by employees;
9. Access to the storage, breeding and rearing areas is restricted to the authorised staff.

In addition, the suggestions below can be integrated into the facility:

1. Foreign substances are prevented from contaminating the substrates or the environment where insects are reared by falling or dropping down (this is particularly crucial when designing new equipment or affecting repairs to existing structures);
2. The building structure could be higher than the surrounding ground to protect it from demolition and contamination;
3. The premises are kept in a good state of repair: the roofing, in particular, should be kept watertight to prevent the substrates, the environment where insects are reared and the storage areas from being affected by water leaks, which can cause mold and attract unwanted insects; Consideration is given to the design and layout of new buildings to minimise roosting and nesting areas for birds/rodents and other areas that will harbour and attract pests.
4. The site is recommended to have:
   • clearly defined boundaries to keep out animals, pests or unauthorised persons;
   • no open water ways that attract birds, insects, rodents etc.;
   • minimal vegetation and foliage. When present, shrubs and plants should be located at minimum distance respective to recommended legislative or certification standards from the buildings;
   • an area of minimum distance respective to recommended legislative or certification standards around the building, i.e. a gravel walk, which is free of grass, weed, flowers, plants, and other vegetation;
   • weed control to reduce harbourage for insects and rodents but also to prevent air-borne seeds getting into the factory;

Annex II Chapter I of Regulation (EC) No 852/2004 on food hygiene indicates:

‘1. Food premises are to be kept clean and maintained in good repair and condition. (...)’
• general facilities designed to meet security and pest control strategies and if needed separate utility buildings, trailers, garages, wastewater treatment facilities, storage sheds, and guard shacks;
• boundaries enough to effectively prevent intrusion.

6. Building design for good hygienic operations should include the followings:
• measures to prevent entry of contaminants from doors, windows, or other openings, by keeping them closed or using insect proof screens;
• the airflow systems should be adequately adapted to insect production specifications. Excess of heat and/or humidity should be optimised and can even be used for other production activities;
• all facilities should have maintenance for the roof, wall and foundations to prevent leakage;
• measures to prevent entry and harbouring of pests, birds and wild insects;
• there should not be structures or equipment’s, which could provide places for microbial contamination or provide an environment invasion (e.g. lightings with horizontal parts or fixed to walls which could accumulate dust and residues);
• measures should be taken to reduce cross contamination by planned segregation of flow of air, personnel, materials, products and waste;
• there should be separate storage areas for raw materials, packing materials, chilled or frozen products as well as cleaning tools and agents etc. Furthermore, these areas should fulfil other EU legislative requirements e.g. cleaning agents should be kept in locked cupboards;
• operators should maintain raw materials, products and insects at appropriate temperatures and allow monitoring of these temperatures;
• there should be few personnel entries or openings acknowledging security and fire escape requirements to prevent contamination from people.

7. Hygienic rooms where microbiologically decontaminated ingredients of insect-based products or formulations are sampled, handled or further processed should:
• protect against accumulation of dirt and shredding of particles into food;
• protect against contact with toxic materials, dirt, dust, fumes, smoke and other contaminants;
• protect against condensation and undesirable growth of mold, yeast and bacteria (or microbial growth) on surfaces;
• permit sufficient cleaning and/or disinfection and maintenance;
• allow immediate drying after cleaning and disinfection methods;
• provide enough lightning and ventilation.

Finally, cross-contamination shall be prevented. An assessment of potential contamination sources shall be conducted, in particular, to identify the susceptibility of the product and activities taking place along the processing line. Areas where the potential for microbiological cross-contamination exists (airborne or from traffic patterns) shall be identified and segregation (zoning) plan implemented. More specifically, the following measures shall be considered:
1. physical barriers, walls or separate structures;
2. access controls with requirements to change into work clothes;
3. restricted traffic patterns or equipment segregation;
4. separating wet areas from dry areas;
5. separating high-risk areas from other areas, e.g. that the filling area is separated from the handling of raw materials and other food processing;
6. forward moving flow of product (by pipes, conveyors, trucks etc.), from the reception of raw material to the release of the final products to reduce distances travelled by material and staff;
7. areas in which steam is used or aerosols are formed should be separated from areas where products are exposed/freely accessible;
8. adequate and separate location of facilities for staff (cloak rooms, toilets, cafeterias, etc.);
9. have a designed plan in order to move insects personnel and waste without cross contamination.

Construction materials shall be selected to prevent contamination of reared insects and of the stored products. Floors, walls and ceilings shall be washable or covered/painted with a washable protective layer. Technologies used for the construction of livestock buildings are recommended i.e., 'sandwich panel'. Raw timber and materials with rough surfaces should be generally avoided.

All surfaces in contact or close to the product shall be made with smooth, impermeable, corrosion resistant and non-toxic material. All such surfaces shall also be designed to:
1. be easily cleaned and disinfected;
2. protect the product from external contamination;
3. not present any ‘dead space’, that is space which is not easily accessible for cleaning;
4. be resistant to the cleaning systems applied.

Ceilings and walls shall be made of non-toxic materials which do not flake which are impervious to water and steam. Walls shall be covered with materials which are impervious, non-absorbent, light coloured, washable and non-toxic. Their surfaces should be smooth, without cracks or flakes and easy to clean and to sanitise. Wall-floor junctions and corners shall be designed to facilitate cleaning. In processing areas, wall-floor junctions shall be rounded.

Doors should be made from smooth and non-absorbent materials which are easy to clean.

Floors should be made of impervious and non-absorbing materials. They should be washable, slip resistant, non-toxic and without cracks.

2.2.3. Building and premises: ventilation

Annex II, Chapter I, of the Regulation (EC) No 852/2004 on food hygiene indicates:

‘5. There must be suitable and sufficient means of natural or mechanical ventilation. Mechanical airflow from a contaminated area to a clean area is to be avoided. Ventilation systems are to be so constructed as to enable filters and other parts requiring cleaning or replacement to be readily accessible.

6. Sanitary conveniences are to have adequate natural or mechanical ventilation.’

2.2.4. Water supply

The supply of potable water shall be sufficient to meet the needs of the production process(es). A large water supply, under pressure and at an adequate temperature, is required as well as adequate facilities and equipment for its storage and distribution. Potable water shall be protected against contamination.

The processing establishment shall have a supply of potable water, which prior to its first use (including ice), shall meet all applicable local and national regulatory requirements. Plant water including cooling
and process water shall meet quality and microbiological requirements appropriate to the intended usage. The necessary monitoring protocols should be in place.

2.2.5. Sanitary facilities, staff rooms and laboratories

Annex II, Chapter, Regulation (EC) No 852/2004 indicates:

3. An adequate number of flush lavatories are to be available and connected to an effective drainage system. Lavatories are not to open directly into rooms in which food is handled.

4. An adequate number of washbasins is to be available, suitably located and designated for cleaning hands. Washbasins for cleaning hands to be provided with hot and cold running water, materials for cleaning hands and for hygienic drying. Where necessary, the facilities for washing food are to be separate from the hand-washing facility.

Management must ensure that sanitary facilities are available to any staff. The sanitary area is equipped with sinks and toilets, has soap or cleaning solution at disposal and is supplied with running water.

Staff facilities shall be well lit, ventilated and kept clean. When necessary, Management makes cloakrooms or private closets available to staff so that they can change their clothes before and after performing work-related duties.

These facilities shall be made available to any person frequenting the processing, packaging and storage areas, including visitors. Personnel may only access a high-risk zone through a cloakroom, specially fitted for the purpose, and must observe procedures for putting on working clothes which are clean and visually identifiable. Working clothes and normal clothes shall be stored separately.

Facilities to wash and disinfect hands and shoes shall be available at the entry to the processing areas. Alternatively, shoes must be changed to footwear dedicated to the processing area. The washbasins must be located in highly visible spots before entering the process areas, ensuring that staff have passed them. Washbasins shall be equipped with hands-free operated taps dispensing warm water, with adequate soap dispensers and with hygienic hand drying equipment. When paper napkins are used, there shall be an adequate number of dispensers and waste bins close to each washbasin. The drainage of the washbasins shall be linked directly to the general drainage network.

In-line and on-line testing facilities shall be designed in a manner that sampling practices do not increase the risk of product contamination.

Microbiology laboratories shall be designed, located and operated so as to prevent contamination of people, plant and products. They shall not open directly on to a production area.
2.3. Production equipment

Annex II of the Regulation (EC) No 183/2005 on feed hygiene indicates:

‘2. The lay-out, design, construction and size of the facilities and equipment shall: (a) permit adequate cleaning and/or disinfection; (b) be such as to minimise the risk of error and to avoid contamination, cross-contamination and any adverse effects generally on the safety and quality of the products. Machinery coming into contact with feed shall be dried following any wet cleaning process.

3. Facilities and equipment to be used for mixing and/or manufacturing operations shall undergo appropriate and regular checks, in accordance with written procedures pre-established by the manufacturer for the products. (a) All scales and metering devices used in the manufacture of feeds shall be appropriate for the range of weights or volumes to be measured and shall be tested for accuracy regularly. (b) All mixers used in the manufacture of feeds shall be appropriate for the range of weights or volumes being mixed and shall be capable of manufacturing suitable homogeneous mixtures and homogeneous dilutions. Operators shall demonstrate the effectiveness of mixers with regard to homogeneity.’

Annex II, Chapter V, of the Regulation (EC) No 852/2004 on food hygiene indicates:

‘1. All articles, fittings and equipment with which food comes into contact are to: (a) be effectively cleaned and, where necessary, disinfected. Cleaning and disinfection are to take place at a frequency sufficient to avoid any risk of contamination; (b) be so constructed, be of such materials and be kept in such good order, repair and condition as to minimise any risk of contamination.’

General (design, ‘Cleaning-in-Place’-CIP and installation)

All machines and equipment used for manufacture shall be designed so as to:
1. be easily cleaned and disinfected following validated cleaning procedures and facilitate maintenance;
2. not increase the likelihood of contaminating the product from external sources;
3. prevent that the goods are altered by sludge, water, rain, and other potential contaminants;
4. minimise contact between the operator’s hands and the products;
5. not present any ‘dead space’, that is space which is not easily accessible for cleaning;
6. use food grade lubricants;
7. allow easy disassembling for inspection with tools normally used by the operating and the cleaning personnel if not designed specifically for CIP (cleaning – in place)

All elements including those within a CIP circuit shall be designed and dimensioned to ensure efficient cleaning. All equipment surfaces in contact or close to the product shall be made with smooth, impermeable, corrosion resistant and non-toxic material.

Contact surfaces shall not affect, or be affected by, the intended product or cleaning system.

They shall meet current EU regulations on materials in contact with food37. Food contact equipment shall be constructed of durable materials able to resist repeated cleaning.

Machinery should be placed in a way that allows adequate maintenance and cleaning to be carried out. The operation of machinery must correspond with its intended purpose and its location must allow it to work according to good operational practice. The location of machinery shall also allow its operation to be monitored, where needed.

37 See EC safety guideline for Food contact materials https://ec.europa.eu/food/safety/chemical_safety/food_contact_materials_en
If items of equipment are not sealed to the floor, they shall be raised from the floor by a sufficient space to allow easy cleaning and inspection. Ingress of contaminants such as undesirable insects, dust and condensate shall be prevented by ensuring that all the equipment is fitted with appropriate lids. The openings shall also be protected by raised edges so as to prevent the entry of surface drainage.

All joints should be smooth and finished close to the adjoining surfaces, be free from crevices and have smooth rounded corners. Where standing water cannot be removed and may result in contamination of food, the surfaces shall be sloped in order to allow self-drainage.

The fitting of shafts shall be such that leakage of lubricant into the product or leakage of product into the lubricant is prevented. It is recommended to use a seal for the shafts on the product side and another seal on the lubricant side. Any leakage on either side shall flow into an open area without pressure.

**Design: equipment specific rules**

**Vessels** shall be designed in such a way as to allow their cleaning with a CIP system wherever possible.

Pipelines shall be designed so as to be cleanable with CIP whenever possible. All product and cleaning pipelines shall be rigid, self-draining and fixed. Pipelines shall preferably be welded or equipped with hygienic joints. Use of plug-cocks shall be avoided if they must be manually disassembled, cleaned and disinfected.

The use of flexible pipelines shall be limited to a minimum, because of their unhygienic junctions. The internal surface shall be regularly inspected. Permanent junctions which are hygienic shall be used.

In order to prevent cross-contamination, there shall not be any piping which connects directly between areas where raw materials are stored and handled and areas where pasteurised products are processed, handled and packed. The same principle shall apply to CIP circuits.

**Pumps** shall be of a hygienic design and preferably cleanable in place. All pipes shall be designed and equipped to avoid contamination by condensation. The insulation used on the various pipelines shall have an outer layer which is of non-absorbent and cleanable material.

**Equipment for CIP** shall be designed and installed with no empty spaces that may trap product and prevent cleaning effectiveness. CIP systems shall be separated from active product lines.

**Heat treatment equipment** shall be designed and installed to ensure that all particles reach the required temperature within the stipulated time. Heat treatment equipment which is linked to a Critical Control Point (CCP) must be equipped with time and temperature control and monitoring devices. A system which prevents non-conforming products (i.e. not treated as intended) from moving forward in the process flow should also be linked. Non-conforming products must be sent back to be heat treated again.

All parts of the **freezing equipment** in contact with the product shall be easily accessible for inspection. The mechanical parts and the framework of the freezing equipment shall be designed so as to avoid inaccessible crevices.

**Containers for waste and inedible or hazardous substances** shall be:

1. clearly identified for their intended purpose;
2. constructed of impervious material which can be readily cleaned and disinfected;
3. closed, when not in immediate use;
4. preferably fitted with a foot-operated lid or other suitable means to minimise contamination of hands.
This equipment shall be designed in such a way as to prevent rodents from having access and avoid any contamination of the food or feed, the potable water, the equipment, the premises and passages.

Safe food is achieved through adequately designed and effective food safety management systems that include good hygienic practices and HACCP. Adequate traceability and recall procedures are further important tools in case of an undetected loss of control or a problem has been detected after the product has left the control of the food business operator.

Cleaning of production equipment

Equipment must be maintained in a sufficiently clean and hygienically acceptable condition in order to avoid pest damages and microbiological contamination. Technical maintenance/service is to be done by qualified staff.

Cleaning could be done both manually or automatically. However, it is important to standardise and validate protocols.

Cleaning programmes shall be established to ensure that the equipment and environment are maintained in a good hygienic condition. The effectiveness and suitability of those programmes shall be monitored on a regular basis.

The equipment is to be cleaned on a regular basis, by means of sweeping and collecting dust or equivalent procedures. This should also be performed prior to a change in products should the products not be compatible.

Records of the cleaning measures must be kept. The record is a part of the internal quality management system. If vehicles (such as pay loaders, etc.) are used, they are to be cleaned on a regular basis.

Regular checks and audits

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**Annex II of the Regulation (EC) No 183/2005 on feed hygiene indicates**

‘3. Facilities and equipment to be used for mixing and/or manufacturing operations shall undergo appropriate and regular checks, in accordance with written procedures pre-established by the manufacturer for the products. (a) All scales and metering devices used in the manufacture of feeds shall be appropriate for the range of weights or volumes to be measured and shall be tested for accuracy regularly. (b) All mixers used in the manufacture of feeds shall be appropriate for the range of weights or volumes being mixed, and shall be capable of manufacturing suitable homogeneous mixtures and homogeneous dilutions. Operators shall demonstrate the effectiveness of mixers with regard to homogeneity’.

**Annex II, Chapter V, of the Regulation (EC) 852/2004 on food hygiene indicates:**

‘2. Where necessary, equipment is to be fitted with any appropriate control device to guarantee fulfillment of this Regulation's objectives'.

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Appropriate hygiene, quality and safety controls are undertaken on the premises, and on machinery and equipment used throughout the production chain. Controls aim to identify issues and correct them, where and when necessary: equipment is regularly checked, maintained and cleaned by qualified staff at fixed and pre-defined intervals.

**Maintenance inspections** are performed and recorded on all equipment. Maintenance inspections at predefined intervals shall be performed and recorded on all equipment where corrosion or failure to operate correctly will result in product degradation or cross-contamination. Records are to be kept about the service and maintenance of the equipment used in the operations. These records are a part of the internal management system.

Each room and machinery have their own cleaning specifications. The effectiveness and suitability of these procedures and instructions shall be monitored on a regular basis. The cleaning materials are also made available in case of emergency or specific punctual needs.

The equipment is replaced when necessary for hygiene, environment, safety, quality or security reasons.

### 2.4. Pest control measures

Pests (such as birds, insects, spiders, rodents and other small mammals) represent a hazard for the safety of food and feedstuffs derived from insects. That is why a documented **pest control programme** shall be in place to prevent pest activity inside the facility and within the boundaries of the outer grounds.

Potential breeding sites must be removed, any orifices sealed off or hermetically blocked, and windows, doors and air vents fitted with appropriate devices.

The most effective contribution towards infestation control is maintaining good housekeeping and standards (e.g. controlling the accumulation of food and paper debris, keeping gangways and passages clear, removing redundant equipment and materials from production areas, good stock rotation, keeping organic and soiled waste containers covered, etc. (the presence of foodstuffs and water, even as mere trails, unprotected from contact with ambient air is liable to attract pests and shall be always avoided to prevent attracting pests).

The presence of infestation must be checked regularly and the monitoring plan must be reviewed according to the results of the inspections. If rodent baits are used in the factory for the control of rats and mice, they shall be based on fatty and waxy substrates and shall be placed in a solid box. The use of poison baits for rodents shall be limited along the external walls of the facility (unsecured bait stations). Electric flying insect killers must not attract outside insects and must be placed more than three meters away from unprotected products. No domestic animals should be allowed to gain entrance in production or storage areas.

When rodent activity demands, programmes may be set up to utilise poison within the manufacturing site. In this case, the programme shall be controlled in respect of authorised handling of poison bait and great care is taken to prevent any bait spillage and subsequent food safety risks:

1. All bait stations must be clearly identified/coded at the point of use;
2. The bait station must be contained in a secure metal trap;
3. The poison must be of a solid block type (not loose granulates).

Usage and handling of pesticides and/or biocides must be done in accordance with applicable regulations\(^{38}\). Pest control as well as the risk of microbiological contamination to the products and facilities shall be part of the HACCP system and should be documented. Special attention should be taken for processed feed material such as oilseeds meals, fish meal, maize products.

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2.5. Waste management

Annex II of the Regulation (EC) No 183/2005 on feed hygiene states:

‘5. Waste and materials not suitable as feed should be isolated and identified. Any such materials containing hazardous levels of veterinary drugs, contaminants or other hazards shall be disposed of in an appropriate way and not used as feed.’

Annex II, Chapter VI, of the Regulation (EC) No 852/2004 on food hygiene indicates:

1. ‘1. Food waste, non-edible by-products and other refuse are to be removed from rooms where food is present as quickly as possible, so as to avoid their accumulation.

2. Food waste, non-edible by-products and other refuse are to be deposited in closable containers, unless food business operators can demonstrate to the competent authority that other types of containers or evacuation systems used are appropriate. These containers are to be of appropriate construction, kept in sound condition, be easy to clean and, where necessary, to disinfect.

3. Adequate provision is to be made for the storage and disposal of food waste, non-edible byproducts and other refuse. Refuse stores are to be designed and managed in such a way as to enable them to be kept clean and, where necessary, free of animals and pests.

4. All waste is to be eliminated in a hygienic and environmentally friendly way in accordance with community legislation applicable to that effect, and is not to constitute a direct or indirect source of contamination.’

Waste generated from production or insects or their products, containing hazardous levels of contaminants such as mycotoxins, heavy metals, pesticide residues, chemicals, or other hazards (physical) must be controlled. These must be disposed of in an appropriate way to prevent the contamination of the rearing environment, the substrates used to feed the insects and the insects themselves. These products are to be labelled and stored in a dedicated area with clear zoning points for authorized access.

By-products from insect rearing could include parts from insects, insects that have died naturally, insect eggs, and pupas, together with excrement, frass, or substrate if to be discarded must be properly heated before throwing it away or burnt, to prevent any potential remaining eggs from hatching in nature. Other wastes generated from the production process such as discarded packaging material, wastewater, etc.

Examples of waste materials expected from insect production:

1. Substrates discarded due to non-conformity;

2. Packaging used for transport of substrates (e.g. paper sacks, big-bags and disposable containers);

3. Plastic foil wrapping used to protect bulk packed substrates.

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39 Waste: any substance which constitutes scrap material, an effluent, unwanted surplus substance, article which requires disposing of as being broken, worn out, contaminated or otherwise spoiled.
2.6. Monitoring (sampling and analyses)

2.6.1. General requirements

Insect producers are responsible for demonstrating the safety of the products leaving their production facilities. Official sampling procedures should be put in place to verify that such conditions are met: e.g. to verify that their own product safety sampling systems work properly. Such sampling obligations are often associated with the fulfilment of compulsory microbiological criteria/targets (e.g. for processed insect proteins intended for animal feed use) and maximum limits for contaminants (food contaminants and undesirable substances and products for feed).

While most of the microbiological criteria that are provided for in the EU legislation (e.g. criteria for food products) concern animal species other than insects (see below), insect producers are advised to test their finished products periodically against those pathogens, as these could have been transmitted to the animal through the feeding substrate or the production process. This recommendation is in line with the conclusions from the EFSA released on 8 October 2015.

Besides the above-mentioned EU microbiological criteria, insect producers must comply with specific limits and/or standards as set out in food and feed safety assurance systems, established by national authorities or private organisations. Such systems may serve as a point of reference for IPIFF and its members to complement and update the recommendations that are presented in this Guide, in the future. Processed feed material such as oilseeds meals, fish meal, maize products.

2.6.2. Food safety requirements and recommended practices

Regulation (EC) No 2073/2005 foresees that *Listeria monocytogenes* must be controlled in ready-to-eat foods (e.g. limit of 100 cfu/g for ready-to-eat foods other than those intended for infants that are already placed on the market). These limits, therefore, also apply to food made from insects.

In addition, microbiological limits have been set for raw materials used in meat preparation, for minced meat and meat preparation (e.g. absence of Salmonella in 10 g for minced meat and meat preparation made from other species than poultry intended to be eaten cooked, 500 cfu/g for *E. Coli* in minced meat at the end of the manufacturing process), or for cooked crustaceans and molluscan shellfish (i.e. Salmonella absence in 25 g of product) under Regulation (EC) No 2073/2005.

Although these limits are not binding for insect products, insect producers shall assess these risks by testing their finished products periodically against the above. Proposed applications, shelf life and further processing should be taken into consideration when considering microbiological limits; referring to Regulation (EC) No 2073/2005. The microbiological criteria’s in the table mentioned below, indicating to Regulation (EC) No 2073/2005 refers to Annex I - Microbiological criteria for foodstuffs – in the aforementioned Regulation.

If deemed necessary, insects should also be periodically tested for the presence of other specific pathogens, and for chemicals (e.g. pesticides or heavy metals and mycotoxins following the limits foreseen in Directive 2002/32/EC on undesirable substances in animal feed) and physical agents (e.g. water activity).

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40 Contrary to warm blooded animals, mass-reared insects are not likely to contain substantial number of typical pathogen agents – e.g. Salmonella, *Listeria Monocytogenes*. 
An overview of microbiological, physical and chemical parameters commonly monitored by producers of insects and insect-based products intended for human consumption (prior to being incorporated as an ingredient in food end-product or to be used as an end-product) are listed below, in addition to legal obligations by operators. The following list of potential hazards are recommended to be monitored in start-up phases (during initial risk analysis and determining monitoring plan). Identification of hazards, are direct control measures to be taken using good hygiene/manufacturing practices to fulfil legal/product specific monitoring requirements in order to avoid the identified hazards to impact on food safety. The hazards identified for insect-based products can be controlled by prerequisite programs and HACCP procedures, which also include several hazards ‘commonly controlled’ under mandatory EU legal requirements. The hazards are identified, and limits developed based on practices by IPIFF members. The criteria in the table are subject to products sampled at the end of the manufacturing process or production whole/ground insects, ready to eat or as a food ingredient. The frequencies for monitoring these pathogens depend on the respective insect species, production methodology and specification of the insect-based product(s).
Microbiological parameters recommended to be monitored:

<table>
<thead>
<tr>
<th>Hazards</th>
<th>Main origins</th>
<th>Severity</th>
<th>Management</th>
<th>Target</th>
<th>Limit</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobic flora 30°C</td>
<td>Hygiene indicator-Process Manipulations</td>
<td>Low</td>
<td>Good Hygiene Practices</td>
<td>10,000 cfu/g</td>
<td>500,000 cfu/g</td>
<td>REG EU 2073/2005 Section dry fruits</td>
</tr>
<tr>
<td>E. coli</td>
<td>Hygiene indicator-Process Manipulations</td>
<td>Low</td>
<td>Good Hygiene Practices</td>
<td>10 cfu/g</td>
<td>500 cfu/g</td>
<td>REG EU 2073/2005 Section dry fruits</td>
</tr>
<tr>
<td>Staphylococcus coagulase + (S. aureus)</td>
<td>Hygiene indicator-Process Manipulations (raw materials or processing operations)</td>
<td>Medium</td>
<td>Good Hygiene Practices</td>
<td>10 cfu/g</td>
<td>100 cfu/g</td>
<td>REG EU 2073/2005 Section dry fruits and Minced meat</td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td></td>
<td>High</td>
<td>Sourcing/breeding management</td>
<td>Absence in 25g</td>
<td>Absence in 25g</td>
<td>REG EU 2073/2005 Section ready to eat foods</td>
</tr>
<tr>
<td>Salmonella</td>
<td>Insects intestinal tractus, feed</td>
<td>High</td>
<td>Absence in 25g</td>
<td>Absence in 25g</td>
<td>Absence in 25g</td>
<td>REG EU 2073/2005 Section shellfish</td>
</tr>
<tr>
<td>Cronobacter spp.</td>
<td>Insects, feed</td>
<td>Medium</td>
<td>Sourcing/breeding management</td>
<td>Absence in 10g</td>
<td>Absence in 10g</td>
<td>REG EU 2073/2005 Section baby powder</td>
</tr>
<tr>
<td>Bacillus cereus</td>
<td>Feed</td>
<td>Medium</td>
<td>Feedstock/breeding management</td>
<td>10 cfu/g</td>
<td>100 cfu/g</td>
<td></td>
</tr>
<tr>
<td>Monitoring</td>
<td>Insect guts</td>
<td>Medium</td>
<td>Sourcing/breeding management</td>
<td>Absence in 25g</td>
<td>Absence in 25g</td>
<td></td>
</tr>
<tr>
<td>Moulds and Yeast</td>
<td>Hygiene indicator-Process Manipulations, feed</td>
<td>Medium</td>
<td>Good Hygiene Practices</td>
<td>100 cfu/g</td>
<td>1000 cfu/g</td>
<td></td>
</tr>
</tbody>
</table>

Chemical parameters recommended to be monitored:
- Pesticides (Organochlorine pesticides, organophosphorus pesticides, other pesticides);
- Heavy metals (lead, cadmium);
- Cleaning and disinfection residues;
- Contamination through material contact.

Physical parameters recommended to be monitored:
- Metal pieces;
- Foreign particles, glass and plastic pieces;
- Insect parts such as wings or legs (if applicable).
Allergens

Considering the existence of scientific evidence showing allergic cross-reactivity between insects and crustaceans, and/or unprocessed or processed insects that may contain allergens(s) originating from the feed materials which were ingested by the insects, allergen residue and cross contamination among products must be monitored. Monitoring for the presence of one or more of the 14 EU listed food allergens and or the insect itself linked to the listed allergen crustaceans is recommended to be included in the 'monitoring plan'.

On authorisation of the respective insects as novel food, operators should refer and must mandatorily follow the specifications on hazards to be monitored, as indicated in the Union list of novel foods.

2.6.3. Feed safety requirements and recommended practices

Samples of the final products taken during or on withdrawal from storage at the processing plant must comply with the following standards:

1. Salmonella: absence in 25 g: n = 5, c = 0, m = 0, M = 0
2. Enterobacteriaceae: n = 5, c = 2, m = 10, M = 300 in 1 g where:

- n = number of samples to be tested;
- m = threshold value for the number of bacteria; the result is considered satisfactory if the number of bacteria in all samples does not exceed m;
- M = maximum value for the number of bacteria; the result is considered unsatisfactory if the number of bacteria in one or more samples is M or more;
- and c = number of samples the bacterial count of which may be between m and M, the sample still being considered acceptable if the bacterial count of the other samples is m or less.

Operators applying the so-called 'method 7' (annex IV, Chapter 3, point G. of Regulation (EU) No 142/2011) must demonstrate the absence of Clostridium perfringens in 1 g of the product. The sample must be taken directly after treatment, on a daily basis, over a period of 30 production days.

If deemed necessary, insects should also be periodically tested for the presence of other specific pathogens, including chemicals (e.g. pesticides or heavy metals and mycotoxins following the limits foreseen in Directive 2002/32/EC on undesirable substances in animal feed) and physical agents (a w).

Some possible chemical and physical parameters identified regarding insect production for feed are listed below:
- Pesticide residues;
- Mycotoxins (Aflatoxin, Ochratoxins, Deoxynivalenol, Zearalenone, Fumonisin);
- Heavy metals (As, Cd, Cr, Cu, Hg, Pb, Ni, Zn);
- Polycyclic aromatic hydrocarbons;
- Dioxins;
- Animal proteins;
- GMOs;
- Metal, plastic, stone pieces;
- Foreign objects.

2.6.4. Creating a monitoring programme

Sampling and testing measures implemented by insect producers must be specifically foreseen in the monitoring programme in Chapter 7.3.9. on HACCP.

General remarks regarding sampling for insect products as food and feed:
- Sampling based on the results could be intensified or reduced;
- In the case of a positive detection of microbial contamination, it is advisable to test for contamination afterwards;
- Water activity (microbial growth does not take place any more, below 0.60 a.w. whatever the matrix) and pH measurements are of great importance because it is the final
step in the production process to guarantee food safety. Registration of water activity must be recorded on the ‘product registration’ form.

An example of monitoring procedures for batches (see definition of ‘batch’ in Annex I) of materials used in production of insect-based products. Operators are recommended to perform analysis on fresh samples (or in case stored in freezers not more than 24 hrs) in order to have accurate results on microbiological colonies.

**Insects as Feed:**

A batch, subject to the following monitoring plan, may comprise maximum 100 tons. For batches of up to 100 tons, at least 1 sample is taken and for batches of more than 100 tons at least 5 samples are taken. For the latter a mix of the sample may be made for the analysis. Sampling and analysis of Salmonella and Enterobacteriaceae in feeds: The critical control points must be examined for Salmonella. The frequency of inspection must be once per month and if this is negative for a half year then the frequency can be reduced to once per two months. In the event of a positive finding analysis must be done again once per month for at least half a year. The positive samples must be classified for corrective measures. Minimum sampling frequencies are illustrated below for a start-up phase.

**For incoming raw materials (substrate) for breeding of insects as feed:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Analysis</th>
<th>Frequency</th>
<th>Number of subsamples</th>
<th>When</th>
<th>Responsibility</th>
<th>Storage locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incoming raw materials</td>
<td>Chemical Residue</td>
<td>Every batch</td>
<td>1</td>
<td>Arrival</td>
<td>Internal / External qualified laboratory</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>Moisture content percentage</td>
<td>Every batch</td>
<td>1</td>
<td>Arrival</td>
<td>Internal / External qualified laboratory</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>Ph</td>
<td>Every batch</td>
<td>1</td>
<td>Arrival</td>
<td>Internal / External qualified laboratory</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>Mycotoxins, heavy metals, PAHs, PAs</td>
<td>1 time per year/ or when suspicion</td>
<td>1</td>
<td>Arrival</td>
<td>Internal / External qualified laboratory</td>
<td>All</td>
</tr>
</tbody>
</table>

Microbiological analysis for raw materials frequency minimum once a year. In case deviations are recorded in the breeding facility testing protocols should be amplified accordingly. Physical hazards should be determined and monitored accordingly in every batch.

**For out going feed products**

<table>
<thead>
<tr>
<th>Product</th>
<th>Analysis</th>
<th>Frequency</th>
<th>Number of subsamples</th>
<th>When</th>
<th>Responsibility</th>
<th>Storage locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insect-based feed product</td>
<td>Chemical (all), microbiological (all)</td>
<td>1 time per year</td>
<td>1</td>
<td>1 month after production batch</td>
<td>Internal / External qualified laboratory</td>
<td>All</td>
</tr>
<tr>
<td>Clostridium Perfringens</td>
<td>30 days (Method 7 Plan)</td>
<td>1</td>
<td>Directly after the treatment</td>
<td>Internal / External qualified laboratory</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>Salmonella</td>
<td>30 days (Method 7 Plan)</td>
<td>5</td>
<td>During the filling of packaging</td>
<td>Internal / External qualified laboratory</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>Enterobacteriaceae</td>
<td>30 days (Method 7 Plan)</td>
<td>5</td>
<td>During the filling of packaging</td>
<td>Internal / External qualified laboratory</td>
<td>All</td>
<td></td>
</tr>
</tbody>
</table>
Moisture content percentage  3x a day  1  During production  Internal / External qualified laboratory  All

Microbiological (all) analysis frequency of the end product can be increased to one time/month if requested. Physical hazards should be determined and monitored accordingly in every batch.

For insects as food activities

Number of subsamples and frequencies for sampling of insect-based food products should be increased/ decreased. Specific chemical and microbiological hazards should be monitored, respective to the conducted risk assessments on the products (depending on insect species and/or product form-flour, whole insect, etc) and the weights of each batch. Minimum sampling frequencies are illustrated below for a start-up phase.

<table>
<thead>
<tr>
<th>Product</th>
<th>Analysis</th>
<th>Frequency</th>
<th>Number of subsamples</th>
<th>When</th>
<th>Responsibility</th>
<th>Storage locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insect-based product as raw material</td>
<td>Microbiological (all)</td>
<td>Once a month when &gt;1 batch is produced per month/ every batch if &lt;1 batch is produced in 1 month/ if suspicion</td>
<td>1</td>
<td>Arrival</td>
<td>Internal / External qualified laboratory</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>Microbiological (specific)*</td>
<td>Every batch</td>
<td>1</td>
<td>Arrival</td>
<td>Internal / External qualified laboratory</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>Chemical (all)</td>
<td>Once a year</td>
<td>1</td>
<td>Arrival</td>
<td>Internal / External qualified laboratory</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>Chemical specific</td>
<td>Every batch</td>
<td>1</td>
<td>Arrival</td>
<td>Internal / External qualified laboratory</td>
<td>All</td>
</tr>
<tr>
<td>During production and raw material</td>
<td>Moisture content percentage</td>
<td>Every batch</td>
<td>1</td>
<td>During production and arrival</td>
<td>Internal / External qualified laboratory</td>
<td>All</td>
</tr>
<tr>
<td>Insect based product final product**</td>
<td>Microbiological (all)</td>
<td>Once per month</td>
<td>1</td>
<td>Process end</td>
<td>Internal / External qualified laboratory</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>Chemical (all)</td>
<td>Twice per year</td>
<td>1</td>
<td>Process end</td>
<td>Internal / External qualified laboratory</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>Chemical specific</td>
<td>Per quarter</td>
<td>1</td>
<td>Process end</td>
<td>Internal / External qualified laboratory</td>
<td>All</td>
</tr>
</tbody>
</table>

* Yeast/Moulds, Listeria monocytogenes, Bacillus cereus group, Enterobacteriaceae, Salmonella, criterion to be maintained according to the risk analysis especially for the monitoring of raw material flours used for the production of insect based food products.

** Parameters are to be defined based on the products in which insects are incorporated (e.g. insect-based pastas, granola bars, etc).

Physical hazards should be determined and monitored accordingly in every batch.
2.7. Personnel

2.7.1. Information flow and training

The employees, including temporary, recently hired staff, maintenance and transport staff as well as suppliers, are informed about and trained in their duties and areas of responsibilities. They are aware of hygiene requirements. The purpose of training employees is to ensure that they have the competencies needed to meet the corporate objectives on food safety.

The Management and the HSEQ manager make sure all type of staff is made aware of hygiene issues along the insect food and feed production chains.

Training of all staff - whether permanent, temporary or sub-contractor - shall at least address the following:

1. GHP and HACCP standards;
2. Food safety, including carrying out monitoring, corrections and corrective actions;
3. Safety of people, particularly with regard to the potential allergenic properties of the insect species reared;
4. Specific competencies related to the operations carried out;
5. Basic first aid skills;
6. Principles and conditions for rearing;
7. Principles and conditions for processing;
8. Required documentation;
9. Pathogens and pests that could grow in an insect farm to enable early recognition of disease symptoms.

Newcomers to the organisation shall receive specific training according to a hygiene training schedule adapted to the competences of the person engaged. The main objective of the frequent (annual) training scheduled is to ensure that every employee has the skills necessary to evaluate and interpret the results from the annual HACCP review. Frequent performance reviews shall ensure that each member of staff has the competencies required to meet the company objectives (particularly on food safety) and tasks and to successfully complete the tasks their role profile requires. Opportunities for improvement and expansion of their skill-set shall be provided. The effectiveness of staff training shall be regularly evaluated.

For internal staff, training also addresses internal management, recording procedures, commercial uses and when appropriate legislative aspects. There should be personnel on-site who are specifically trained for emergency situations.

For externals visitors, a HSEQ presentation should be done covering for example:

10. the main factory risks;
11. forbidden behaviour (smoking, running etc.);
12. emergency exits and emergency procedures;
13. individual protection equipment.

2.7.2. Clothing and personal behaviour

Annex II of the Regulation (EC) No 852/2004 on food hygiene indicates:

’14. Every person working in a food-handling area is to maintain a high degree of personal cleanliness and is to wear suitable, clean, and where necessary, protective clothing.”
The Management ensures staff has access to and is using appropriate clean clothing and protective wear (e.g., helmet, safety shoes, gloves when required, apron, protective glasses, dust masks) when operating within the production facilities. A list of necessary clothing should be elaborated and communicated to the staff and updated when necessary.

**Examples of appropriate clothing in insect production facilities:**

1. Ear plugs should for people working in high noise environment;
2. Helmet and glasses should be used by maintenance staff;
3. Gloves for people with direct product contact;
4. Mask for people working in breeding chambers;
5. When dealing with insect frass, which is a potential allergen, the staff responsible for harvesting should make sure to use appropriate protective tools (e.g., protective glasses, dust mask with filters, and aprons).

**Annex II of the Regulation (EC) No 852/2004 on food hygiene indicates:**

‘2. No person suffering from, or being a carrier of a disease likely to be transmitted through food or afflicted, for example, with infected wounds, skin infections, sores or diarrhea is to be permitted to handle food or enter any food-handling area in any capacity if there is any likelihood of direct or indirect contamination. Any person so affected and employed in a food business and who is likely to come in contact with food is to report immediately the illness or symptoms, and if possible, their causes, to the food business operator.’

Furthermore, the staff is required to avoid any behaviour that could impact the safety of the food and feed produces and comply with the following minimum requirements: in particular any form of smoking, eating, chewing and spitting is prohibited inside the production area. Signs and instructions should clearly indicate prohibited behaviour and staff must comply with it.

**2.7.3. Personal health**

Operators who may come in contact with foodstuffs must always be in good health: no person who suffers from or is a carrier of a disease likely to be transmitted through food or feed is to be permitted to handle insect products (e.g. whole animals, killed animals, processed products), food and feed, or enter any food/feed handling area.

Personnel shall be instructed by their supervisors to report poor health conditions such as specific communicable diseases transmissible onto the food/feed products, illness, open lesions or any other abnormal source of microbiological contamination to avoid contaminating food, food-contact surfaces or food packaging materials.

The management will, in turn, submit a declaration to support medical examination in case of health problems are discovered/encountered during operator activities e.g. gastroenteritis; vomiting; carrying Salmonella; high temperature; a sore throat with fever; infected skin lesions; nose, eye or ear discharges. Supervisors shall verify that the staff have understood the instructions. People who report or are show
to have the above symptoms shall be excluded from any operations involving food handling until they have recovered. Personnel must be aware of the diseases which must be reported to management.

Subject to legal restrictions in the country of operation, employees shall undergo a medical examination prior to employment in food contact operations, unless documented hazard or medical assessment indicates otherwise.

Summary: the implementation of the above mentioned PrPs are summarised here. If the PRPs are properly implemented, maintained and verified, risks for food/feed safety are reduced.

### 6.2. Building and Premises

**Aim**
Lay-out, design and maintenance of company premises must be as such that risks of contamination of insect food/feed stuff is minimised.

**Action**
- Risk assessment on environment/company premises and implementing hygiene practices
  - Plan on facility site map
  - Plan on access, outlets, physical and organisation separation plans

### 6.3. Production equipment

**Aim**
- Prevent contamination of insect food/feed products due to unsuitable equipment design, leading to inefficiency in cleaning and disinfection procedures. Develop, implement and maintain a cleaning and disinfection program.
- Prevent contamination of insect food/feed products due to maintenance, lack of maintenance or not well calibrated equipment. Develop, implement and maintain a maintenance program

**Action**
- Compliant Equipment design to hygiene requirements and cleaning and disinfection programs.
- Maintenance and calibration procedure, program and records.

### 6.4. Pest control measures

**Aim**
- Prevent pest (including insects, birds) and increments from contaminating insect food/feed products.
- Make a pest control program, implement and maintain it.

**Action**
- Pest control procedure, program and records.

### 6.5. Waste management

**Aim**
- Identify waste and minimise the risk of unintended introduction into insect food/feed ingredients.

**Action**
- Waste management procedure, program and records.

### 6.6. Monitoring (sampling and analyses)

**Aim**
- To demonstrate and ensure the safety of the insects food/feed product.

**Action**
- Risk assessment and develop monitoring plan
- Maintain records

### 6.7. Personnel

**Aim**
- Establish hygiene policy and access control and communicate these to all personnel and subcontractors.

**Action**
- Communication of hygiene policy (instruction agreed by employees and subcontractors)
- Access regulation (instruction)
3.1. Substrates supply and insect producers sourcing activities

3.1.1. Background information

Insect producers select substrates based on a number of criteria, including the nutritional composition, the expected effects on the targeted insect species (e.g. speed of growth, weight gain, feed conversion ratio or fatty acid profile), the absence of hazards on the targeted animals or the ease of removal during harvesting (see Chapter 3.4. below).

Furthermore, the characteristics of the substrates used are critical parameters for a suitable and safe growth of the animal: in general substrates used for flies (e.g. Musca domestica and Hermetia Illucens) contain higher levels of moisture (sometimes referred to as 'xiroculture'), whereas mealworm (Tenebrio molitor) and lesser mealworm (Alphitobius diaperinus) species are usually raised on dry substrates (sometimes referred to as 'hygroculture').

The origin of the substrate is an important factor with respect to product traceability. When procuring the substrate, it is important to consider the reliability of suppliers and their management systems put in place.
3.1.2. Applicable legislative requirements

Insect producers must only source substrates that are eligible as feed materials for farmed animals within the European Union - rules as defined under the EU Animal-By-Products legislation (i.e. Regulation (EC) No 1069/2009 & Regulation (EU) No 142/2011) and EU on placing on the market feed (Regulation (EC) No 767/2009) - Annex III (prohibition to use manure/animal faeces).

Furthermore, insect producers must conform to the general provisions of Regulation (EC) No 183/2005 on feed hygiene.). Notably, the substrates sourced outside the insect production facility must be obtained from a registered or approved feed business operator, in accordance with Regulation (EC) No 183/2005 (article 5.6).

- Substrates' suppliers producing or placing on the market certain feed additives, premixtures and/or compound feeding stuffs prepared using feed additives shall be approved in accordance with article 10 (1) of the above Regulation;
- Pursuant to the ‘European Commission Guidelines for the feed use of food no longer intended for human consumption’ (16 April 2018), suppliers of former foodstuffs must have been registered or approved under the EU food hygiene legislation41 and/or the EU animal by-products legislation if these products contain materials of animal origin42.

Furthermore, substrates suppliers must have implemented a HACCP plan, if not covered by Article 5 (1) of Regulation (EC) No 183/2005 (applicable to ‘primary producers’).

3.1.3. Specifications and checking measures

Substrates sourced outside the insect production facility must be obtained from a registered or approved feed business operator, or from an approved establishment in accordance with Regulation (EC) No 183/2005 (article 5.6).

It is also recommended that substrate suppliers are selected and audited through internal approval guidance, taking into account the safety of the product, registration of the production sites, the safety management system in place and implementation of good hygiene practices and/or the implementation of HACCP procedures when applicable.

Insect producers must also register the substrate supplier’s name, its address and delivery date43, in accordance with EU specific requirements on traceability and record keeping, as in article 18 of Regulation (EC) No 178/2002.

Insect producers must keep up-to-date information listing the prerequisites for substrates to be safely used as feed for insects intended for food or feed purposes (the so-called ‘specifications’). The specifications also indicate when and to what extent deviations may be accepted.

The specifications must at least cover:

1. The analytical characteristics of the incoming substrate;
2. The results of the risk analysis carried out for each incoming substrate, e.g. the product specification and monitoring results;
3. The list of approved geographic origins and sources;
4. The animal species for which their use is approved;
5. Notes on any hazards or limitations on their use and any other special characteristics;
6. Conditions of usage (e.g. pH, temperature).

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41 See section 3.2 of the EC Guidelines for the feed use of food no longer intended for human consumption.
42 See section 4.2 of the above-mentioned EC Guidelines.
43 Annex III on Record-Keeping (b) (iv) Regulation (EC) No 183/2005
Insects’ nutrition and the quality of the substrates ingested may have a strong influence on its microflora (e.g. certain insects may be vectors of Salmonella, Campylobacter or Escherichia Coli) or on the presence of chemical contaminants - dioxin and PCB transferred via the substrate - may accumulate in insects. Furthermore, the substrate may have been contaminated with pests/rodents or other physical contaminants.

In light of the above hazards, insect producers should carry out regular checks of incoming materials through sampling measures to verify compliance with parameters as defined in the specifications (e.g. test against the presence of unauthorised substances and/or applicable limits for contaminants present in the substrate). Samples and results of the analysis shall be made available to the national competent authorities upon request at any time.

While EU legislation does not foresee specific regulatory provisions regarding (microbiological or chemical) analyses and pathogen agents in substrates destined for insects, operators may implement their own sampling measures/protocols:

- Sampling measures must always be conducted if there is any doubt about the quality of the substrate and/or in the absence of analyses conducted by the supplier;
- Although the substrates are delivered by trusted suppliers with full traceability ensured and/or accompanied by analytical results, sampling measures must be randomly conducted to detect the presence/levels of mycotoxins, heavy metals and residues of pesticides and the samples should be stored at least until the end of the production cycle of the batch being fed with;
- If the substrates undergo chemical/biochemical (acidification/enzymatic hydrolysis etc.) or any fermentation processes, the analysis should be conducted, based on the producer’s assessment of possible resulting hazards on insects.

### 3.2. Storage of substrates

Insect producers must pay attention to the physical conditions (storage technology, storage atmospheric characteristics) and biosecurity levels to prevent the introduction of organisms from the environment surrounding the storage facilities of the substrate.

To this end, insect producers must follow these principles:

1. Incoming materials must be stored in dry (i.e. for dried substrates), temperature appropriate and hygienic conditions;
2. Installations must be free from vermin, birds and any form of pests. Storage facilities must have roofs, walls or other protection systems, and be regularly checked in order to avoid leaks or rodent infestation;
3. Damaged or corrupted substrates must be contained and evaluated for an exemption to be reintroduced as substrate or disposal.

Furthermore, there must be a system of site allocation for safe storage (e.g. easily identifiable, intake identification easily visible). In case of any doubt about the identity of a product during storage (i.e., damaged packaging), a ‘non- conformity procedure’ must be established whereby the HSEQ Manager or any other competent and/or designated person must decide on the destination of the product (re-identification, clearance for use, disposal, etc.). Records must be kept at all times about the actions taken. The substrates that have been rejected by the HSEQ Manager must be clearly identified and segregated from other materials in a manner which precludes their unauthorised used.
Finally, insect producers must pre-treat, whenever deemed necessary (i.e. should risks of contamination be identified), the substrates before feeding them to insects, including through shredding, grinding, milling, mixing or acidification.

**Summary of recommended practices or ‘warning points’ in the management of incoming substrates**

1. Ensure that the substrates are provided by trusted suppliers;

2. Only source your substrate from registered or approved Feed or Feed Business Operators

3. Only source and use legally substrates which are eligible as feed for farmed animals, in accordance with EU legislation;

4. Ensure that designated and trained staff are present at the point of delivery;

5. Visually control the truck before unloading and accepting the delivery to detect damaged seals or packaging;

6. Register all batches of substrate;

7. Undertake your own testing/sampling of the substrate following a risk-based approach, after assessing the potential contamination of the feed (notably, you should pay attention to the development of Salmonella spp., Campylobacter and Enterobacteria);

8. Pre-treat the substrate whenever necessary derived products -see above).
4.1. Introduction: scope and legal framework

Insect rearing activities cover the following production steps:

1. Administration of feed/substrates to insects;
2. Insect growth phase;
3. Insect harvesting;
4. Pre-treatment step.

All the above-mentioned steps are considered ‘primary production’ activities44 under EU food and feed safety legislation. Consequently, insect producers that are active in these fields fall subject to distinct hygiene requirements. In practice, those operations often take place in the same establishment of processing activities, therefore limiting the risks for contamination which may arise from transport from one establishment to another. However, insect producers may decide to outsource certain stages for the rearing activities. In that case, operators should refer to the recommendations provided in section 4.3. below.

For more information about applicable requirements, you may refer to subchapter 1.1.

This chapter applies to insect products intended for human consumption and animal feed.

4.2. Administration of feed/substrates
4.2.1. Background information

Substrate administration to insects constitutes an important component of the breeding process. Such operations are designed to provide insects, specific to their species and consumption habits, with access to liquid and solid nutrients (i.e. wet and dry substrates) as a source of energy needed for their growth.

Eggs are usually introduced onto the substrate manually, mechanically or by natural oviposition (directly from adult insects). The larvae are maintained on the substrate for a certain number of days or weeks depending on the species produced and the temperature and humidity levels within the building.

4.2.2. Applicable legislative requirements

All operations associated the feeding of the animals are considered ‘primary production’ activities. Therefore, they are subject to the specific requirements contained in Annex I of Regulation (EC) No 183/2005, Annex I of Regulation (EC) No 852/2004 and Annex III of Regulation (EC) No 183/2005.

See subchapter 1.1. for more information.

Annex III of Regulation (EC) No 183/2005 on feed hygiene indicates:

‘Feeding’

2. Distribution

‘The on-farm feed distribution system shall ensure that the right feed is sent to the right destination. During distribution and feeding, feed shall be handled in such a way as to ensure that contamination does not occur from contaminated storage areas and equipment (...).’

4.3.3. Recommended practices

In order to prevent the risks of contamination – which may originate from the introduction of pathogens, chemical contaminations, cross-contamination - the administration of the substrate to the animals should be done according to the following principles:

• The substrate used should be selected by taking into consideration the chosen insect species, based on its mycotic, bacterial and viral disease resistance;

• Each batch of substrate delivered to the animal must be traceable;

• The equipment destined to provide the nutrients/substrates (or any other material which may enter into contact with the animals) should be certified as ‘food contact’ material (avoid chemical contamination) and equally thoroughly cleaned;

• Insect producers should thoroughly clean boxes/cages containing insects and equipment destined to provide the substrate and/or the water to the animal between each batch of production.

Such principles should help to avoid or minimise any cross-contamination and errors. Any other technical or organisational measures that are deemed necessary by insect producers to prevent such risks must be taken (respective to the insect farming techniques, e.g. automated, manual, vertical stacking of breeding trays, movement of material, etc). These should include regular checks in the course of manufacture designation and training of staff at the point of distribution in order to prevent cross-contamination.

4.3. Insect growth phase

Photo: Courtesy of Protifarm.
4.3.1. Background information

Besides the composition of the substrate, insect rearing conditions may also contribute to the development of microorganisms (naturally or accidentally) and/or to the presence of chemical contaminants (e.g. transferred via the growing medium) in the final product. Farmed insects, therefore, require an adequate environment and the application of tailor-made techniques that take into account their particular characteristics.

The key parameters to be controlled include:

1. **The temperature:** insect growth rate is indeed heavily influenced by temperature levels. Temperatures between 25°C to 45°C are most beneficial in the majority of cases.

2. **Humidity:** temperatures must correlate with a specific level of relative humidity, depending on the phase of development (e.g. approx. 70% of humidity for Tenebrio Molitor, 50-70 % for Black Soldier Fly and house fly, 90% for crickets and 50% after hatchings).

3. **Enclosed space:** the insect colony must be enclosed and secured to facilitate pest control and prevent livestock escape. It is common to use multiple self-contained spaces, each with its own population, water supply food sources, and space maximisers.

4. **Ventilation:** proper ventilation of the premises is required and must be suited to the species characteristics and projected temperature/humidity levels. This ensures clean rearing conditions and avoids cross-contamination through the air.

Generally speaking, a good understanding of the main insect species (including their different life cycles) used in production activities is necessary for the development of suitable rearing methods and further processing steps.

Owing to the differences that exist between insect species (e.g. in terms of nutritional needs), the chosen substrate or growing environment may differ substantially.
Examples:

- Black soldier flies are typically fed and grown on wet substrates, whereas mealworms (e.g. yellow mealworm and lesser mealworm), or crickets are grown on dry materials;

- Intense light and certain wavelengths may affect both feed intake and pupation of certain insect species: e.g. bright light inhibits the growth of black soldier fly species, and to some extent affects the growth of other allowed species;

- Production equipment used must be shaped and adapted to each species in order to prevent escape risks: e.g. mealworms can be safely raised in open containers, while Black Soldier Fly or Housefly must be stored in closed containers specifically designed to prevent any escapes.

The responsibility lies with each producer to optimise and tailor the rearing conditions according to the specific insect species to ensure that these risks are minimised. Finally, the quality of the insect breeding flocks is an important parameter to take into consideration (see Chapter 3.3.3 for more details).

### 4.3.2. Recommended practices

1. **Insect breeding flock management:**
   First of all, it is recommended to use breeding flocks of a known and traceable origin, that can be traced back for at least 3 generations.

   During the rearing process, insect producers should also maintain consistent population density at each developmental stage and keep records of all breeding flocks (e.g. via a traceability report).

2. **Control of overall growing environment:**

   Farmed insects must be kept in a closed environment, whether in vessels, containers, boxes or cages, where the supply of air and substrate can be well controlled. Appropriate cleaning and sanitary measures should also be undertaken to avoid contamination or spread to diseases among the breeding flocks.

   Insect producers should set up a pest control plan in the growing rooms (e.g. check the absence of pests in the breeding rooms such as protection from invasion of external insects or rodent control, and good conditions of the fixtures). Respective operators and breeders should consider the location of the production site (e.g. close to marshlands, swamps, etc) to identify potential pest invasion.

   *(more details in Chapter 6.4. Pest control measures)*

   Having a register on rearing conditions and supplied raw materials will help to control and monitor that production is between the established limits, to optimise the yield and to guarantee the survival of the livestock (e.g. Conditions temperature, moisture, substrate quantities, conditions of water - pH, hardness). Furthermore, if applicable, the correct and appropriate use as well as traceability, of veterinary medicinal products and feed additives should be maintained.
3. Separation of the insect from its feeding substrate before harvesting:

Different practices are used depending on the species reared, the farming system used or the substrates given to the insects. However, as a general rule, no fresh substrate should be added prior to harvesting: in some cases, insects are being removed from the growing substrate several hours before harvesting.

Examples of practices followed by insect producers are provided below:

1. Mealworms and crickets usually go through a specific practice in the breeding process for intestine cleaning before harvesting (e.g. mealworms can be left 12-24 hours after separation from the substrate to empty intestines before killing);

2. Housefly larvae to be harvested are often isolated from the substrates by lowering oxygen concentration in a closed container, creating an avoidance of substrate intake by the larvae.

4.3.3. Harvesting

4.3.4. Background information

Harvesting operations consist of collecting larvae or adults at the end of the rearing cycle. Insects are removed from the rearing containers or chambers and then separated from the growing substrate and frass.

For holometabolic insects (i.e. mealworms, black soldier fly, housefly) fully grown larvae are harvested, whereas in hemimetabolous insects (e.g. crickets and grasshoppers) animals are harvested at young nymphae or adult stage.
The harvesting method(s) used may, therefore, also differ from one species to another based on their breeding behaviour:

1. Usually, **mealworm larvae** remain in their growing substrate until they are mechanically separated (sieving);
2. **Black soldier fly** larvae may naturally (at a mature level) migrate from the moist substrate to a dry environment, where they can be easily sieved manually or mechanically.

Current sector harvesting practices include:

1. **Mealworm and black soldier fly** larvae are often collected by a sieving procedure (manual or automated);
2. **Cricket adults** are often collected by sieving from the growing substrate or by insect collecting nets.

The responsibility lies with each insect producer to take account of the characteristics of each insect species reared and to design a harvesting process, which enables the effective separation of the larvae or adult insects from their frass, dead individuals and remaining substrates before killing:

1. Most insect producers use **sieving machines** (for larvae) or **‘sorters’** (vertical devices like stackers, cardboard tubes or egg trays for crickets);
2. Hand-selecting insects is also sometimes practiced.

### 4.3.5. Recommended practices

In case the sieving technique is used, the following specific measures are recommended:

- Sieve size (mesh) should enable effective one or two-step separation of insects from frass and the remaining substrate;
- Clean the sieving equipment (e.g. washing, use of appropriate cleaning and sanitation material, drying) thoroughly on a regular basis (between harvests) in order to limit microbiological exchange, the proliferation of larvae from unhatched eggs, or the spread of foreign bodies into breeding insects;
- Equipment, boxes, tools and nets should be cleaned consequently according to respective operators established safety management protocols (GHPs, PRPs, HACCP principles) to avoid contamination;
- In the particular case of volatile feces, operations should separate it from the larvae in a specific confined area, in order to avoid contamination of products in other production lines;
- Collected frass intended for intended for uses such as land fertilisers must be controlled (e.g. microbiological analysis, heavy metals) and stored in a dedicated area. Non-reused frass (e.g. improper for land use/fertilisers) must be disposed of appropriately;
- If wet residual feeding substrate is reused, a drying step should ensure water activity suitable for storage. The operator should identify the acceptable water activity for storage periods that would not encourage microbiological contamination of the substrates meant to be reused.

Besides or in addition to sieving, insect producers are encouraged to use sorting solutions enabling them to efficiently detect and remove foreign materials (e.g. metals or plastic coming from the equipment) or dead insects (e.g. black color larvae).
4.3.6. Pre-treatment step

Pre-treatment steps generally refer to the cleaning and storage of insect post-harvest to prepare or keep them in hygienic (e.g. washing) and appropriate conditions (e.g. chilling) before killing and processing.

Chilling is commonly used by producers, i.e. a pre-treatment step which makes it possible to keep the insects alive while also immobilising them. For example, cold temperatures of 0°C-5°C are often used for black soldier larvae and mealworm, while temperatures between 5°C-10°C are typically applied for crickets. The operator ensures that the temperature remains consistent throughout the process. Such measures provide adequate storage periods to maintain product properties and avoid microbiological contamination.

Chilling can be used prior to freeze-drying the insects. Chilled insects can be stored/transported in containers. The insects have to form a layer of a certain thickness.

4.3.7. Specific case of sourcing/sub-contracting practices

The acquisition of insect larvae, as well as part or totality of the rearing process, can be outsourced or subcontracted.

Suppliers or subcontractors responsible for such activities shall fulfil the same legislative requirements and good hygiene practices as described throughout this chapter (i.e. compliance with Annex I of Regulation 183/2005 and in Annex I of Regulation (EC) 852/2004). Their activities should be monitored through an appropriate vendor/supplier approval system. They should demonstrate their commitment to GHP, the safety of the feed substrates and the delivered products (e.g. ‘in-house’ inspections).

In the case of multi-species facilities (insect rearing and other animal husbandry activities), rooms dedicated to rearing activities and those in which incoming substrates have been sorted must be physically separated from each other to avoid all risks of cross-contamination.
All equipment, vehicles, boxes and tools used in the facilities of such subcontractors must be dedicated solely to insect rearing activities. They must be thoroughly cleaned between batches and not circulated outside of the insect rearing perimeter.

The admission of people to the facilities must be strictly controlled. Workers involved with different animals must not enter the rearing perimeter without clean and dedicated clothing, shoes, gloves and other necessary protective gear.

**Summary of ‘recommended practices or ‘warning points’ associated with insect rearing activities**

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<tr>
<th>Administration of feed/substrates (Chapter 4.2.)</th>
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</thead>
<tbody>
<tr>
<td>1. The traceability of the substrates given to the animals must be ensured;</td>
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<tr>
<td>2. Only use certified food contact equipment to provide the nutrients/substrates to the animal;</td>
</tr>
<tr>
<td>3. Comply with feed preparation formulas;</td>
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<tr>
<td>4. Visually control the truck before unloading and accepting the delivery to detect damaged seals or packaging;</td>
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<tr>
<td>5. Between each batch of production, thoroughly clean the equipment destined to host the insects and/or to provide the substrate to the animal.</td>
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<tr>
<th>During the insects’ growth phase (Chapter 4.3.)</th>
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<tbody>
<tr>
<td>1. Maintain adequate abiotic conditions, especially temperature, light and moisture (taking into consideration the needs of the species);</td>
</tr>
<tr>
<td>2. Register all breeding flocks (e.g. traceability report) and ensure they come from a traceable source;</td>
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<tr>
<td>3. Check overall environmental conditions to ensure the absence of pests in the breeding rooms.</td>
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<tr>
<th>Harvesting (Chapter 4.3.3.)</th>
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</thead>
<tbody>
<tr>
<td>1. Ensure safe and efficient separation of insects from remaining substrates, frass, dead insects and other foreign bodies;</td>
</tr>
<tr>
<td>2. Ensure safe disposal of dead insects, growing substrate and unused frass;</td>
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<tr>
<td>3. Clean thoroughly and regularly the equipment used for harvesting operations;</td>
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<td>4. Implement and record analyses on collected frass.</td>
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CHAPTER 5 – OVERVIEW OF PROCESSING METHODS APPLIED TO INSECTS INTENDED FOR HUMAN CONSUMPTION AND ANIMAL NUTRITION

5.1. Introduction: scope, legal framework and general recommendations

To this end, this chapter is divided into three subchapters:

1. The killing of the animal (various methods are used);
2. The 'post-killing steps' (e.g. freeze-drying/heating);
3. The fat extraction steps (mechanical, chemical).

The different steps or techniques described throughout this chapter are not an exhaustive list of all methods that may be used by operators on the ground.

5.1.1. Background information

This chapter provides an overview of the processing methods involved for insects which are applicable to the production of both animal feed/food for human consumption. The processing methods discussed in this chapter focus on the killing and post-killing steps resulting in insect-derived ingredients (e.g. processed proteins or insect fat). Chapter 7 provides a detailed description to implement HACCP principles for the following processing methods discussed below.
5.1.2. Applicable legislative requirements for insects as feed

The killing of insects and the further processing steps required to produce animal feed are covered by the EU legislation on animal by-products (i.e. Regulation (EC) No 1069/2009 and its implementing Regulation (EU) No 142/2011). Pursuant to Regulation (EC) No 1069/2009, insects and their derived products are treated as ‘category 3’ materials, and are thus authorised for use in feed for food, if being previously processed. The possibilities apply without prejudice to the restrictions which may deriv from the ‘TSE legislation’ (Regulation (EC) No 999/2001). (See chapter 1.1.3 for further details on this subject)

Their categorisation as ‘category 3 materials’ implies a number of consequences as to the legal obligations and safety requirements imposed on producers, including the following:

1. Insect processing establishments must be specifically approved for the processing of killed insects into insect-based ingredients; (see chapter 1.1.1. for more details on this subject)

2. Insect processing establishments shall comply general requirements (see below):

3. Insect producers must conform with common processing standards and/or criteria as defined in Regulation (EU) No 142/2011 (Annex X, chapter II, section 1 B) (see below).

Insect producers of feed must comply with the methods provided for in Regulation (EU) No 142/2011. Insect operators must choose between methods 1 to 5 or method 7, as referred to in Annex IV of the above Regulation:

1. If opting for methods 1 to 5, producers must comply with specific parameters (e.g. reduction of particle size, heat treatment, time and pressure) as defined in Annex IV, Chapter 3, points A to E;

2. If opting for Method 7 operators shall comply with the following conditions (defined in Annex IV, Chapter 3, point G).

• General requirements

The decision of the operator to destine killed insects (e.g. whole insects, insect PAPs or fat derived from insects) for other purposes than human consumption (e.g. feed or for technical uses) should be considered as an irreversible decision, in accordance the provisions of the ABP legislation, i.e. article 2. 1 (b) of Regulation (EC) No 1069/2009.

Furthermore, the operator shall issue an accompanying commercial document and a health certificates indicating the destination of the product, in accordance with article 21 3. of Regulation (EC) No 1069/2009. The latter document shall at least include information on the origin, the destination and the quantity of such products, and a description of the animal by-products or derived products. Article 26 of the above Regulation provides that the treatment, processing or storage of animal by-products (e.g. insect PAPs) shall be done under conditions which prevent cross contamination and if appropriate in a dedicated part of the establishment or plant (e.g. unprocessed materials shall not mixed with insect PAPs).

• Applicable processing methods

General

‘Terrestrial invertebrates’ are classified category 3 materials, pursuant to article art. 10 (l) of Regulation (EU) No 1069/2009. Therefore, insect derived ingredients intended for animal (e.g. insect processed protein, insect fat, hydrolysed proteins, gelatine) must be treated in accordance with validated processing methods (article 31 1. (b) of Regulation (EC) No 1069/2009).

- These methods are defined in Annex IV, chapter III to Regulation (EU) No 142/2011 (method 1-5 or method 7);

- Some specific requirements and/or other processing methods are defined in that same Regulation in the case of fat derivatives (i.e. Annex X, chapter II, section 3), gelatine and hydrolysed proteins (i.e. Annex X, chapter II, section V) as well as collagen (i.e. Annex X, chapter II, section 8).
• Required processing methods for insect PAPs

The insect PAPs must be produced in line with the requirements laid down in Regulation (EU) No 1069/2009 for category 3 materials (i.e. article 13 of Regulation (EU) No 1069/2009 requires that category 3 materials intended as feed for farmed animals or for the manufacturing of pet food are being processed) and notably of article 31 in case of PAPs to be placed on the EU market as feed for farmed animals, or article 35 in the case of pet food.

According to annex X, chapter II, section 1 B 2, PAPs with the exception of fishmeal, must have been submitted to any of processing methods 1 to 5 or processing method 7 (as set out in Chapter III of Annex IV).

• Required processing methods for fat and oil derived from insects

Defined in Annex I (definition 8) to Regulation (EU) No 142/2011 under the terminology of ‘rendered fat’, fat and oil derived from insects must come from insects which have been processed as required for category 3 materials (article 14 of Regulation (EU) No 1069/2009) and follow the production and processing methods 1 to 5 or processing method 7 (as defined in Annex X chapter II, section 3 to Regulation (EU) No 142/2011).

• Required processing methods for hydrolysed proteins from insects

In the case of hydrolysed proteins, the processing facility must be approved as it normally applies for actors processing animal by products in accordance Regulation 1069/2009 (article 24 1 a.). While specific hygiene and processing are foreseen in annexes X (chapter II, section 5) of Regulation (EU) No 142/2011, a specific processing method is required in case of non-ruminant animals (as only method defined for ruminant animals).

The responsibility therefore lies with the operator to demonstrate that the methods allow to reduce risks.

• Specific requirements applying for gelatine and collagen

Some specific hygiene requirements processing standards apply in the case of gelatine and collagen (which may also be provided from insects), as provided respectively in section 5 and 8 in chapter II of annex X to Regulation (EU) No 142/2011).

- Gelatine must be subjected to a treatment with acid or alkali, followed by one or more rinses (section 5 B.). The pH must be adjusted subsequently. Gelatine must be extracted by heating one or several times in succession, followed by purification by means of filtration and sterilisation. Subject to the processes referred to in point 1, gelatine may then undergo a drying process and, where appropriate, a process of pulverisation or lamination;

- Collagen must be produced by a process ensuring that unprocessed Category 3 material is subjected to a treatment involving washing, pH adjustment using acid or alkali followed by one or more rinses, filtration and extrusion. After that treatment collagen may undergo a drying process. (section 8 B);
**Processing method 1 (pressure sterilisation)**

Reduction

1. ‘If the particle size of the animal by-products to be processed is more than 50 millimetres, the animal by-products must be reduced in size using appropriate equipment, set so that the particle size after reduction is no greater than 50 millimetres. The effectiveness of the equipment must be checked daily and its condition recorded. If checks disclose the existence of particles larger than 50 millimetres, the process must be stopped and repairs made before the process is resumed.

Time, temperature and pressure

2. ‘The animal by-products with the particle size of no greater than 50 millimetres must be heated to a core temperature of more than 133 °C for at least 20 minutes without interruption at a pressure (absolute) of at least 3 bars. The pressure must be produced by the evacuation of all air in the sterilisation chamber and the replacement of the air by steam (‘saturated steam’); the heat treatment may be applied as the sole process or as a pre- or post-process sterilisation phase.’

3. ‘The processing may be carried out in batch or continuous systems.’

**Processing method 2**

Reduction

1. If the particle size of the animal by-products to be processed is more than 150 millimetres, the animal by-products must be reduced in size using appropriate equipment, set so that the particle size after reduction is no greater than 150 millimetres. The effectiveness of the equipment must be checked daily and its condition recorded. If checks disclose the existence of particles larger than 150 millimetres, the process must be stopped and repairs made before the process is resumed.

Time, temperature and pressure

2. ‘After reduction the animal by-products must be heated in a manner which ensures that a core temperature greater than 100 °C is achieved for at least 125 minutes, a core temperature greater than 110 °C is achieved for at least 120 minutes and a core temperature greater that 120 °C is achieved for at least 50 minutes. The core temperatures may be achieved consecutively or through a coincidental combination of the time periods indicated.

3. The processing must be carried out in a batch system.’
### Processing method 3

#### Reduction

1. ‘If the particle size of the animal by-products to be processed is more than 30 millimetres, the animal by-products must be reduced in size using appropriate equipment, set so that the particle size after reduction is no greater than 30 millimetres. The effectiveness of the equipment must be checked daily and its condition recorded. If checks disclose the existence of particles larger than 30 millimetres, the process must be stopped and repairs made before the process is resumed.’

#### Time, temperature and pressure

2. ‘After reduction the animal by-products must be heated in a manner which ensures that a core temperature greater than 100 °C is achieved for at least 95 minutes, a core temperature greater than 110 °C is achieved for at least 55 minutes and a core temperature greater that 120 °C is achieved for at least 13 minutes. The core temperatures may be achieved consecutively or through a coincidental combination of the time periods indicated.’

3. ‘The processing may be carried out in batch or continuous systems.’

### Processing method 4

#### Reduction

1. ‘If the particle size of the animal by-products to be processed is more than 30 millimetres, the animal by-products must be reduced in size using appropriate equipment, set so that the particle size after reduction is no greater than 30 millimetres. The effectiveness of the equipment must be checked daily and its condition recorded. If checks disclose the existence of particles larger than 30 millimetres, the process must be stopped and repairs made before the process is resumed.’

#### Time, temperature and pressure

2. ‘After reduction the animal by-products must be placed in a vessel with added fat and heated in a manner which ensures that a core temperature greater than 100 °C is achieved for at least 16 minutes, a core temperature greater than 110 °C is achieved for at least 13 minutes, a core temperature greater than 120 °C is achieved for at least eight minutes and a core temperature greater that 130 °C is achieved for at least three minutes. The core temperatures may be achieved consecutively or through a coincidental combination of the time periods indicated.’

3. ‘The processing may be carried out in batch or continuous systems.’
Processing method 5

Reduction

1. 'If the particle size of the animal by-products to be processed is more than 20 millimetres, the animal by-products must be reduced in size using appropriate equipment, set so that the particle size after reduction is no greater than 20 millimetres. The effectiveness of the equipment must be checked daily and its condition recorded. If checks disclose the existence of particles larger than 20 millimetres, the process must be stopped and repairs made before the process is resumed.'

Time, temperature and pressure

2. 'After reduction the animal by-products must be heated until they coagulate and then pressed so that fat and water are removed from the proteinaceous material. The proteinaceous material must then be heated in a manner which ensures that a core temperature greater than 80 °C is achieved for at least 120 minutes and a core temperature greater that 100 °C is achieved for at least 60 minutes. The core temperatures may be achieved consecutively or through a coincidental combination of the time periods indicated.'

3. 'The processing may be carried out in batch or continuous systems.'

Processing method 7 (refers to) any processing method authorised by the competent authority where the following have been demonstrated by the operator to that authority:

(a) 'The identification of relevant hazards in the starting material, in view of the origin of the material, and of the potential risks in view of the animal health status of the member states or the area or zone where the method is to be used;

(b) 'The capacity of the processing method to reduce those hazards to a level which does not pose any significant risks to public and animal health';

(c) 'the sampling of the final product on a daily basis over a period of 30 production days in compliance with the following microbiological standards.

1. Samples of material taken directly after the treatment: clostridium perfringens absent in 1 g of the products

2. Samples of material taken during or upon withdrawal from storage: Salmonella: absence in 25 g: n=5, c=0, m=0, M=0 Enterobacteriaceae: n=5, c=2; m=10; M=300 in 1 g

where:

n = number of samples to be tested;
m = threshold value for the number of bacteria; the result is considered satisfactory if the number of bacteria in all samples does not exceed m;
M = maximum value for the number of bacteria; the result is considered unsatisfactory if the
Annex X of the above Regulation imposes microbiological targets for the derived products.

**Annex X, Chapter I Regulation (EU) No 142/2011**

The following microbiological standards shall apply to derived products: samples of the final products taken during or on withdrawal from storage at the processing plant must comply with the following standards:

*Salmonella: absence in 25 g: n = 5, c = 0, m = 0, M = 0*

*Enterobacteriacea: n = 5, c = 2, m = 10, M = 300 in 1 g*

where: 
- **n** = number of samples to be tested;
- **m** = threshold value for the number of bacteria; the result is considered satisfactory if the number of bacteria in all samples does not exceed **m**;
- **M** = maximum value for the number of bacteria; the result is considered unsatisfactory if the number of bacteria in one or more samples is **M** or more; and
- **c** = number of samples the bacterial count of which may be between **m** and **M**, the sample still being considered acceptable if the bacterial count of the other samples is **m** or less.

Details of the critical points under which each processing plant satisfactorily complies with the microbiological standards indicated above must be recorded and maintained so the operator and the competent authority can monitor the operation of the processing plant. The information to be recorded and monitored must include the particle size, and, as appropriate the critical temperature, the absolute time, pressure profile, raw material feed rate and fat recycling rate.”
**Substrates for Insects for all applications (food, feed, technical uses)** — Farmed insects qualify as ‘farmed animals’— Article 3 6. of Regulation (EC) 1069/2009

### Feed materials of vegetal origin

<table>
<thead>
<tr>
<th>Authorised</th>
<th>Prohibited</th>
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<tbody>
<tr>
<td>Feed materials of animal origin</td>
<td>The ‘Feed Marketing Regulation’ — Regulation (EC) No 767/2009 Annex III:</td>
</tr>
<tr>
<td>ABP health rules - Regulation (EU) No 142/2011:</td>
<td>Faeces and separated digestive tract content; hide treated with tanning substances; seeds and other plant-propagating materials (treated with plant protection products); wood and their derived products; waste derived from urban, domestic and industrial waste treatment; packaging from agri-food products and parts thereof; protein products obtained from yeasts of the Canadian variety cultivated on n-alkanes.</td>
</tr>
<tr>
<td>- Hydrolysed proteins, fishmeal, collagen and gelatine or blood products derived from non-ruminants (or parts of non-ruminants)</td>
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<tr>
<td>- Hydrolysed proteins from ruminant, hide and skins as well as for all trichloracetic phosphate (including compound feed containing such products)</td>
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### Former Foodstuffs

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<tr>
<th>Authorised</th>
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<tr>
<td>- Without meat and/or fish - only products containing the following ingredients of animal origin:</td>
<td>- manure (Art. 9 (a))</td>
</tr>
<tr>
<td>eggs and egg products; milk, milk-based-products and milk-derived products; honey; rendered fat; collagen; gelatine</td>
<td>- catering waste (Art. 11 1. (b))</td>
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<tr>
<td>*these ingredients must have been previously processed (either prior their intended use as food product or after being requalified as animal-by-product).</td>
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### Residue limits for contaminants and requirements applying to feed additives

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<tr>
<th>Authorised</th>
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<tbody>
<tr>
<td>Feed additives</td>
<td>The ‘Feed Marketing Regulation’ — Regulation (EC) No 767/2009</td>
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<tr>
<td>The ‘Feed Marketing Regulation’ — Regulation (EC) No 767/2009 provides that animals (including therefore insects) bred in the EU may be only be fed with safe feed.</td>
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<tr>
<td>Regulation (EC) No 396/2005 - maximum residue levels of pesticides in feed</td>
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<tr>
<td>Undesirable Substances Directive (i.e. Directive 2002/32/EC)</td>
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<tr>
<td>Only the feed additives which are authorised for all animal species may be used as feed ingredient for insects. — Regulation (EC) No 1831/2003 No specific additives for insects have been defined.</td>
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### Feed materials of animal origin

<table>
<thead>
<tr>
<th>Authorised</th>
<th>Prohibited</th>
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<tbody>
<tr>
<td>Insects as feed - Regulation (EU) No 68/2013 on the Catalogue of feed materials</td>
<td></td>
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<tr>
<td>Insect proteins (under entry 9.4.1. ‘Processed animal protein’)</td>
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</tr>
<tr>
<td>Insect fats (under entry 9.2.1 ‘animal fat’)</td>
<td></td>
</tr>
<tr>
<td>Whole insects (untreated) (under entry 9.16.2. ‘terrestrial invertebrates, dead’)</td>
<td></td>
</tr>
<tr>
<td>Whole insects (treated-e.g. Freeze drying) (under entry 9.16.2. ‘terrestrial invertebrates, dead’)</td>
<td></td>
</tr>
<tr>
<td>Live insects (under entry 9.16.1 ‘terrestrial invertebrates, live’)</td>
<td></td>
</tr>
<tr>
<td>Hydrolysed insect proteins (under entry 9.6.1. Hydrolysed animal proteins)</td>
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</table>

* If product and processing method approved by the national competent authority of the country where the product is being commercialised. ** Limited to Black Soldier Fly (Hermetia illucens), Common Housefly (Musca domestica), Yellow Mealworm (Tenebrio molitor), Lesser Mealworm (Alphitobius diaperinus), House cricket (Acheta domesticus), Banded cricket (Gryllodes sigillatus) and Field Cricket (Gryllus assimilis).

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- Insect PAPs must be produced in processing plants approved in accordance with Article 241(a) of Regulation (EC) No 1069/2009 and dedicated exclusively to the production of products derived from farmed insects — Regulation (EC) No 999/2001; annex IV, Chapter III, section F. 1 (a).
- Insect PAPs must be produced according to processing methods 1 to 5 or processing method 7 (Regulation (EU) No 142/2011, Annex X, Chapter II, section 1 B 2.

No restriction as to the insect species (provided that these are not pathogenic to humans and animals).
5.1.3. Applicable legislative requirements for insects as food

Producers of insects and products thereof that are intended for human consumption must comply with the ‘general’ requirements contained in Regulation (EC) No 178/2002 which lays down the general principles and requirements of food law (‘General Food Law’), Regulation (EC) 852/2004 on the hygiene of foodstuffs and Regulation (EC) No 853/200446 (two definitions in Annex I point 8, Annex II Sections - I on ID marking and IV on Requirements applicable to frozen food of animal origin laying down specific hygiene rules for food of animal origin).

Insects are considered as novel food in the EU and is covered under Regulation (EU) 2015/2283 requiring pre-market authorisations before commercialising these products on the EU market. Operators will also have to comply with the specifications for the authorised edible insects (labelling, hazard limits) as defined in the Regulation (EU) 2017/2470 establishing the Union list of novel foods.

5.1.4. General recommendations

The implementation of GHP throughout the manufacturing process is crucial for the production of food/feed products, to prevent biosecurity as well as health-associated risks.

To this end, insect producers for feed shall refer to the general requirements provided for in Annex II of Regulation (EU) No 183/2005. This Annex sets out the following obligations:

1. Written procedures identifying critical points in the manufacturing process must be established;
2. Measures to monitor the presence of prohibited undesirable substances in the feed are in place;
3. Waste materials must be eliminated;
4. Traceability measures and prevention of cross-contamination;

The main duty lies with insect producers to ensure that the processing method(s) implemented are adequate to achieve the general requirements foreseen in the EU legislation (e.g. processing methods used may differ substantially from one operator to another and/or according to the species reared).

For insects as food business operators must follow Regulation (EC) No 852/2004, article 4.2 lays down general hygiene requirements and applicable specific requirements provided for in Regulation (EC) No 853/2004. Furthermore, Article 5 of aforementioned Regulation, requires food business operators to put in place, implement and maintain a permanent procedure or procedures based on the HACCP principles. Recommendations on implementing HACCP principles for insect as food and feed activities are outlined in further detail in Chapter 7.

46 Footnote: Article 6 (import conditions)
5.2. Killing step

5.2.1. Introduction

The killing of insects can be performed through different methods, depending on the species reared:

1. Farmed mealworms and crickets are often killed with hot water, boiling vapour or freezing.
2. Farmed black soldier flies are often subject to mincing and hot water.

The present Guide provides a non-exhaustive list and description of the techniques that are commonly used by European insect producers.

5.2.2. Heating

Killing by hot water

Killing by heating may be done by plunging insects in hot water (i.e. 'blanching'). The high temperatures in this step allows for an instant death of the insects and destroy microbial flora mitigating microbiological hazards in the product. The killing temperatures vary from one insect species to another, and from their growth status (e.g. for black soldier fly, the temperature applied is usually of minimum 80°C for about 4-6 minutes, for mealworms above 90°C for about 5-7 minutes). It is important to note that not all possible time temperature combinations will result in a sufficient reduction of possible microbiological pathogens. The appropriate combinations must be determined by the operator respective to the species, in addition respective pathogen monitoring protocols should be conducted.

Blanching times will depend on the end product and legislative requirements (See section 5.1.2.). The following conditions should also be considered:

1. The levels of temperatures used;
2. Bacterial spores and their survival on the insects;
3. Any other insects reared in the manufacturing environment.

In case hot water or boiling water treatments are applied, residual water post-treatment should be strictly monitored in order to avoid microbiological contamination before further processing (e.g. before freeze drying, or mincing). In case of unwanted contaminants detected, insect producers could implement necessary corrective measures, in order to mitigate contamination further down in the process line. Furthermore, in accordance to Regulation (EC) No 852/2004, where heat treatment is applied to foodstuffs in hermetically sealed containers it is to be ensured that water used to cool the container after heat treatment is not a source of contamination for the foodstuff.
Other heating techniques used

Other techniques resulting in near-instant deaths, such as microwave, or infra-red tunnels, may also be used. Processing parameters such as time of exposure or thickness of products should be adapted to the species reared. An inadequate heat treatment caused by non-compliance of time/temperature conditions can lead to a bacterial proliferation. The operator shall follow safety standards (e.g. quick cooling methods, motoring water activity, storage conditions) when preparing blanched insects for the next steps (e.g. packaging or grinding) of manufacturing.

Photo: Example of a thermal step. Courtesy of Protifarm.

5.2.3. Freezing

Through freezing the nutritional value of the insects can be maintained until they are further processed. Insects must be killed at temperatures below 5°C, however, most freezers operate at -20°C. Operators using such techniques freeze insects in bulk and set appropriate freezing times to kill the animals. The time varies from one species to another.

Various methods of industrial tunnel freezing are available such as cryogenic, fluidisation, and impingement, using liquid nitrogen/CO2 or cooled air.

Before freezing, insects are chilled and deactivated (see chapter 3.5. for more details), as these methods ensure a consistently high quality of the product.

Frozen insects could be stored in sealed boxes or bags (at -20°C) in order to minimise the loss of mass, prior to further processing.

5.3. Post killing steps

5.3.1. Background information

A number of processing methods may be applied on larvae and/or on adult insects after the killing steps. Referred to in the present Guide as 'post-killing steps', these methods have specific purposes in terms of water, fat or chitin extraction. These steps can be of thermal, chemical or mechanical nature.
5.3.2. Freeze-drying

Freeze-drying is used to remove water from insects before they are ground or milled. This technique consists of maintaining a low temperature to dehydrate the insects using sublimation. The subsequent reduced water activity as well as lower temperatures ensure the low survival and growth microbial flora. This permits an extended shelf life and mitigates microbiological contamination risks for the product under the appropriate storage conditions.

In order to ensure the safety of the product, insect producers must conform with the following procedures:

1. Prior to placing the insects in the freeze dryer, the operator shall ensure that insects are kept away from any potential contamination sources (potential cross contamination during storage before freeze drying, transfer or handling);
2. Freeze-drying temperatures must be maintained throughout the process (the level of temperature required varies according to equipment and processes used);
3. The freeze-drying environment is thoroughly cleaned between two batches.
4. Freeze-dried products are very hygroscopic and ‘attract water’, so if not stored in a closed containers, the water activity of the product may rise again and allow microbial growth.
5.3.3. Heat-based dehydration methods

Depending on the killing method used, larvae or adult insects might still have to be dried in order to remove the water and avoid microbiological contamination. This can be achieved with an oven, where high temperatures are maintained to allow moisture to draw off.

In order to ensure the safety of the product, insect producers must conform to the following procedures:

1. Drying temperatures must be maintained throughout the process to ensure product safety and mitigate any potential microbiological contamination post process (the temperature levels and time required may, however, vary between insect species or the treatment before drying step (e.g. blanching time) and processes used (e.g. oven, microwave).

2. The oven is thoroughly to be cleaned between batches and the residues of killed insects are taken away and disposed of with insect waste.
5.3.4. Grinding

The majority of insect applications in animal feed require a grinding/milling process which transforms the insects into fine particles and a homogeneous powder. Considering the characteristics of the product (powder form), it is susceptible to potential microbiological contamination risk if hygiene practices are not maintained in production. Water activity and storage temperatures should be appropriately monitored (see chapter 7.3.9. Establish monitoring procedures).

The grinding/milling machinery should be cleaned regularly and thoroughly based on its installation (cleaning-in-place (CIP) and cleaning-out-of-place (COP) systems).

5.3.5. Fractioning

Fractioning consists of applying physical, chemical and biochemical processes to extract protein, fat/oil, chitin and derivatives (e.g. chitosan and glucosamine) at the end of the process. To obtain fat/oil mechanical separation (pressing), heat treatment or organic solvents (e.g. supercritical CO2 in low temperatures under high pressure) might be used. The latter method also preserves the nutritional values and bioactivity of the dry protein residues (fully defatted insect meal).

Mechanical separation (pressing) and/or heat treatment is used for oil/fat extraction.

Chitin extraction requires chemical and/or enzymatic processing. Insect producers should identify possible hazards and/or contaminations during the aforementioned processes. Parameters such as mechanical errors, chemicals hazards (residual from cleaning procedures or mechanical leaks) and efficient cleaning methods between batches should be considered among others.
Photo: Mechanical Pressing, Ecolea Technologie
6.1. Introduction: applicable legislative requirements

Producers of insect products for feed use shall refer to the EU feed hygiene provisions regarding storage and transport contained in the EU feed hygiene legislation (i.e. annex II Regulation (EC) No 183/2005). The same legislation applies to them as to any other ‘feed business operator that is active in stages other than primary production’.

<table>
<thead>
<tr>
<th>Regulations and relevant annexes</th>
<th>Aspects operators must cover</th>
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<tr>
<td>Regulation (EC) 183/2005</td>
<td>1. Facilities and equipment</td>
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<td>2. Personnel</td>
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<td>3. Production</td>
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<td>4. Quality control, audit</td>
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<td>6. Record-keeping</td>
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<td>7. Complaints and product recall</td>
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</table>
Similar requirements are foreseen in EU food hygiene legislation for food business producers (Regulation (EC) No 852/2004, annex II’): these should, therefore, serve as relevant source of information for producers of insects intended for food use.

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<thead>
<tr>
<th>Regulations and relevant annexes</th>
<th>Aspects operators must cover</th>
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<tbody>
<tr>
<td></td>
<td>2. Specific requirements in rooms where foodstuffs are prepared, treated or processed</td>
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<td>3. Transport</td>
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<td></td>
<td>4. Equipment requirements</td>
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<td>7. Personal hygiene</td>
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<td>8. Provisions applicable to the wrapping and packaging of foodstuffs</td>
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<td>9. Heat treatment</td>
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<td>10. Training</td>
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The following sections outline a set of concrete recommendations for translating these general requirements into practice.

Furthermore, specifically for food business operators, Commission Regulation (EC) No 1935/2004\(^{47}\) provides a harmonised legal EU framework on the general principles of safety and inertness for all Food Contact Materials (FCMs). The Regulation revolves around the following core principles that require materials to not: release their constituents into food at levels harmful to human health, change food composition, taste and odour in an unacceptable way. FCMs include direct or indirect contact of materials during the production process of insect-based food products (e.g. containers for transporting final insect-based food products, machinery to process food, packaging materials, etc.). Furthermore, specific FCMs could be subject to requirement on import for non-EU countries (e.g. Products originating or consigned from China or Hong Kong). Furthermore, Regulation (EC) No 2023/2006 on Good Manufacturing Practices for materials and articles intended to come into contact with food, ensures that the manufacturing process is well controlled so that the specifications for FCMs remain in conformity with the legislation.

6.2. Recommended practices for storage and transport operations

6.2.1. Premises layout

The layout of the premises is designed to ensure a safe environment and prevent contamination, allow maintenance and minimise deterioration.

Live insects (e.g. often destined to pet food animals or farmed poultry species), should be stored in premises that are designed to avoid any release of the insects into the environment. Furthermore, distinctive storage arrangements should be in place to segregate between treated (slightly processed e.g. washing, freezing) and untreated live insects destined as feed. They should also be kept in a different storage arrangement to avoid cross contamination with processed insects in case the company produces both types of products.

Storage areas shall also be designed or arranged to allow segregation to avoid cross-contamination of raw materials (processed), other ingredients (salt, oil, etc.), flavouring ingredients (relevant for insects as food), packaging, chemicals (e.g. cleaning materials), waste, frass and processed insects. When operators produce both processed insect products and frass, a clear storage differentiation should be maintained.

A separate area for storing materials identified as potentially unsafe shall be provided (e.g. secure storage of cleaning and disinfecting materials). Furthermore, producers should prevent non-dedicated vehicles from parking (e.g. fork-lift trucks, lorries) or circulating in storage areas, where possible.

Dry storage facilities (e.g. used to store dry ingredients, packaging) shall provide protection from dust, condensation, drains, waste and other sources of contamination. They shall be kept dry and well ventilated. The storage areas shall be designed to minimize the risk of product contamination respective to the operator capacities and activity.

The monitoring and control of temperature and humidity shall be applied as required by product or storage specifications. Products should be kept at appropriate temperature such as (e.g. low temperature and humidity to inhibit microbiological growth), considering its composition and potential use, to avoid microbiological contamination.

Cleaning and disinfection agents and other chemicals which are used for hygienic purposes must, if applicable, be stored separately in clearly identified areas. This is to avoid the risk of unintentional contamination or contamination due to negligence.

All materials and products shall be stored off the floor and with sufficient space between the material and the walls to allow inspection and pest control activities to be carried out.

6.2.2. Premises maintenance and cleaning

The storage premises are checked and maintained in accordance with the evaluation procedures detailed in the monitoring programme (see chapter 2.6. for more details on the monitoring programme). Maintenance operations are undertaken by certified and/or qualified agents to ensure adequate functioning of the premises: e.g. to check that humidity levels correspond to the safety standards applicable for storage, functioning of airflow systems.

The storage premises are kept clean under any circumstances (e.g. to ensure that pests do not spread). Each cleaning employee is required to indicate at what time the storage room or storage equipment was cleaned. The employee signs the document when finished with the cleaning operations. The storage handler keeps a book with the number of cleaning operations per day or per week, depending on the needs. It is important to establish a procedure including cleaning and disinfection activities, monitoring of hygiene and prevention of contamination by cleaning (agents). A documented cleaning and disinfection program is recommended to include the following elements: cleaning method, standards, frequency, chemicals used, equipment used,
time and temperature specifications. Records of cleaning and disinfection procedures must be kept. The cleaning and disinfection agents used must be in accordance with the user instructions of the manufacturer and product safety data (information on the potential hazards: health, fire, reactivity and environmental). If cleaning and disinfection agents come into contact with feed/food material, then the responsible personnel must ensure that the control systems always ensure correct and effective levels of dilution of the agents. Only permitted cleaning and disinfection agents must be in contact with food/feed materials. These activities should not form any risk under any circumstances to food/feed materials. It is to be ensured that objects used for cleaning, cleaning agents themselves, do not remain behind without need on/in the cleaned equipment or areas.

A proper ventilation system equips the storage premises to make sure air-flow is constantly renewed in the premises. The storage premises must be ventilated to prevent excess humidity or heat.

### 6.2.3. Control of storage conditions

If insects are intended for food use, raw materials and ingredients shall be stored at the temperatures specified by the food establishment responsible for their manufacture. Storage management of non-insect material should follow the principle of first expired – first out (FEFO).

Material that requires cold storage shall be placed under chilled conditions without any unnecessary delay.

Finished products must be clearly identified and appropriately handled and stored.

Placement of finished products in the warehouse shall be managed according to the principle of first in – first out (FIFO).

A thermometer must be fitted in a prominent position on a wall of the warehouse. Temperature readings must be taken regularly, in order to monitor and take corrective actions, on unwanted deviations in temperatures. A monitoring and maintenance plan should be in place.

Traffic and pedestrianised access arrangements shall be put in place to ensure the safety of the area in order to unintentionally or intentionally cause contaminations to the products. Pedestrianised areas should be clearly marked to avoid accidents and provided directions avoiding restricted access. The traffic and pedestrian access should be for authorised personnel only. These arrangements should be in place where applicable depending on the capacities of the producers. Small holding producers may not directly need to apply traffic arrangements.

### Storage conditions are respective to insect based products and their intended use, some typical examples of the storage conditions are listed below:

1. Dry, cool and closed for insect powders: These products would typically be further incorporated into food or feed formations. Considering its characterises and potential use, such storage parameters are implemented.

2. Frozen storage for whole insects: these products would typically be further used as feed or food. Although they could be further ground or used whole, very low temperatures allow longer shelf life, despite its higher water activity compared to powdered insects.

Producers of insects intended for food use should periodically check the stability of their product during the shelf life period. In case of deviations, there should be a strategic analysis to identify root causes and the appropriate actions to be taken. Any deviation during the shelf life period should be properly documented. (See 7.3.8. Establish critical limits)
6.2.4. Transport operations

This section only concerns transport operations of insect end-products (i.e. killed insects); therefore, it excludes transport of live animals (e.g. breeding stocks or live insects intended for pet food).

6.2.4.1. General requirements and recommended practices

Manufacturers or handlers, whose mission is to transport food and feed products derived from insects, should maintain the same hygiene standards applied throughout the production chain. These operators are, therefore, compliant with legal requirements set in Regulation (CE) No 852/2004 on the hygiene of foodstuffs and Regulation (EC) No 183/2005 laying down requirements on feedstuff (see section 6.1. above for more details).

A few examples of recommended practices are provided below:

- The selection of transports and their activities should be monitored through an appropriate vendor/supplier approval system, demonstrating their commitment to good hygiene practices, especially with their transportation units and workers;
- The transporter shall provide information of the previous shipment and proof of disinfection before insect ingredients are loaded.

Food and Feed business operators shall notify the appropriate competent authority of any establishments under their control, active in transport as laid down by Regulation (EC) No 183/2005 (see Chapter ‘Facilities and Equipment’ and ‘Storage’) and Regulation (EC) No 852/2004 as amended (see annex II - Chapter IV transport: Point 4, 5 and 6).

6.2.4.2. Transport units

Any mode of transport used for transporting food and feed products derived from insects, should be designed appropriately to avoid cross-contamination due to simultaneous or consecutive transport. Transport means must be cleanable and must be made of appropriate material or should be appropriately coated. Appropriate measures to prevent.

The design and manufacture of the transportation units should facilitate inspection, cleaning, disinfection, and when appropriate enable temperature and cooling control. Sanitary requirements are as important in the transport operations as they are in the manufacturing activities.
Upon request by the competent authorities, evidence may be requested to demonstrate that the heating media or cooling system employed has been properly cleaned, evaluated and safely used. Before compartments are loaded, they must be inspected by staff authorised by the operator, the owner or the receiver of the goods (e.g. the truck driver in case of self-service truck stations). An inspection of the loading compartment will be carried out to establish that the loading compartment:

1. Is clean, dry, odourless and correctly maintained;
2. Is compatible with the loading and transport of the specific products;
3. Is suited to the transport needs and forms a closed whole;
4. Does not contain pests and rodents in the widest sense of the term;
5. Does not contain residues or remains from previous loads and/or from cleaning products.

Appropriate measures must be taken to prevent any harmful influence from other products that could arise during loading and transport. This must include consideration of other operations when transporting within a port complex.

Compartments that have been used to transport products regarded as ‘high-risk’ during the previous load must undergo a risk analysis and may be refused. Construction materials shall be selected to prevent contamination of reared insects and of the stored products. Floors, walls and ceilings shall be washable or covered/painted with a washable protective layer. Technologies used for livestock building construction are recommended, including ‘sandwich panel’ etc. Raw timber, and materials with rough surfaces should be generally avoided. The operator should prevent non-dedicated vehicles from parking (e.g. fork lift trucks, lorries) or circulating in storage areas, where possible.

**Summary of ‘recommended practices or ‘warning points’ associated with storing or delivery operations**

<table>
<thead>
<tr>
<th>Food and feed storing temperatures:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Freeze-dried: unchilled</td>
</tr>
<tr>
<td>2. Fresh: 0-7°C</td>
</tr>
<tr>
<td>3. Frozen: -18°C or colder</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food and feed storing temperatures:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Freeze-dried: unchilled</td>
</tr>
<tr>
<td>2. Fresh: 0-7°C</td>
</tr>
<tr>
<td>3. Frozen: -15°C or colder</td>
</tr>
<tr>
<td>4. Dried: ambient temperatures</td>
</tr>
</tbody>
</table>

If the temperature is warmer than above-mentioned limits, the product must be rejected, or Q/A must prove that no damage occurred (e.g. microbiological tests, in case of suspected contamination) to the product due to the fact that was exceeding the above thresholds for the respective period.
Example of elements a Load Compartment Inspection (LCI) module should include:

<table>
<thead>
<tr>
<th>General Information</th>
<th>Product Batch Reference number / Instructing Company representative and Name of personnel / Name of the transporter / telephone number of the transporter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place of inspection</td>
<td>(e.g. Storage unit 1/2/3)</td>
</tr>
<tr>
<td>Load in Kg</td>
<td></td>
</tr>
<tr>
<td>Temperature (if applicable)</td>
<td></td>
</tr>
<tr>
<td>Destination</td>
<td></td>
</tr>
<tr>
<td>Procedure Information</td>
<td>Date / Start time / End time</td>
</tr>
<tr>
<td>Previous cargo in compartment</td>
<td>Last / second last / third last cargo compliant to standards predetermined</td>
</tr>
<tr>
<td>Cleaning</td>
<td>Dry / With water / With water + detergent / With water + detergent + disinfection</td>
</tr>
<tr>
<td>Inspection</td>
<td>Empty</td>
</tr>
<tr>
<td></td>
<td>Clean</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
</tr>
<tr>
<td></td>
<td>Free from pests</td>
</tr>
<tr>
<td></td>
<td>Free from remnants from previous cargo</td>
</tr>
<tr>
<td></td>
<td>Visual: completely intact and fully closing</td>
</tr>
<tr>
<td>Final result</td>
<td>Accepted: Yes/No</td>
</tr>
<tr>
<td>Remarks</td>
<td></td>
</tr>
<tr>
<td>Signatures</td>
<td>Surveyor and transporter</td>
</tr>
</tbody>
</table>

**Summary recommendations of hygiene control measures in respect to transport of insect-based products:**

- Specifications carrier loads to ensure carrier cleanliness and avoid hazard contaminations;
- Specifications carrier loads to ensure adequate product conditions to avoid hazard contaminations;
- Shipping control to ensure package integrity to avoid hazard contaminations;
- Shipping control to ensure presence of harmful pests;
- Document the above measures.

**6.3. Packaging**

Sealing and packaging of insects is a crucial part of the manufacturing process as it contributes to the condition the products will be in when they reach the end-user. Good hygiene, environment, security and quality practices must, therefore, be respected throughout the packaging process to ensure safe food or feed is delivered. To this end, several measures are recommended.

1. The producer using packaging ensures it is clean before insects are placed inside. Where necessary (such as recycled or reused material) it should be disinfected.

2. The producer ensures the packaging is closed immediately.
3. Storage rooms and recipients/containers/vessels are kept clean to avoid development of non-desired pests. Levels of humidity and light exposure are monitored and maintained in accordance with the end-product needs.

4. When sealing the final product, the operator ensures that no external source of contamination (e.g. pests, physical hazards, etc) is included in the sealed bag. If potential risks are identified appropriate measures should be in place (e.g. use of metal detectors in the end of the process lines to detect possible physical hazards originating from the machinery).

5. The packaging material used (i.e. FCMs) must come from a reliable suppliers in order to mitigate chemical, physical and microbiological hazards which could compromise the food/feed safety.

**Summary recommendations of hygiene control measures in respect to packaging of insect-based products:**

- Have certified suppliers for packaging materials receiving records of packaging materials to avoid packaging material contamination (migration analysis of the materials);
- Packaging material conformity for appropriate storage conditions (e.g. frozen products);
- Maintain staff hygiene and attire;
- Set up a cleaning and disinfection plan to avoid chemical residues and microbiological contaminations;
- Develop a quality control plan and preventive maintenance from physical hazards;
- Develop production planning and control to avoid labelling and packaging errors;
- Document the above measures.

**6.4. Labelling**

Edible insect-based food products on authorisation as a novel food, are subject to all provisions of the Food Information to Consumers Regulation (FIC) - Regulation (EU) No 1169/2011. Producers of insects intended for food should indicate on the product label its proper storage conditions, shelf life and intended use of the product.

Please refer to the IPIFF guidance document on food information to consumers for detailed labelling guidance for insect-based food products.

Insects as feed:

1. The rules on the marketing of feed materials and compound feed are established in Regulation (EC) No 767/2009 on the placing on the market and use of feed, and in compliance with the Regulation (EC) No 1069/2009 and Regulation (EU) No 142/2011 (e.g. labelling as Category 3 material, 2011).

2. End products shall be labelled with the legislative 'mandatory labelling particulars', and insect-based food business operators should emphasise on the following:
   - Traceability information (e.g. type of feed, batch or lot number, net quantity, etc.);
   - Instructions for use (e.g. general instructions for use, species and category of target animals, restrictions for certain species, etc.);
   - Feed specifications (e.g. mandatory nutritional constituent, etc).

CHAPTER 7
IMPLEMENTATION OF HACCP PRINCIPLES
BY INSECT PRODUCERS

7.1. Introduction

Food and feed producers use the HACCP (Hazard Analysis and Critical Control Points) approach to anticipate, prevent, eliminate or reduce to acceptable levels physical, biological and chemicals hazards in the food and feed production chain.

Instead of relying on end-product testing, HACCP offers a preventative approach that can be applied to the food chain, from primary production – although not required by EU food and feed hygiene legislation - to the final consumption of the insects irrespective of whether they are intended for food or feed.

A wide range of prerequisite measures are available, however, specific measures to ensure high quality and safety may be required respective to different insect species depending on their biological makeup.

It is important to stress that HACCP systems are company-specific and are based on respective farming, rearing and production techniques followed within the identified company.

Although no significant health problems have arisen from the consumption of edible insects, consumer confidence is arguably strongly correlated with the perceived safety of a given product. The HACCP is, therefore, crucial to ensure edible insects are subject to the highest safety standards possible.

The HACCP elements underlined in the following pages aim to provide a basic guide for HACCP aspects that shall be covered by the industry. The application of HACCP does not apply to primary producers (i.e. insect farming activities), however, they should be aware of the hazards associated with their activities and address them using GHP (see recommendations in earlier sections), which may include hazard monitoring activities. Those establishments that the HACCP applies (after primary production), hazard analysis is expected, subsequently to which Critical control points (CCPs) should be determined and should be concluded that GHPs are sufficient. Operators are also recommended refer to the European Commission notice (2016/C 278/01) on the implementation of food safety management systems covering prerequisite programs (PRPs) and procedures based on the HACCP principles.

Reminder: The implementation of the GHPs described in the first chapters of this Guide is a mandatory prerequisite to the HACCP plan.

7.2. HACCP principles

HACCP is designed to prevent problems before they occur, correct deviations when they are detected and provide all the records for further analysis. It relies on seven principles:

1. Conduct a hazard analysis;
2. Determine the Critical Control Points (CCP) and Operational Prerequisite Programmes (OPRP);
3. Establish critical limits;
4. Establish a system to monitor the CCP and the OPRP;
5. Establish corrective actions to be taken when monitoring indicates that a particular CCP is not under control;
6. Establish procedures of verification to confirm that a HACCP System is working effectively;

Implementing a robust HACCP system can be achieved with twelve sequenced steps:

1. Assemble the HACCP team;
2. Describe the food and its distribution;
3. Identify the intended use and consumers;
4. Develop a flow diagram describing the process;
5. Verify the flow diagram;
6. Conduct hazard analysis (Principle 1);
7. Determine critical control points (CCPs) (Principle 2);
8. Establish critical limits (Principle 3);
9. Establish monitoring procedures (Principle 4);
10. Establish corrective actions (Principle 5);
11. Establish verification procedures (Principle 6);
12. Establish record-keeping and documentation procedures (Principle 7).

The first five steps are preparatory phases to the application of the classical seven HACCP principles.

7.3.1. Assemble the HACCP team

The HACCP team consists of a group of people responsible for applying the HACCP method. They are identified within the company and properly trained to implement, review and maintain the HACCP plan. The team will be in charge of responding to every crisis circumstance encountered related to the respective product(s).

In cases where the formation of the company consists of few personnel (e.g. startups), the HACCP team participant could be outsourced or if within the company, undertake multiple responsibilities whilst fulfilling the required competence of the position.

The team should include multidisciplinary specialists of different levels (field staff and management), related to the insect sector and have the following skills:

1. Understanding of the biological, chemical or physical hazards connected to products for feed and food in the insect sector;
2. Having responsibility for, or being closely involved with engineering/producing/controlling activities;
3. Having sufficient knowledge of the hygiene and safety operations applied to the process plant and equipment;
4. The team lead - HACCP team leader- must be a management representative or have direct access to management.
A representation of a HACCP team for an insect producing company as food and feed is portrayed below.

<table>
<thead>
<tr>
<th>Name</th>
<th>Role HACCP Team</th>
<th>Job title</th>
<th>Organisation</th>
<th>Contribution</th>
<th>Contact email</th>
<th>Approved By</th>
</tr>
</thead>
<tbody>
<tr>
<td>XXXXXXX</td>
<td>HACCP Lead</td>
<td>Chief Operations Officer</td>
<td>XXXX</td>
<td>Select HACCP team, chair HACCP meetings, manage HACCP process</td>
<td><a href="mailto:XXX@xxx.com">XXX@xxx.com</a></td>
<td>XXX XXX</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>Product specialist</td>
<td>Technical Manager</td>
<td>XXXX</td>
<td>Product specifications</td>
<td><a href="mailto:XXX@xxx.com">XXX@xxx.com</a></td>
<td>XXX XXX</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>QMS Team</td>
<td>QHSE Specialist</td>
<td>XXXX</td>
<td>Quality and Hygiene design and implementation</td>
<td><a href="mailto:XXX@xxx.com">XXX@xxx.com</a></td>
<td>XXX XXX</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>Process specialists</td>
<td>Process Operator</td>
<td>XXXX</td>
<td>Operations, working practices specifications</td>
<td><a href="mailto:XXX@xxx.com">XXX@xxx.com</a></td>
<td>XXX XXX</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>Insect rearing expert</td>
<td>Insect rearing expert</td>
<td>XXXX</td>
<td>Insect rearing specifications</td>
<td><a href="mailto:XXX@xxx.com">XXX@xxx.com</a></td>
<td>XXX XXX</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>Entomologist</td>
<td>Entomologist</td>
<td>XXXX</td>
<td>Insect health and characteristic specifications</td>
<td><a href="mailto:XXX@xxx.com">XXX@xxx.com</a></td>
<td>XXX XXX</td>
</tr>
<tr>
<td>XXXXXXX</td>
<td>Additional specialists</td>
<td>Consultant in the food/feed production chain</td>
<td>XXXX</td>
<td>Knowledge in regulations</td>
<td><a href="mailto:XXX@xxx.com">XXX@xxx.com</a></td>
<td>XXX XXX</td>
</tr>
</tbody>
</table>

7.3.2. Describe the product and its distribution

A detailed description of the products must be done to provide a relevant basis for the hazard analysis and ensure a proper assessment of food safety. The following elements should be covered:

1. A description of the feed/food range of products (e.g. Whole insects, protein meal, fat, hydrolyzed proteins);
2. The origin and description of the intakes at rearing or processing level, ingredients, additives as well as their prominent physical properties (Aw, pH, etc.);
3. Processing methods involved (freezing, refrigerating, heating, drying, etc.);
4. Microbiological or chemical criteria applicable;
5. Packaging (e.g. carton, plastic-based materials, vacuum, etc.);
6. The storage conditions, shelf life, delivery methods.

A non-exhaustive example of a product description is illustrated below

<table>
<thead>
<tr>
<th>Name of Product</th>
<th>‘Name of insect species’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life Stage</td>
<td></td>
</tr>
<tr>
<td>Product description</td>
<td>‘insect meal, powder, etc’</td>
</tr>
<tr>
<td>Processing method used</td>
<td></td>
</tr>
<tr>
<td>Category of product</td>
<td>Raw/Semi-finished/Finished product</td>
</tr>
<tr>
<td>Packaging</td>
<td></td>
</tr>
</tbody>
</table>
7.3.3. Identify the intended use and consumers

Considering the applicable regulations for the insect in food or feed, the HACCP team should describe the normal/expected use of the product by customers, and the targeted consumers (humans, pets, farmed fishes, etc.).

1. Describe the expected use;
   E.g. ‘Name of product’ ‘powder/meal’ is a natural balanced source of protein, fat and fibres, obtained by processing ‘name and life stage of insect species’ reared on feed material. The product is a powder/meal typically used at ‘XX %’ for wet/dry pet food/animal feed/fish feed/edible food formulations as a source of proteins and fats.

2. Identify the consumers;
   E.g. Local and International pet food/animal feed/fish feed/edible food market

3. Identify possible misuses.
   E.g. Improper storage conditions, preparation of formulations.

7.3.4. Develop a flow diagram describing the process

The flow diagram acts as a key element for the comprehension of the steps associated with insect processing activities.

Preceding, following or sub-contracted steps might also be considered.

The flow diagram must list the consecutive processes and does not need to be complex (block type flow diagram).

Representation of a flow diagram applicable to insects as food/feed producers and processors based on IPIFF member activities.
1. Killing step: Blanching/mincing, etc (depending on product specifications)

2. Cooling/Thermal processing (depending on product specifications)

3. Mechanical separation/crushing (depending on product specifications)

4. Drying/freezing (depending on product specifications)

5. Packaging

6. Storage

7. Transport

8. Reception of raw materials

9. Storage

10. Unpacking

11. Processing/formulating into food/feed product

12. Mixing

13. Thermal treatment (depending on product specifications)

14. Packaging

15. Storage

16. Transport

17. Transport

Legend: Processing of insects: ■ Processing 2: Integration of processed insects as an ingredient: □
It could be supported or annotated with the following technical data, for a better understanding.

1. Segregation of clean and dirty routes;
2. Equipment layout and characteristics;
3. Sequence of process steps (including the incorporation of feed/ingredients/additives, delays between steps, etc.);
4. Technical parameters of operations (time/temperature at processing or storage of insect ingredients);
5. Flow of semi-finished/finished products, wastes (including potential cross-contamination).

**7.3.5. Verify the flow diagram**

An on-site review shall be conducted to demonstrate the accuracy of the diagram. All process routes including interactions between the personnel, wastes and the product must be investigated.

Evidence of the verification by the food safety team must be documented and recorded.

**7.3.6. Conduct Hazard analysis (Principle 1)**

Hazard analysis consists on the consecutive implementation of the following activities

1. Hazard identification;
2. Hazard evaluation and preventive measures;

**Hazard identification** results in creating the most comprehensive list of hazards which are reasonably likely to occur and cause injury or disease if not effectively controlled.

Different tools can be used by the HACCP team to properly sort hazards at each step of the process (Ishikawa diagram, histories of non-compliances in the company/sector or a list of predefined questions – Appendix A).

An example of using 5 Ms method for the process step (Step 9 in the process diagram portrayed above) on storage of insect sourced raw materials.

<table>
<thead>
<tr>
<th>Material</th>
<th>Insect powder quality, specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Milieu' - Environment</td>
<td>Atmosphere, surrounding areas, pests</td>
</tr>
<tr>
<td>Man</td>
<td>Staff hygiene</td>
</tr>
<tr>
<td>Method</td>
<td>Operating method, cleaning and disinfection plan</td>
</tr>
<tr>
<td>Machine</td>
<td>Installations, transport equipment</td>
</tr>
</tbody>
</table>

Hazards are usually divided into the following categories:

**1. Biological**
- pathogenic microorganisms (Listeria, Salmonella, Bacillus Cereus, Staphylococcus aureus, E. coli), These may originate from
  - contaminated goods
  - water/air used in processing
  - accumulation of biofilms in equipment;
A representation of a HACCP team for an insect producing company as food and feed is portrayed below.

- **Viruses, parasites**
  These may originate from contaminated goods;

- **Yeast and moulds**
  These may originate from contaminated goods;

- **Mycotoxins**
  These may originate from
  - contaminated goods
  - long storage and/or bad storage conditions of the goods.

2. **Chemical**:
   - pesticides (Organochlorine, Organophosphorus, Carbamate) residues on goods;
   - cleaning and disinfection product residues on equipment’s;
   - heavy metals traces on goods;
   - equipment maintenance residues.

3. **Physical**: contaminants such as broken glass, plastic or metal fragments, dead or other types of insect pests, stones.

4. **Allergens (food)**: Allergens from the insect (allergic cross-reactivity between insects and crustaceans) themselves and/or unprocessed or processed insects that may contain allergens(s) originating from the feed materials which were ingested by the insects. Other sources can include products containing allergens used to formulate final product.

These hazards can be introduced, controlled or enhanced (e.g. introduction, survival or multiplication of organisms in the case of microbiological hazards).

Please refer to hazards to be monitored in section 2.6. Monitoring (sampling and analyses).

The second step of the **hazard analysis**, involves a **risk assessment** and the definition of **preventive measures**.

In the risk assessment identified hazard are rated according to:

1. Their severity of harm for the end user of insect-based products;
2. Their probability of occurrence without suitable control measures.

Even though no hierarchy is imposed, severity and occurrence can be rated from 1 to 5. Their multiplication provides an estimation of the overall risk as well as possible responsive actions.

Example of a risk assessment matrix:
Finally, the HACCP team shall describe the control measures required to prevent the occurrence of the hazard, eliminate it or reduce it to an acceptable level. When necessary, an action plan should be set up, details of people in charge and lead-times to implement the control measure (see 3.10 – corrective actions).

Outputs of the analysis can be documented and recorded within a table identifying the potential types of hazards, their causes, the risk of occurrence and proposed control measures for each processing step.

Example of a risk assessment table:

<table>
<thead>
<tr>
<th>Process Stage:</th>
<th>Hazard</th>
<th>Reference number in process diagram</th>
<th>Causes</th>
<th>Risk</th>
<th>Preventive measures</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MONITORING OF TEMP/TIME</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Instruction / training for reception</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Controlled substrate Management (analysis, audits), Testing for pesticides and heavy metal residues.</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Instruction / training on handling</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Instruction / training on monitoring</td>
<td>X</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>Designated closed storehouse for raw material, Implementation of a pest control program, visual control at reception</td>
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</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>MONITORING OF TEMP/TIME</td>
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</tr>
<tr>
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<td></td>
<td></td>
<td>Instruction / training for reception</td>
<td>X</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>Cleaning and disinfection methods</td>
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<tr>
<td></td>
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<td></td>
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<td></td>
<td>Instruction / training on monitoring</td>
<td>X</td>
</tr>
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<td></td>
<td>Instruction / training on reception</td>
<td>X</td>
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<td>Cleaning and disinfection methods</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Requires suppliers of packaging films migration certificates, protected packaging</td>
<td>X</td>
</tr>
</tbody>
</table>
### Packaging

<table>
<thead>
<tr>
<th>Physical</th>
<th>Contaminated goods</th>
<th>Method</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal, plastic, stone pieces in material</td>
<td>X</td>
<td></td>
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</tr>
</tbody>
</table>

### Microbiological

<table>
<thead>
<tr>
<th>Microbiological pathogens</th>
<th>Contaminated product</th>
<th>Material</th>
<th>1</th>
<th>4</th>
<th>4</th>
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</thead>
</table>

### Chemical

<table>
<thead>
<tr>
<th>Cleaning chemicals in material</th>
<th>Cross contamination</th>
<th>1</th>
<th>4</th>
<th>4</th>
</tr>
</thead>
</table>

### Physical

<table>
<thead>
<tr>
<th>Foreign objects</th>
<th>Contaminated product</th>
<th>Method</th>
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<th>4</th>
<th>4</th>
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</table>

### Storage

<table>
<thead>
<tr>
<th>Microbiological pathogens</th>
<th>Contaminated product</th>
<th>Material</th>
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<th>4</th>
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</thead>
</table>

### Transport

<table>
<thead>
<tr>
<th>Foreign objects</th>
<th>Contaminated product</th>
<th>Method</th>
<th>1</th>
<th>4</th>
<th>4</th>
</tr>
</thead>
</table>

### Microbiological

<table>
<thead>
<tr>
<th>Microbiological pathogens</th>
<th>Contaminated product</th>
<th>Method</th>
<th>1</th>
<th>4</th>
<th>4</th>
</tr>
</thead>
</table>

### Chemical

<table>
<thead>
<tr>
<th>Enterobacteriaceae</th>
<th>Contaminated goods</th>
<th>Material</th>
<th>1</th>
<th>5</th>
<th>5</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Salmonella</th>
<th>Contaminated goods</th>
<th>Material</th>
<th>1</th>
<th>5</th>
<th>5</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Moulds and yeasts</th>
<th>Contaminated goods</th>
<th>Material</th>
<th>2</th>
<th>5</th>
<th>10</th>
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</thead>
</table>

### Physical

<table>
<thead>
<tr>
<th>Microbiological pathogens</th>
<th>Staff hygiene</th>
<th>Man</th>
<th>2</th>
<th>4</th>
<th>8</th>
</tr>
</thead>
</table>

### Microbiological

<table>
<thead>
<tr>
<th>Microbiological pathogens</th>
<th>Cleanliness of the reception area</th>
<th>Method</th>
<th>1</th>
<th>4</th>
<th>4</th>
</tr>
</thead>
</table>

### Chemical

<table>
<thead>
<tr>
<th>Heavy metals and Pesticides in raw material</th>
<th>Contaminated goods</th>
<th>Man</th>
<th>2</th>
<th>5</th>
<th>10</th>
</tr>
</thead>
</table>

### Physical

<table>
<thead>
<tr>
<th>Metal, plastic, stone pieces in raw material</th>
<th>Contaminated goods</th>
<th>Material</th>
<th>1</th>
<th>4</th>
<th>4</th>
</tr>
</thead>
</table>

### Pests

<table>
<thead>
<tr>
<th>Pests</th>
<th>Infested goods</th>
<th>Environment</th>
<th>1</th>
<th>5</th>
<th>5</th>
</tr>
</thead>
</table>

### Allergens

<table>
<thead>
<tr>
<th>Allergen cross contamination</th>
<th>Poor storage and mixing raw materials</th>
<th>Method</th>
<th>1</th>
<th>4</th>
<th>4</th>
</tr>
</thead>
</table>

### Control at every stage of the manufacturing process, quality control plan preventive maintenance

### Visual inspection

### FIFO, product monitoring

### Pest control programme. Warehouse and loading areas are dry, locked and secure, under supervision and properly sanitized.

### Check transport conditions, visual inspections (audits, certificates)

### Cleaning and disinfection procedures - Closed production system - Use only feed materials and feed additives according to feed legislation and/or 'private standards' requirements for feeding of foodproducing animals.

### Instruction / training for reception

### Cleaning and disinfection plan

### Controlled reception, Supplier Management (analysis, audits), Testing for pesticides and heavy metal residues.

### Controlled reception, Supplier Management (analysis, audits), raw material analysis

### Designated closed storehouse for raw material, Implementation of a pest control programm, visual control at reception

### The organisation and procedure on storage of raw material
7.3.7. Determine critical control points (CCPs) (Principle 2)

A **CCP (Critical Control Point)** is a step at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level.

All CCPs require control measures, monitoring procedures, responsible staff and records. In addition, CCPs require that measurable critical limits be identified to determine safe and unsafe conditions.

Examples of CCPs may include:
1. Chilling;
2. Thermal processing;
3. Metal detectors in process lines.

The determination of CCPs can be done with a decision tree (see Appendix B, which indicates a logical reasoning approach.

Other significant hazards not identified as a CCP, are defined as **oPRP (Operational Prerequisite Program).**

oPRPs are essential to reduce the likelihood of introducing food safety hazards and/or contamination to the products or the processing environments as well as limiting the proliferation of hazards. These are not part of HACCP rather GHPs to which more attention needs to be paid by monitoring.

oPRPs require control measures, monitoring procedures, responsible staff and records. They do not require that critical limits be set.

As a comparison, CCP must be monitored on a permanent basis (continuously or not continuously), while oPRP are monitored on a regular basis (non-frequent monitoring) but not necessarily on a permanent basis.

Reminder: **PrP** (prerequisite programs) or **GHP** (Good Hygiene Practice) are basic food safety conditions, necessary to implement or maintain a hygienic environment throughout the feed/food chain, suitable for the production, handling and provision of safe end-products. They are the first step to implement before considering a HACCP analysis.

An example of a CCP determination regarding insect as food/feed processing using thermal treatment (Blanching, Thermal treatment, drying) – corresponding to process step 1, 2, 4 in the process chart portrayed above. One or all the thermal treatment steps could be determined as a CCP depending on the processing method used for the specific insect species. For this example, step 1- blanching is considered as a CCP.
**Description of the CCP: Blanching**

<table>
<thead>
<tr>
<th>Description of risk</th>
<th>Unsafe end products by the presence of microbiological contamination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process step</td>
<td>Blanching</td>
</tr>
<tr>
<td>Reference number in process diagram</td>
<td>1</td>
</tr>
<tr>
<td>Type of risk</td>
<td>Temperature and/or time too low with as a result insufficient killing microbiological population</td>
</tr>
</tbody>
</table>

**Control measure**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Heating of the ‘product’ above ‘XX’ °C for a minimum of ‘X’ minutes to guarantee microbiological killing. Also to be considered, that the coldest point of the product mass (which is not necessarily the centre) has been subjected to the required time-temperature combination</th>
</tr>
</thead>
</table>
| Control | • Equipment temperature log  
• Alarm signal in case of temperatures below parameters  
• Insects sampling after blanching treatment for post-mortem inspection: colour verification (visual control)  
• End products sampling for bacteriological analysis (Salmonella and Enterobacteriaceae)  
• Equipment surface examination to ensure efficiency of cleaning and disinfection measures |
| Frequency | • Continuous measurement during production for post-mortem inspection,  
• Continuous monitoring of the log data for equipment time/temperature efficiency, |
| Responsible person | Operator |
| Referral document Control measure | Sr.no.xx. Procedures production: control measure |
| Recording | Paper and/or electronical documentation (quality department document) |

**Corrective Actions in the event of deviations**

| Corrective action | • Action on equipment deviations (time/temperature) and check product temperature  
• After consultation, reheat or dispose |
7.3.8. Establish critical limits (Principle 3)

For each CCP, the HACCP team must determine critical limits and tolerances for monitoring purposes. These limits must be established to ensure that the hazard never exceeds the acceptable level in the finished product. Limits must be measurable, clearly documented and validated.

Example of criteria:

1. Temperature, time or pressure according to processing methods (e.g.: annex 4, chapter 3 of Regulation (EU) No 142/2011
2. Moisture level (Water activity)
3. pH

Example of management of process monitoring during blanching of edible insects

**Operating limit**: Blanching time and temperature is adequate

**Critical Limit**:  
Process parameters  
- Blanching temperature: more than XX°C;  
- Blanching time: more than X min;  
Insect's post-mortem inspection:  
- 100 % of killed dead insects;  
- 0 % of dead black insects;

**Process adjustment**:  
Implementation of verification procedures on equipment efficiency and or staff competency

<table>
<thead>
<tr>
<th>Responsible person</th>
<th>Production Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Referral document</td>
<td>Sr.no.xx. Procedures production: corrective action</td>
</tr>
<tr>
<td>corrective action</td>
<td></td>
</tr>
<tr>
<td>Recording</td>
<td>Paper and/or electronical documentation (quality department document)</td>
</tr>
<tr>
<td><strong>Verification</strong></td>
<td>Paper and/or electronical documentation (quality department document)</td>
</tr>
<tr>
<td>Method</td>
<td>Calibration equipment</td>
</tr>
<tr>
<td>Frequency</td>
<td>Minimum once a year or when in doubt</td>
</tr>
<tr>
<td>Referral document</td>
<td>Sr.no.xx. Calibration report</td>
</tr>
<tr>
<td>corrective action</td>
<td></td>
</tr>
<tr>
<td>Responsible person</td>
<td>Production manager</td>
</tr>
<tr>
<td><strong>Comments</strong></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Method</th>
<th>Calibration equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>Minimum once a year or when in doubt</td>
</tr>
<tr>
<td>Referral document</td>
<td>Sr.no.xx. Calibration report</td>
</tr>
<tr>
<td>Responsible person</td>
<td>Production manager</td>
</tr>
</tbody>
</table>
Corrective action:

Implementation of corrective actions on equipment deviation and product quality.

7.3.9. Establish monitoring procedures (Principle 4)

Monitoring procedures are essential to demonstrate product compliance with specified critical limits and feed/food safety requirements. Respective food/feed business operator, who produces, trades, processes or stores the feed/food material must set up, implement and carry out a monitoring plan, based on the operators own risk assessment for the undertaken activities. Monitoring procedures also facilitate CCP tracking. This enables immediate corrective actions to be taken when a loss of control is noticed and before a critical limit is reached. Observations or measurements of each CCP provide accurate records and written evidence to justify the possible retirement of insect PAPs before they are placed on the market. Each company has its own responsibility and specifies the critical points for its own business situation and determines a minimum sampling plan. A sampling process diagram should be part of the sampling plan. This shows the critical points for the process control.

For Each CCP, the monitoring procedure should include:

1. The description of monitoring methods;
2. Parameters for hazards;
3. Corrective actions if trends indicate a loss of control;
4. When, how and who is performing monitoring and checking.

Staff responsible for the monitoring process must be trained and fully aware of the monitoring techniques for which they are responsible.

Refer to example in 7.3.7. Determine critical control points (CCPs) - Description of the CCP: Blanching
7.3.10. Establish corrective actions (Principle 5)

For each CCP, a pre-established set of corrective actions should be planned to avoid hazardous feed/food from reaching customers.

Corrective actions should include:

1. The identification of people in charge of implementing the corrective actions;
2. The means and methods required to correct the cause of the deviation;
3. The disposition to be taken with the non-compliant product (finished or semi-finished) manufactured during the process deviation;
4. Recording of all context information about the non-compliance and verification checks.

Please refer to the example provided on CCP determination and description - 3.7. Determine critical control points (CCPs) (Principle 2).

7.3.11. Establish procedures of verification to confirm that a HACCP System is working effectively (Principle 6)

Verifications determine the validity of the HACCP system and its ability to operate according to the plan. The proper instituting of verification processes of HACCP plans should be undertaken during its development and implementation, maintenance and upon HACCP System change.

Procedures should be established for verification. Verifications should be handled by persons with appropriate and sufficient expertise. To determine if the HACCP system is working correctly, the verification methods can include random sampling and analysis. Verification frequencies should be enough to confirm that the HACCP system is working effectively. When necessary, this review might result in the amendment of existing procedures. The changes should be incorporated into the documentation and recordkeeping system, to ensure that up-to-date information is available.

Examples of Verification activities include:
- Review of the HACCP system and its records, e.g. via audit and inspection;
- Review of incidents on product recall, complaints;

7.3.12. Establish documentation concerning all procedures and records appropriate to these principles and their applications (Principle 7)

The records kept for HACCP system should include:

1. Records that are generated during the operation of the HACCP system.
2. A summary of the hazard analysis, including the rationale for determining hazards and control measures.
3. The HACCP Plan, including:
   a. A list of the HACCP team and assigned responsibilities;
   b. A description of the finished product, including its distribution, intended use and target consumer;
   c. A list of product ingredients and incoming materials;
d. A plant schematic;
e. A Verified flow diagram;
f. A List of hazards identified;
g. Critical control point determination - decision tree;
h. A HACCP Plan Summary Table that includes information for:
   • Steps in the process that are critical control points;
   • The hazard(s) of concern;
   • Monitoring;
   • Corrective actions;
   • Verification procedures and schedule;
   • Record keeping procedures.

3. Support documentation such as HACCP plan review, verification and validation records.
The following glossary provides the most relevant EU regulatory and non-regulatory definitions applicable to the insect food and feed sectors in the context of good hygiene, security, environment and quality practices.

This section is subject to change, according to the regulatory developments occurring in the food and feed sectors which might impact the insect sector.

1. EU regulatory and non-regulatory definitions

1. **Batch**\(^{49}\): an identifiable quantity of feed/raw material/material/product determined to have common characteristics, such as origin, variety, type of packaging, packer, consignor or labeling, and, in the case of a production process, a unit of production from a single plant using uniform production parameters or a number of such units, when produced in continuous order and stored together.

2. **Biosecurity**: proven procedures and practices to prevent or limit the exposition of the flocks to external biological factors and to minimise farm influence on surroundings.

3. **Critical Control Point (CCP)**: a step at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level.

4. **Cleaning**: the removal of soil, dust, food residue, dirt, grease or other objectionable matter.

5. **CIP**: Clean-In-Place

6. **Competent authority**\(^{50}\): the central authority of a Member State competent to ensure compliance with the requirements of the applicable regulation or any other authority to which that central authority has delegated that competence.

7. **Contamination**\(^{51}\): the presence or introduction of a hazard.

8. **Environment**: the natural world, as a whole or in a particular geographical area, especially as affected by human activity.

9. **Equipment**: any items, machinery used for the purpose of the treating, processing, manufacturing or packing insects for food and feed.

10. **Establishment**: any unit of a feed or food business.

11. **Established breeding lines**: farmed insects have to be kept as established breeding lines in captivity for at least three generations, with traceable well documented origin.

12. **Farmed insect**\(^{52}\): any insect species kept deliberately in established culture, maintained in a controlled environment on a mass scale.

13. **Feed hygiene**\(^{53}\): the measures and conditions necessary to control hazards and to ensure fitness for animal consumption of a feed, taking into account its intended use.

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\(^{49}\) Art 3 2. (r) of Regulation (EC) No 767/2009

\(^{50}\) Art 2 1. (d) of Regulation (EC) 852/2004

\(^{51}\) Art 2 1. (c) of Regulation (EC) 852/2004

\(^{52}\) Art 3(6) of Regulation (EC) No 1069/2009

\(^{53}\) Art 3 (a) of Regulation (EC) 183/2005
14. **Food Contact Materials**: Food Contact Materials (FCMs) are all materials and articles intended to come into contact with food, such as packaging and containers, kitchen equipment, cutlery and dishes. These can be made from a variety of materials including plastics, rubber, paper and metal.

15. **Food safety**: assurance that food is acceptable for human consumption according to its intended use.

16. **Feedingstuff**: means any substance or product, including additives, whether processed, partially processed or unprocessed, intended to be used for oral feeding to animals.

17. **Foodstuff**: ‘food’ (or ‘foodstuff’) means any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans.

18. **Former foodstuffs**: means foodstuffs, other than catering reflux, which were manufactured for human consumption in full compliance with the EU food law but which are no longer intended for human consumption for practical or logistical reasons or due to problems of manufacturing or packaging defects or other defects and which do not present any health risks when used as feed.

19. **Good Hygiene Practices (GHP)**: essential conditions and activities that are necessary to maintain a hygienic environment throughout the food (and feed) chain(s) suitable for the production, handling and provision of safe end-products.

20. **Good quality products**: products which have reached higher quality standards from a safety perspective according to the GHP outlined in this Guide.

21. **HACCP (Hazard Analysis and Critical Control Points)**: a system which identifies, evaluates and controls hazards which are significant for food safety.

22. **HACCP system/plan**: a document prepared in accordance with the principles of HACCP to ensure control of hazards which are significant for food safety in the segment of the food chain under consideration.

23. **Hazard**: a (micro)biological, chemical, physical or allergen agent in, or condition of, food or feed with the potential to cause an adverse health effect.

24. **HESQ**: Health, Environment, Safety and Quality

25. **Insect frass**: mixture of excrements derived from farmed insects, feeding substrate and dead insects or part of insects

26. **oPRP**: an oPRP is identified during the hazard analysis as essential in order to control the likelihood of introducing food safety hazards to and/or the contamination or proliferation of food safety hazards in the product(s) or in the processing environment. oPRPs are defined as a PRP that has a control measure that controls a significant hazard—ISO 22000.

27. **Packaging**: the placing of one or more wrapped foodstuffs in a second container, and the latter container itself which protects the quality of the product.

28. **Prerequisite programme (PRP)**: list of the measures to be undertaken in order to maintain full control of hygiene, biosecurity and quality of farmed insects.

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54 Art 3 4. of Regulation (EC)178/2002
55 Art 2 of Regulation (EC) 178/2002
57 ISO22000:2005
58 FAO, Hazard analysis and critical control point (HACCP) system and guidelines for its application
59 Art 3 14. of Regulation (EC) 178/2002
60 Art 2 1. (k) of Regulation (EC)852/2004 31 Art 2 1. (k) of Regulation (EC) 852/2004
29. **Primary products**: products of primary production including products of the soil, of stock farming, of hunting and fishing.

30. **Primary production of feed**: the production of agricultural products, including in particular growing, harvesting, milking, rearing of animals (prior to their slaughter), or fishing resulting exclusively in products which do not undergo any other operation following their harvest, collection or capture, apart from simple physical treatment.

31. **Processing**: any action that substantially alters the initial product, including heating, smoking, curing, maturing, drying, marinating, extraction, extrusion or a combination of those processes.

32. **Processed animal protein (PAP)**: animal protein derived entirely from Category 3 material, which have been treated in accordance with Section 1 of Chapter II of Annex X (including blood meal and fishmeal) so as to render them suitable for direct use as feed material or for any other use in feedingstuffs, including pet food, or for use in organic fertilisers or soil improvers; however, it does not include blood products, milk, milk-based products, milk-derived products, colostrum, colostrum products, centrifuge or separator sludge, gelatine, hydrolysed proteins and dicalcium phosphate, eggs and egg-products, including eggshells, tricalcium phosphate and collagen.

33. **Processed products**: foodstuffs resulting from the processing of unprocessed products. These products may contain ingredients that are necessary for their manufacture or to give them specific characteristics.


35. **Quarantine**: temporary retirement of breeding flocks in order to eliminate potential risks of contagious factors, parasites transmission or other factors (e.g. risk of inbreeding). This is an important element of biosecurity.

36. **Substrate for insects**: The feed material used to farm insects. Insect producers must only source substrates that are legally authorised as feed for insects within the European Union - rules as defined under the EU Animal-By-Products legislation (i.e. Regulation (EC) No 1069/2009 & Regulation (EU) No 142/2011) and Regulation (EC) No 767/2009 (on the placing on the market and use of feed) - Annex III (prohibition to use manure/animal faeces).

37. **Traceability**: the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution.

38. **Treated insects**: these refer to insects that have undergone treatment after the killing step such as drying or freezing, without changing the nature of the insect as a product.

39. **Processed insects**: these refer to insects that have undergone processing methods such as mincing or grinding that have changed the composition of the product.

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61 Art 21. (f) of Regulation (EC) 852/2004
62 Art 3 (f) of Regulation (EC) 183/2005
63 Art 21. (m) of Regulation (EC) 852/2004
64 Annex I of Regulation (EU) 142/2011
65 Art 21. (0) of Regulation (EC) 852/2004
66 Art 21. (g) of Regulation (EC) 852/2004
67 Art 3 15. Regulation (EC) 178/2002
ANNEX II
LIST OF INSECTS AUTHORISED FOR THE PRODUCTION OF PROCESSED ANIMAL PROTEINS INTENDED AS FEED FOR FARMED ANIMALS (OTHER THAN FUR ANIMALS) WITHIN THE EU

1. Gryllodes sigillatus (Walker, 1869)

Order: Orthoptera; Family Gryllidae

Tropical house cricket, Indian house cricket or banded cricket, native to Southwest Asia, widespread in tropical regions around the world. Due to its high thermal optimum, this species is considered non-invasive in temperate zones.

Adults grow up to 20-22 mm, both male and female have reduced wings, in females only a small scale is visible behind the thorax. Tropical house crickets are light yellow in colour and can be easily distinguished from house crickets by two thick, black bands on the thorax and upper abdomen.

![Figure 1. Gryllodes sigillatus](image)

<table>
<thead>
<tr>
<th>Incubation period (days from egg-laying to hatching)</th>
<th>12&lt;sub&gt;a&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to maturity (days from hatch to max body weight)</td>
<td>33-40&lt;sub&gt;b&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

*<sub>a</sub> = Ivy and Sakaluk (2005)  <sub>b</sub> = McFarlane (1964)*

1. Species are extremely resistant to environmental conditions, and is very productive in mass culture, tolerating the high population density.

2. Protein content in larvae and imagines varies from 60 to 70% (d.m.), with fat content of 20-25% (d.m.) and generally lower chitin content than average crickets.

3. Species is immune to the cricket paralysis virus.

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68 In accordance with point 2 of Part A of Section II of Annex X to Regulation (EU) No 142/2011
2. **Gryllus assimilis (Fabricius, 1775)**

Order: Orthoptera; Family Gryllidae

Jamaican field cricket, tropical species of cricket native to West Indies and Southern part of North America. Due to its high thermal optimum, this species is considered non-invasive in temperate zones.

Adults grow up to 25-28 mm, both sexes are fully winged. Adult females are slightly bigger with prominent ovipositor protruding from the abdomen. Crickets are greyish yellow in colour, more robust than house crickets.

![Gryllus assimilis](image1)

<table>
<thead>
<tr>
<th>Incubation period (days from egg-laying to hatching)</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to maturity (days from hatch to max body weight)</td>
<td>42-49</td>
</tr>
</tbody>
</table>

1. Species is relatively resistant to environmental conditions, and is productive in mass culture, however under high population density it shows a tendency towards cannibalism.

2. Protein content in larvae and imagines varies from 50 to 65 % (d.m.), with a fat content of 25-30 % (d.m.).

3. Contains a high level of chitin.

3. **Acheta domesticus (Linnaeus, 1758)**

Order: Orthoptera; Family Gryllidae

House cricket, native to Southwest Asia, widespread in tropical and temperate zones. Species are native to most of the European countries.

Adults grow up to 20-22 mm, both sexes are fully winged. Adult females are slightly bigger with prominent ovipositor protruding from the abdomen. Crickets are greyish yellow in colour.

![Acheta domesticus](image2)

<table>
<thead>
<tr>
<th>Incubation period (days from egg-laying to hatch)</th>
<th>11&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to maturity (days from hatch to max body weight)</td>
<td>32-49&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> = Nowosielski and Patton (1965) <sup>b</sup> = Ghouri and McFarlane (1958)
1. Species are resistant to environmental conditions, and is very productive in mass culture, tolerating high population densities. The species is however very susceptible to the Cricket Paralysis Virus.

2. Protein content in larvae and imagines varies from 60 to 70% (d.m.), with a fat content of 20-25% (d.m.).

4. **Tenebrio molitor (Linnaeus, 1758)**

   Order: Coleoptera; Family: Tenebrionidae.

   ![Tenebrio molitor Adult, larva, pupae respectively. Photos courtesy of HiProMine.](image)

   **Figure 4. Tenebrio molitor** Adult, larva, pupae respectively. Photos courtesy of HiProMine.

   Lesser Mealworm
   Alphitobius diaperinus
   1-1.2 cm

   Mealworm
   Tenebrio molitor
   1-2 cm

   ![Mealworm species, credits Protifarm](image)

   **Figure 5. Mealworm species, credits Protifarm**

   Known as mealworm, species of the darkling beetles. It has a cosmopolitan distribution, being common in Europe, as a pest of the grain storages.
The adult beetles are up to 15-18 millimeters long. It is shiny black or brown with reddish brown elytra. The eggs are oval, whitish, about 1.5 millimeters long. The larvae resemble larvae of other mealworms, at the final stage measuring up to 25 millimeters in length.

| Incubation period (days from egg-laying to hatching) | 10-12 |
| Time to maturity (days from hatch to adult)          | 280-400 |

1. Species is resistant to environmental conditions, and is very productive in mass culture, tolerating high population densities.

2. Protein content in larvae varies from 50 to 65% (d.m.), with a fat content of 30-40 % (d.m.) highly depending on the feed and rearing conditions.

5. *Alphitobius diaperinus* (Panzer, 1797)

Order: Coleoptera; Family: Tenebrionidae

Known as lesser mealworm or litter beetle, species of the darkling beetles. It has a cosmopolitan distribution, being common in Europe, as a pest of the grain storages and poultry farms.

The adult beetles are 6 millimeters long, oval in shape. It is shiny black or brown with reddish brown elytra. Colour is variable among individuals and subpopulations and changing with age. The antennae are paler at the tips and are covered in tiny, yellowish hairs. The elytra have shallow longitudinal grooves. The eggs are narrow, whitish, about 1.5 millimeters long. The larvae resemble larvae of other mealworms, at the final stage measuring up to 11 millimeters in length.

1. Species are resistant to environmental conditions and is very productive in mass culture.

2. Protein content in larvae varies from 50 to 65% (d.m.), with fat content of 30-40 % (d.m.) highly depending on the feed and rearing conditions.
6. *Hermetia illucens* (Linnaeus, 1758)

*Order: Diptera; Family: Stratiomyidae*

Incubation period (days from egg-laying to hatching) 4

Time to maturity (days from hatch to max body weight) 12-60

* a = Tomberlin et al., 2002

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Black soldier fly, composting fly belonging to the soldier fly family. It is supposedly native to South America but is currently widespread in tropic and temporal zones worldwide. As it requires a high level of UV irradiation and temperatures above 24 °C to mate it must be considered as non invasive species in colder zones.

The adult flies reach up to 15-18 millimeters in length. Adults are black, showing mimicry to wasps. The eggs are round, yellow and about 0.5 millimeters in diameter. The whitish larvae grow up to 25 millimeters in length, going through six instars to reach the brown prepupa stage. Prepupae leave the moist compost environment to seek for a dry place to pupate, that enables efficient separation of the larvae from the substrate. Larvae of the BSF are very efficient composters, being able to digest a whole variety of organic products.

| Incubation period (days from egg-laying to hatching) | 4a |
| Time to maturity (days from hatch to max body weight) | 12-60 |

1. Species grow in a wide range of environmental conditions, and is very efficient in mass culture, tolerating high population densities and being able to complete the life-cycle within 3 weeks.

2. Protein content in larvae varies from 40 to 50% (d.m.), with a fat content of 35-45 % (d.m.) with high lauric acid content. Exact composition highly depends on the feed and rearing conditions.
7. *Musca domestica* (Linnaeus, 1758)

**Order: Diptera; Family: Muscidae**

House fly, most common fly species, with a cosmopolitan distribution, therefore it is a native species in Europe.

![Musca domestica adult and larvae](https://via.placeholder.com/150)

*Figure 8. Musca domestica adult and larvae respectively. Photos courtesy of Amusca.*

The adult flies reach up to 10-12 millimeters in length. Adults are grey to black with four longitudinal dark lines on the back, and the body covered with hair-like protrusions. Eggs are usually laid on decaying organic matter, yellow in colour and about 0.5 millimeters in diameter. After few days of incubation, they hatch into legless white maggots which after two to five days of development transform into reddish brown pupae of ca. 8 mm in length.

<table>
<thead>
<tr>
<th>Incubation period (days from egg-laying to hatching)</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to maturity (days from hatch to max larval body weight)</td>
<td>2-30</td>
</tr>
</tbody>
</table>

1. Species are resistant to a wide range of environmental conditions, and is very efficient in mass culture, tolerating high population densities.

2. Protein content in larvae varies from 40 to 65 % (d.m.), with a fat content of 20-45 % (d.m.). The amino acid profile composition highly depends on the feed and rearing conditions.
ANNEX III

IPIFF CONTRIBUTORS TO THE GUIDE

As members of the IPIFF Task Force on ‘Good Hygiene Principles’, the following companies contributed actively to the development of the present Guide:

HiProMine
Entomo Farm
NextAlim
Protix
Ynsect
Protifarm
Jimini’s
Koppert
Andromeda
NextProtein
Innovafeed
BioBee
Agronutris
Danish Technnological Institute
Mutatec
Agriprotein
Hermetia
Amusca
Entogourmet
Invers
KU Leuven
Entoprotech
Università di Pisa
Entocycle
Enterra
Next-Generation Network
The Members of the **Advisory Group on the Food Chain and Animal and Plant Health** - based on the revised membership established by the European Commission in 2017 - are being consulted on the present Guide. Namely the following stakeholder organisations:

- AESGP: Association of the European Self-Medication Industry
- AIPCE-CEP: European Fish Processors and Traders Association
- ANIMALHEALTH EUROPE
- BEUC: Bureau Européen des Unions de Consommateurs
- CEFIC: European Chemical Industry Council
- CELCAA: European Liaison Committee for Agriculture and agri-food trade
- CLITRAVI: Centre de liaison des industries transformatrices de viande de l’UE
- COCERAL: Comité du commerce des céréales, aliments du bétail, oléagineux, huile d’olive, huiles et graisses et agrofournitures de l’UE
- COGECIA: European agri-cooperatives
- COPA: European farmers
- ECPA: European Crop Protection Association
- ECSLA: European Cold Storage and Logistics Association
- EFFAT: European Federation of Food, Agriculture and Tourism Trade Unions
- EFPRA: European Fat Processors and Renderers Association
- EHPM: European Federation of Associations of Health Product Manufacturers
- ELO: European Landowners’ Organisation asbl
- ENA: European Nurserystock Association
- EOCC: European Organic Certifiers Council
- EPBA: European Professional Beekeepers Association
- EU specialty food ingredients Federation of European Specialty Food Ingredients Industries (previously known as ELC)
EUROCOMMERCE
EUROCOOP: European Community of Consumer Co-operatives
EUROGROUP FOR ANIMALS
FACE: Federation of Associations for Hunting and Conservation of the EU
EU FEAP: Federation of European Aquaculture Producers
FEDIAF : Fédération européenne des industries des aliments pour animaux familiers
FEFAC : Fédération Européenne des Fabricants d’Aliments Composés
FEFANA: EU Association of Specialty Feed Ingredients and their Mixtures
FESASS Fédération Européenne pour la Santé Animale et la Sécurité Sanitaire
FoEE: Friends of the Earth Europe
FOODDRINKEUROPE
FOODSERVICE EUROPE
FRESHFEL Europe: the forum for the European fresh fruits and vegetables chain
FVE: Federation of Veterinarians of Europe
HOTREC: Hotels, Restaurants and Cafés in Europe
IFOAM EU GROUP: International Federation of Organic Agriculture Movements EU Regional Group
INDEPENDENT RETAIL EUROPE Independent Retail Europe (formerly UGAL) - Union of Groups of Independent Retailers of Europe
PAN EUROPE : Pesticide Action Network Europe
PFP: Primary Food Processors SLOW FOOD Slow Food (NA)
SNE : Specialised Nutrition Europe
UEAPME : Union européenne de l’Artisanat et des petites et moyennes entreprises
UECBV : Union Européenne du Commerce du Bétail et de la Viande
APPENDIX A
EXAMPLES OF QUESTIONS TO BE CONSIDERED WHEN CONDUCTING A HAZARD ANALYSIS.

As outlined by the FDA in the ‘HACCP Principles and Application Guidelines’ source (https://www.fda.gov/Food/GuidanceRegulation/HACCP/ucm2006801.htm#impl)

The hazard analysis consists of asking a series of questions which are appropriate to the process under consideration. The purpose of the questions is to assist in identifying potential hazards.

1. Ingredients:
   - Does the feed/food contain any sensitive ingredients that may present microbiological hazards (e.g., Salmonella, Staphylococcus aureus); chemical hazards (e.g. aflatoxin, antibiotic or pesticide residues); physical hazards (stones, glass, metal, packaging material) or prohibited constituents (e.g. prohibited animal proteins)?
   - Are potable water, ice and steam used in formulating or in handling the feed/food product?
   - What are the sources (e.g. geographical region, specific supplier)?

2. Intrinsic Factors - Physical characteristics and composition (e.g. pH, type of acidulants, fermentable carbohydrate, water activity, preservatives) of the food/feed during and after processing.
   - What hazards may result if the food composition is not controlled?
   - Does the food permit survival or multiplication of pathogens and/or toxin formation in the feed/food during processing?
   - Will the feed/food permit survival or multiplication of pathogens and/or toxin formation during subsequent steps in the food chain?
   - Are there other similar products in the market place? What has been the safety record for these products? What hazards have been associated with the products?

3. Procedures used for processing.
   - Does the process include a controllable processing step that destroys pathogens? If so, which pathogens? Consider both vegetative cells and spores.
   - If the product is subject to recontamination between processing (e.g. cooking, pasteurising) and packaging which biological, chemical or physical hazards are likely to occur?

4. Microbial content of the food
   - What is the normal microbial content of the feed/food?
5. Facility design

- Does the layout of the facility provide an adequate separation of the dirty route from the clean route?
- Is the traffic pattern for people and moving equipment a significant source of contamination?

6. Equipment design and use

- Will the equipment provide the time-temperature control that is necessary for safe feed/food?
- Is the equipment properly sized for the volume of feed/food that will be processed?
- Can the equipment be sufficiently controlled so that the variation in performance will be within the tolerances required to produce a safe feed/food?
- Is the equipment reliable or is it prone to frequent breakdowns?
- Is the equipment designed so that it can be easily cleaned and sanitised?
- Is there a chance for product contamination with hazardous substances (e.g. glass, metal pieces)
- What product safety devices are used to enhance consumer safety?
  - metal detectors
  - magnets
  - sifters
  - filters
  - screens
  - thermometers
- To what degree will normal equipment wear affect the likely occurrence of a physical hazard (e.g., metal) in the product?
- Are allergen protocols needed in using equipment for different products?

7. Packaging

- Does the method of packaging affect the multiplication of microbial pathogens and/or the formation of toxins?
- Does the package include instructions for the safe handling and preparation of the feed/food by the end user?
- Is the packaging material resistant to damage thereby preventing the entrance of microbial contamination?
- Are tamper-evident packaging features used?
- Is each package and case legibly and accurately coded?
- Does each package contain the proper label?
- Are potential allergens in the ingredients included in the list of ingredients on the label?
8. Sanitation

- Can sanitation have an impact on the safety of the feed/food that is being processed?
- Can the facility and equipment be easily cleaned and sanitised to permit the safe handling of feed/food?
- Is it possible to provide sanitary conditions consistently and adequately to assure safe feed/foods?

9. Employee health, hygiene and education

- Can employee health or personal hygiene practices impact upon the safety of the food being processed?
- Do the employees understand the process and the factors they must control to assure the preparation of safe feed/food?
- Will the employees inform management of a problem which could impact upon the safety of feed/food?

10. Conditions of storage between packaging and the end user

- What is the likelihood that the feed/food will be improperly stored at the wrong temperature?
- Would an error in improper storage lead to a microbiologically unsafe feed/food?

11. Intended use

- Will the food be heated by the consumer?
- Will there likely be leftovers?

12. Intended consumer

- Is the food intended for the general public?
- Is the food intended for consumption by a population with increased susceptibility to illness (e.g. infants, the aged, the infirmed, immunocompromised individuals)?
APPENDIX B
DECISION TREE FOR CRITICAL CONTROL POINT (CCP) DETERMINATION

SOURCE: ADAPTED FROM CODEX ALIMENTARIUS

**Question 1**
Do preventative measurement(s) exist?

- **Yes**: Modify step, process or product
- **No**: Is control at this step necessary for safety?

**Question 2**
Is the step specifically designed to eliminate or reduce the likely occurrence of a hazard to an acceptable level?

- **No**: Not a CCP or oPRP
- **Yes**: Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could this increase to unacceptable level?

**Question 3**
Could contamination with identified hazard(s) occur in excess of acceptable level(s) or could this increase to unacceptable level?

- **No**: Not a CCP or oPRP
- **Yes**: Will a subsequent step eliminate identified hazard(s) or reduce likely occurrence to an acceptable level?

**Question 4**
Will a subsequent step eliminate identified hazard(s) or reduce likely occurrence to an acceptable level?

- **No**: Not a CCP or oPRP
- **Yes**: CCP or oPRP

**Stop**
Question 5

Does monitoring of control measure allows to detect a loss of control?

Yes → Question 6

Is it possible to apply a critical limit to the control measure?

Yes → CCP

No → oPRP

No