



The potential and risks of insects usage as animal feed – the legislation in European Union and perspective for Serbia

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ABSTRACT

The world's population is going to face with many challenges in order to keep steady balance between growing population and food production in next few decades. Present meat production is dependant on protein sources whose price are continually increasing. In order to decrease dependency of animal production on conventional feeds, there is a strict need for pronouncement of novel foods. Farmed insects have emerged as an excellent candidate as they are easy to breed, do not require a lot of space, and their ecological footprint is low. Taking everything into account, Serbia has the certain potential for developing in this novel farming, as it has many researchers whose work is related to insect biology, animal production and sufficient production of many food substrates which can be used for insect production. Serbia is making significant advance to becoming one of the EU countries so it needs to harmonize its legislation to the one in force in the Union. Accordingly, the purpose of this paper is to provide a review of the existing legislation in the European Union and research papers, making a proposal for future Serbian regulation, concerning the functioning, establishment, and management of insects production facilities.

Key words: insects, feed, legislative, EU, Serbia

Introduction

The reports by FAO (The Food and Agriculture Organization of the United Nations) in 2018 highlighted the expectation that by 2050 the world's population will reach 9.1 billion. Therefore, food production must increase by 70 percent in order to feed this larger, more urban and richer population (FAO, 2018). The other predictions are highlighting that meat consumption is not going to decline, moreover, the global meat production is projected to more than a double, from 229 million tonnes in 1999/2001 to 465 million tonnes by 2050 (Steinfeld et al., 2006; Caparros Megido et al., 2016). After summarising this forecast, it is obvious that this increase will put a lot of pressure in the environment to produce animal products as well as the feed used for animal production. During the last decade, the price of conventional feeds such as soybean meal (Asche et al., 2013), and fishmeals (Deutsch et al., 2007; Olsen and Hasan, 2012; Cashion and Manach, 2017) are increasing. Taking everything into account, there is a strict need for finding novel food sources to overcome the problems and feed the increasing population. According to Pali-Schöll et al. (2018), there are several alternatives that have been proposed: production of algae, fungi, *in vitro* meat, and the insects.

The usage of insects as animal feed

When discussing insect production, there are several advantages which should be emphasized (Halloran and Vantomme, 2013):

- (1) Insects have a high feed conversion efficiency because they are cold-blooded. Feed-to-meat conversion rates (how much feed is needed to produce a 1 kg increase in weight) vary widely depending on the class of the animal and the production practices used, but nonetheless insects are extremely efficient. On average, insects can convert 2 kg of feed into 1 kg of insect mass, whereas cattle require 8 kg of feed to produce 1 kg of body weight gain.
- (2) The production of greenhouse gases by most insects is likely to be lower than that of conventional livestock. For example, pigs produce 10–100 times more greenhouse gases per kg of weight than mealworms.

- (3) Insects can feed on bio-waste, such as food and human waste, compost and animal slurry, and can transform this into high-quality protein that can be used for animal feed. I.e. insects species farmed as a meat alternative such as *Hermetia illucens* L. (Salomone et al., 2016) can be produced on human food waste, which is additional benefit, doing them as a link in a circular economy, where they transform organic waste into useful proteins.
- (4) Insects use significantly less water than conventional livestock. Mealworms, for example, are more drought-resistant than cattle.
- (5) Insect farming is less land-dependent than conventional livestock farming. Generally, space requirements are low because insect are reared in containers piled up on top of each other making them excellent candidates for vertical agriculture production.
- (6) The nutritional content of insects depends on their stage of life (metamorphic stage), habitat and diet. However, it is widely accepted that insects provide high-quality protein and nutrients comparable with meat and fish. Most insect species are high in fatty acids (comparable with fish). They are also rich in fibre and micronutrients such as copper, iron, magnesium, manganese, phosphorous, selenium and zinc.

Insects for animal feed are attracting increasing attention for their potential ability to address some of the most poignant issues threatening our environment. The main reason for this is the high feed conversion efficiency of insects and their ability to feed on various feed sources (van Huis et al. 2013; Halloran et al. 2014).

Research about insects as animal feed has developed rapidly over the past decade. It is not surprising that the number of papers found in this topic from 2000-15 has tripled compared to the last 30 years of 20th century (Sánchez-Muros et al., 2016). A large number of students, professors and scientist from a variety of scientific fields such as entomology, livestock science, protein chemistry, human nutrition, and environmental science have become interested in this new interdisciplinary area.

When discussing insect rearing and its consumption, it is important to emphasize that entomophagy (the consumption of insects as food) has been practiced since the early development of human population. Today, according to Jongema (2017), there is more than 2000 species which are considered as edible and the most important orders are Coleoptera (31% edible species), Lepidoptera – caterpillars (18%), Hymenoptera (14%), Orthoptera (13%), Hemiptera (10%), Odonata (3%), Isoptera (3%), Diptera (2%) and the others (6%). On the other hand, the number of species used a potential source for animal feed or feed ingredient is significantly smaller, as 24 different species of insect belonging to 6 different orders (Blattodea, Coleoptera, Diptera, Isoptera, Lepidoptera and Orthoptera) were evaluated for that purpose. Contrary to previously mentioned percentile of order used as human feed, in case of animal feed order Diptera (48%) and Lepidoptera (29%) are the most dominant, while the share of Coleoptera is only 9%. The species which are predominately used in experiments are yellow mealworm *Tenebrio molitor* L. (Zhao et al., 2016), black soldier fly *Hermetia illucens* L. (De Marco et al., 2015; Barragan-Fonseca et al., 2017), house fly *Musca domestica* L. (Zuidhof et al., 2003; Hussein et al., 2017), silkworm *Bombyx mori* L. (Khan et al., 2016), house cricket *Acheta domesticus* L. (Fernandez-Cassi et al., 2019) etc.

Being in the process of accession to the European Union, Serbia needs to harmonize its legislation to the one in force in the Union. Presently, there are no registered companies for production of edible insects as animal feed in Serbia, nevertheless it is important to lay the foundations for the future and get prepared for the EU accession process.

The aim of our study is to provide a review and short analysis of the existing legislation in the European Union and research documents, making a proposal of the future Serbian regulation concerning the establishment, functioning and management of insects production facilities.

Environmental aspects of insects production

The increasing demand for animal protein is focusing attention on the finding of novel sources of feed protein and their suitability, quality and safety for future supply. A number of initiatives have been taken by a variety of organizations primely FAO, in promoting scientific facts about the utilization of insects as animal feed.

According to the report of Müller et al. (2017) insect biotechnology has been extraordinarily successful in recent years. This is reflected not only in the intensity of research but also in the commercial potential that has become apparent from the increasing number of newly founded companies in this field. The production of proteins and lipids from insects is ecologically desirable as it can be carried out using only secondary resources and it contributes to the conservation of valuable ecosystems.

Although the total environmental impact of insect rearing is still discussed (van Huis et al., 2013), e.g. depending on rearing systems considered, the value of substrates used and of products obtained (Muys and Roffeis, 2014), there is a consensus that insects can be grown on low valuable by-products or organic waste from agriculture and the food industry, producing valuable protein with a nutritive value comparable to soybean meal.

The waste from insect rearing can be used as an organic fertilizer, resulting in a closed circle principle (Sheppard et al., 2002; Newton et al., 2005; Rumpold and Schlüter, 2013b). In comparison to livestock for human consumption, insects are more efficient in converting feed into biomass; they can be reared on smaller surfaces resulting in a higher yield per hectare than common crops such as soybeans, and have an emission of greenhouse gasses and ammonia per kg meat that is lower than for pigs or cattle (Oonincx et al., 2010; van Huis et al., 2013).

Traditional fish feed production is associated with significant green house gas emissions and extensive land usage. By comparison, mass insect rearing produces a small carbon footprint, can utilize organic waste streams as feedstuff, and insect nutritional value for fish is at least equal to that of commercial feed (Swinscoe et al., 2015).

The production of insects species suitable for animal feed

Insect species considered as animal feed all have high levels of protein and moreover amino acid profiles are suitable to be used as feedstuffs (Henry et al., 2015; Makkar et al., 2014; Van Huis and Tomberlin, 2017; Veldkamp and Bosch, 2015). Verbeke et al. (2015) reported that insects are already used in animal feed for aquaculture and poultry in many parts of the world. Insects are a good source of amino acids, fatty acids and micronutrients (Rumpold and Schlüter, 2013a).

In order to ensure cost effective insect based protein production, the ideal insect candidate should have a short reproduction cycle and should be nutritious, providing high concentrations of protein and sulphur containing amino acids. In order to guarantee a constant insect supply, the ideal insect candidate should further be easy to rear in intensive production sites (Hossain and Blair, 2007).

An insect with many positive properties is the black soldier fly, *Hermetia illucens* Linnaeus (Diptera: Stratiomyidae). The species is endemic in tropical and subtropical regions and is also present in southern Europe and parts of the Balkan Peninsula. It can be reared easily in mass cultures on almost all (decaying) organic matter. The commercial potential using insect products is based on the evolutionary success of insects. The black soldier fly, *H. illucens*, illustrates this nicely. The insect is robust and survives under harsh conditions and is remarkably resistant to bacterial infections. This makes mass cultures attractive as it is possible to raise the larvae with low quality feed and yet the feed conversion ratio is high. The high number of eggs, the short life cycle and the simple rearing conditions have made the larvae popular amongst aquarists and terrarium owners who use the larvae as excellent feed for reptiles or fish. The quality of the dried larvae as feed rivals that of soybean meal. *H. illucens* larvae could be used directly as chicken feed without any further processing if it were allowed by law (Müller et al., 2017).

Current studies have focused on the fact that insects from the Diptera order, e.g. the larvae of the housefly and black soldier fly have a great ability to utilize organic waste material (Cickova et al., 2015; Diener et al., 2011) characterized by high moisture content (60–80%), thus converting it to valuable insect protein. This is particularly attractive for feed and waste management industries. Moreover, the feeding of larvae reduces the amount of available phosphorous in the manure by 61–70% and that of nitrogen by 30–50% (Makkar et al., 2014). As a further co-product, the waste residue of manure can be recycled and used as fertilizer.

Besides that, an optimal diet for the most commonly farmed species – *T. molitor* should be based on raw cereal materials (van Broekhoven et al., 2015). Ramos-Elorduy and Pino (2002) and van Broekhoven et al. (2015) demonstrated that *T. molitor* successfully grows and develops on feed including fruit and vegetable waste in various proportions. For mass production, it is necessary to develop automated process technologies for the rearing, harvest and post-harvest procedures, which certainly include the monitoring of product safety and quality (Rumpold and Schlüter, 2013a).

The obstacles for mass insect production

Environmental assessment and sensitivity analysis to guide future prospects Scaling-up of rearing processes remains a key obstacle for industrial production of insects, along with limitations in mass producing eggs and current legislation, as shown by Cickova et al. (2015) on the black soldier fly (*H. illucens*). The environmental performance of insect production systems is not widely reported in the literature (Thevenot et al., 2018).

Another obstacle in regard to edible insect farming is lack of legislation. However, regulatory authorities of some countries have taken position in making competent legislation in order to identify

insect species as most promising candidates based on regional tradition, availability of data on nutrition, toxicity and ease with which such insects can be bred in captivity and processed for marketing (Swinscoe et al., 2015). Today, farmed animals derived proteins are banned for use in feed for ruminant (e.g. cows) and monogastric animals (e.g. pigs and poultry animals). It is expected that EU-regulations will be adapted in the near future and thereafter insect products may also be used as feed material for poultry and pigs (Veldkamp and Eilenberg, 2018).

Safety aspects

Currently, there are significant knowledge gaps about possible risks of insects usage as animal feed. Although the rearing of insects for use in animal feed is believed to be promising, researchers, stakeholders and policy makers are wary of feed safety hazards associated with the use of insects. Several studies and reviews referred to possible chemical and microbiological safety risks, allergenicity risks in animals, or problems of digestibility and palatability, most of which are not yet well understood or fully manageable (Klunder et al., 2012; Rumpold and Schlüter, 2013b; Charlton, 2014; Charlton et al., 2015; Henry et al., 2015). The breeding and rearing of insects might also impact on the biodiversity considering the possibility of accidental release of non-native species (van Huis et al., 2013). The introduction and use of non-native species should therefore be subjected to a risk assessment procedure, which could in part follow that developed for arthropod biological control agents (De Clercq et al., 2011). Alternatively, the focus could be shifted towards the use of native species.

The mass production of insects as feed for fish in the EU is currently limited because of the major knowledge gaps relating to potential pathogen contamination acquired from the environment, and whether these pathogens pose a risk to the fish and, ultimately, to human consumers of the fish (Swinscoe et al., 2015).

EU Legislation - The production of insect proteins as feed for aquaculture

Insects reared within the European Union fall within the category of 'farmed animals' according to the EU animal by-products legislation (Regulation EC, 2009b).

On 24 May 2017 the European Union (EU) authorized the use of insect proteins in feed for aquaculture. The EU Commission formally adopted Commission Regulation (EU) 2017/893 (Commission Regulation, 2017a) which is effective from 1 July 2017. This authorization is limited to a list of seven species, which must be fed with 'feed grade' substrates.

The amendment to Regulation (EC) No 999/2001 (Regulation EC, 2001) with a view to authorize processed animal protein derived from insects for feeding aquaculture animals is likely to open the opportunity for bigger production of processed animal protein derived from insects in the Union. Whereas the current small scale rearing of insects for pet food can adequately be addressed by existing national control schemes, Union provisions addressing animal health, public health, plant health or environmental risks are appropriate to ensure that insect rearing within the Union on a larger scale is safe. With respect to the insect species reared in the Union, these should not be pathogenic or have other adverse effects on plant, animal or human health; they should not be recognized as vectors of human, animal or plant pathogens and they should not be protected or defined as invasive alien species. Taking into account these national risk assessments, as well as the EFSA opinion of 8 October (EFSA, 2015), the following insect species can be identified as those insect species currently reared in the Union which fulfill the abovementioned safety conditions for insect production for feed use:

- (1) Banded cricket, *Grylodes sigillatus* (Walker, 1869)
- (2) Field cricket, *Gryllus assimilis* (Fabricius, 1775)
- (3) House cricket, *Acheta domesticus* (Linnaeus, 1758)
- (4) Yellow mealworm, *Tenebrio molitor* (Linnaeus, 1758)
- (5) Lesser mealworm, *Alphitobius diaperinus* (Panzer, 1797)
- (6) Black soldier fly, *Hermetia illucens* (Linnaeus, 1758)
- (7) House fly, *Musca domestica* (Linnaeus, 1758)

According to the Commission Regulation (EU) 2017/893 (Commission Regulation 2017a) compound feed containing processed animal protein derived from farmed insects must be produced in establishments authorized for that purpose by the competent authority and which are dedicated exclusively to the production of feed for aquaculture animals.

By way of derogation from that specific condition:

- (1) the production of compound feed, containing processed animal protein derived from farmed insects, for aquaculture animals in establishments which also produce compound feed intended for other farmed animals, except fur animals, may be authorized by the competent authority, following an on-site inspection, subject to compliance with the following conditions:
 - compound feed destined for ruminants must be manufactured and kept, during storage, transport and packaging, in facilities that are physically separate from those facilities where compound feed for non-ruminant animals are manufactured and kept,
 - compound feed destined for aquaculture animals must be manufactured and kept, during storage, transport and packaging, in facilities that are physically separate from those facilities where compound feed for other non-ruminant animals are manufactured and kept,
 - records detailing the purchases and uses of processed animal protein derived from farmed insects and the sales of compound feed containing such protein must be kept available to the competent authority for a period of at least five years,
 - regular sampling and analysis of the compound feed destined for farmed animals other than aquaculture animals in order to verify the absence of unauthorized constituents of animal origin using the methods of analysis for the determination of constituents of animal origin for the control of feed set out in Regulation (EC) No 152/2009 (Commission Regulation, 2009); the frequency of such sampling and analysis shall be determined on the basis of a risk assessment carried out by the operator as part of its procedures based on the HACCP (Hazard Analysis Critical Control Point) principles; the results must be kept available to the competent authority for a period of at least five years;
- (2) a specific authorization for the production of complete feed from compound feed containing processed animal protein derived from farmed insects shall not be required for home compounders that comply with the following conditions:
 - they are registered by the competent authority as producing complete feed from compound feed containing processed animal protein derived from farmed insects,
 - they keep only aquaculture animals, and
 - the compound feed containing processed animal protein derived from farmed insects used in their production contains less than 50% crude protein.

The accompanying commercial document or health certificate referred to Regulation (EC) No 1069/2009 (Regulation EC, 2009b), as appropriate, of processed animal protein derived from farmed insects and the label thereof shall be clearly marked with the following words: “processed insect protein — shall not be used in feed for farmed animals except aquaculture and fur animals”.

The following words shall be clearly indicated on the label of compound feed containing processed animal protein derived from insects: “contains non-ruminant processed animal protein — shall not be fed to farmed animals except aquaculture and fur animals”.

Requirements on substrates as feed for insects

Insects as ‘farmed animals’ (Regulation EC, 2009b) may only be fed with eligible materials for farmed animals: i.e. materials of vegetal origin and/or animal origin that are listed in Regulation (EU) No 142/2011 (Commission Regulation, 2011), Regulation EC No 999/2001 (Regulation EC, 2001) and Regulation No 853/2004 Regulation, EC (2004b). Namely: fishmeal, blood products from non-ruminants, di and tricalcium phosphate of animal origin, hydrolyzed proteins from non-ruminants, hydrolyzed proteins from hides and skins of ruminants, gelatine and collagen from non-ruminants, eggs and egg products, milk, milk based-products, milk-derived products and colostrum, honey, rendered fat. However, the feeding of catering waste (Regulation EC, 2009b), “former foodstuffs” containing meat and fish (Regulation EC No 142/2011) or manure/animal faeces (Regulation EC, 2009a) to insects is prohibited on EU territory.

Furthermore, suppliers of insect producers must comply with the requirements of EU feed hygiene legislation (Regulation EC, 2005). This includes being registered as a feed business operator before their national competent authorities and having implemented a HACCP plan.

Animal health and environmental requirements

Insects intended for animal feed have the legal status of “farmed animal”. The general requirements of animal health, therefore, also apply to insects. 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 - Regulation (EU) 2016/429 (Regulation EC, 2016). That means insect species and products thereof shall not:

- (1) be pathogenic or have other adverse effects on plant, animal or human health (“terrestrial invertebrates” and entry “processed animal proteins” of the Catalogue of feed materials (Commission Regulation 2017b);
- (2) be protected or defined as an invasive alien species in accordance with Regulation (EU) 1143/2014 (Regulation EC, 2014). Insects are, however, exempted from the application of the EU animal welfare legislation, which only concerns vertebrate animals (Council Directive, 1998) concerning the protection of animals kept for farming purposes .

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: *Salmonella* spp. and *Enterobacteriaceae* spp. absence in 25 g.

Operators applying to the Regulation, EC, 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 (Directive, 2002) on undesirable substances in animal feed) and physical agents.

“IPIFF” Guide

“IPIFF” (International Platform of Insects for Food and Feed, Brussels, Belgium) Guide for good hygiene practice for EU producers of insects as feed and food (IPIFF, 2019) is a good example of recommended EU regulations which try to cover the whole chain for production of insects intended for animal feeding.

The production of insects as feed for food producing animals, including terrestrial livestock (e.g., poultry and pig species) or farmed fish, as well as feed for pet food animals. Insect products destined for animal feed may concern: live insects, dead whole insects if subject to light treatment steps (i.e., drying), 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).

This Guide is in line with Regulation (EC) No 183/2005 (Regulation EC, 2005) and Regulation (EC) No 852/2004 (Regulation EC, 2004a) which encourage the development of Guides of “GHP” (Good Hygiene Practices) and the application of HACCP (Hazard Analysis Critical Control Point) principles in order to attain a high standard of feed safety. Also, the present Guide may serve as a point of reference for establishing supplementary guides or for developing feed safety assurance systems that apply to insect production activities. The Guide 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 livestock producers. In respect of the above activities, insect producers must comply with the same general safety requirements and “GHP” as Food or Feed Business Operators that are active in other food or feed sectors.

It may be used as a useful reference for production activities taking place outside the EU, without prejudice to the national legislation. In addition, 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.

Overview of legislation in Serbia relating to insects production

Currently, the production of edible insects intended for animal feeding in Serbia is framed only by few restrictive regulations here listed:

- (1) The animal husbandry law (Serbian regulation, 2016)
In this law it is presented the definition of feed for domestic animals, which must be such as to satisfy the basic needs of farm animals which it is intended. The primary production of food for domestic animals is carried out in accordance with the law governing feed safety and regulations adopted on the basis of that law.
- (2) The law on food safety (Serbian regulation, 2019)
In this document it is provided the definition animal feed as any substance or product, processed, partially processed or unprocessed, and is intended for the feeding of animals used for food production;
- (3) The law on veterinary matters (Serbian regulation 2012)
There is only definition of animal feed. Animal feeding stuffs are substances or nutrients of vegetable, animal or mineral origin, in the natural or processed form, fresh or preserved,

secondary products of biosynthesis, products of industrial processing, organic and inorganic matter, which are individually or as a mixture intended for animal feeding.

Yet, an equally precise regulation does not exist in Serbia. Additionally, from the above-mentioned documents of Serbian regulations it is obvious the lack of many important provisions, which exist in EU legislation. Specifically:

- (1) In The animal husbandry law (Serbian regulation, 2016) it is not mentioned any definition of reared insects within the category of “farmed animals” and the list of insect species which fulfill the safety conditions for insect production for feed use.
- (2) In The law on food safety (Serbian regulation, 2019) it is not present any definition of specific conditions which shall apply to the production and use of processed animal protein derived from farmed insects and compound feed containing such processed animal protein intended to be used for feeding aquaculture animals. Also, it is not mentioned any list of requirements on substrates as feed for insects,
- (3) In The law on veterinary matters (Serbian regulation, 2012) there is lack of rules for insect producers, who must comply with animal health and biosecurity measures on transmissible animal diseases. Also, there are not present feed safety requirements and recommended practices according the control of possible bacterial contamination and instruction on periodical testing for the presence of other specific pathogens, including chemicals and physical agents. On the end, there is absent of health certificate form which should be use for processed animal protein derived from farmed insects for dispatch to or for transit through the European Union.
- (4) We expect that the above mentioned list of EU requirements could be a good starting point to draw up a Serbian legislation but, of course, it will be necessary to adapt the existing conditions to the Serbian agricultural vocation, keeping in mind that there are still no existing insect producers in the country. A detailed analysis and a study of feasibility will represent another important step to be taken before the establishment of rearing insects in Serbia.

Conclusion

As can be seen from the above legislation in European Union, there is the insect production regulated in many areas. This refers to the aspect of the functioning, establishment, and management of insects production facilities. Until now, the precise regulations like this does not exist in Serbia, probably due to the lack of insect’s production within the country.

Because of that, we can only recommend that above mentioned list of requirements could be a good starting point for writing of our legislation. The major issues related to the insects production would be the following:

- (1) Insects intended for animal feed have the legal status of “farmed animal”.
- (2) Serbia authorized the use of insect proteins in feed for aquaculture. This authorization is limited to a list of permitted seven species, which must be fed with ‘feed grade’ substrates.
- (3) Compound feed containing processed animal protein derived from farmed insects must be produced in establishments authorized for that purpose by the competent authority and which are dedicated exclusively to the production of feed for aquaculture animals.
- (4) The accompanying commercial document or health certificate of processed animal protein derived from farmed insects and the label thereof shall be clearly marked with the following words: “processed insect protein — shall not be used in feed for farmed animals except aquaculture and fur animals”.
- (5) Insects as ‘farmed animals’ may only be fed with eligible materials for farmed animals: i.e. materials of vegetal origin and/or animal origin.
- (6) The feeding of catering waste, “former foodstuffs” containing meat and fish or manure/animal faeces to insects is prohibited on Serbian territory.
- (7) Suppliers of insect producers must comply with the requirements of Serbian feed hygiene legislation. This includes being registered as a feed business operator before Serbian competent authorities and having implemented a HACCP plan.
- (8) The general requirements of animal health, also apply to insects. Insect producers must comply with animal health and biosecurity measures on transmissible animal diseases.
- (9) Samples of the final products taken during or on withdrawal from storage at the processing plant must comply with feed safety requirements and recommended practices in Serbia.

We expect that the above mentioned list of requirements will meet the necessities of Serbia as it had already happened for other European countries and it will result in a proposal for the future Serbian regulation.

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Potencijal i rizik upotrebe insekata kao hrane za životinje – legislativa Srbije u odnosu na Evropsku Uniju

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SAŽETAK

Svetska populacija se kreće u susret brojnim izazovima u narednim decenijama, a pre svega kako da se održi stabilne ravnoteže između rastućeg broja stanovništva i proizvodnje hrane. Sadašnja proizvodnja mesa je zavisna od izvora proteina, čija cena nastavlja kontinuirano da raste. Kako bi smanjili zavisnost animalne proizvodnje od konvencionalnih hraniva, postoji jaka potreba za uvođenjem "nove hrane". Farmski gajeni insekti postali su idealni kandidati za to, obzirom da se lako uzgajaju, ne zahtevaju veliki prostor a i mali im je uticaj na životnu sredinu. Uzevši sve u obzir, Srbija ima dovoljni potencijal za razvoj u ovom savremenom farmskom uzgoju, obzirom da se mnogo istraživača bavi biologijom insekata i animalnom proizvodnjom, a raspolaže i sa dovoljnom proizvodnjom različitih substrata (hraniva) koji se mogu koristiti za proizvodnju insekata. Srbija će u tome imati značajnu prednost kada postane članica EU, i zato je neophodno da usaglasi svoju legislativu sa važećom u EU. Zato je cilj ovog rada da prikaže pregled postojeće legislative u EU i naučnih istraživanja, kako bi uradili predlog buduće regulative Srbiji, vezano za funkcionisanje, osnivanje i upravljanje kompanijama za proizvodnju insekata.

KLJUČNE REČI: jestivi insekti, životinje, regulativa, EU, Srbija

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