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### Safety assessment: from fruit and vegetable waste to earthworm as feed sources

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The protein supply of farm animals is a central topic in Europe due to the reliance on imported protein, particularly soy products. On the other hand, livestock producers are in demand of sustainable, healthy and safe protein feed. Thus, it is necessary to develop sustainably feed innovations with a high level of safety. At the same time, food waste has already been recognised as an important global issue. From the environmental point of view, food waste has led to unnecessary exploitation of natural resources. Reduction of food waste is a key driver towards sustainable productive solutions and among the possibilities to achieve this goal, in this study is explored the recycling of fruit and vegetable waste (FVW) as growth substrate for producing fresh earthworms then processed into dried meal. The dried meal is assumed adoptable for feed alternative purposes. These topics are included in the philosophy of the circular economy. The safety and security assessment of the derived earthworm meal as future-generation feedstock is the aim of this study.

In order to consider safety aspects of earthworms grown on FVW as future-generation feedstock, this study evaluated the microbiological quality and chemical contaminants of FVW (i) used as growth substrate; fresh earthworms (ii) and earthworms' meal (iii) resulting from drying processes. The sampling and the analysis methods were carried out taking into account the Regulation (EC) No 152/2009 which laid down the methods of sampling and analysis for the official control of feed. The undesirable substances studied were: nitrites, the presence and the level of contamination of mycotoxins, pesticides, heavy metal and microbiological parameters.

Microbiological analyses revealed the absence of *Salmonella* spp. and *Listeria monocytogenes* in FVW, in fresh earthworms and in earthworms' meal. Microbial contamination was below the limit considered for animal feed. Analysis of persistent organic pollutants (POPs) and pesticides were also conducted showing the conformity of earthworms according to feed safety criteria used for food-producing animals. From this result, earthworms' meal can represent a safe future-generation feedstock with improved sustainability in order to reduce the dependence on imported soybean as protein source.

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### Honey bee pollen inclusion in diets for meagre (*Argyrosomus regius*) juveniles: effects on growth performance and body indexes

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Previous researches have highlighted positive characteristics of honey bee pollen (HBP), such as its strong antioxidant activity through its constituent flavonoids and the positive effects on non-specific immune responses and growth performances of various animal species. Despite these favourable characteristics no researches have been carried out to evaluate the effects of the inclusion of pollen in diets for marine fish species. Thus, the aim of the trial was to evaluate the inclusion of increasing levels of commercial honey bee pollen in diets for meagre (*Argyrosomus regius*) and its effects on growth performance and body indexes. The experiment was conducted at the IMBRC of the Hellenic Centre for Marine Research (Crete, Greece). At the beginning of the trial, 360 fish were lightly anaesthetised, individually weighed ( $3.35 \pm 0.1$  g) and randomly divided into 12 fibreglass tanks (3 replicates/diet) supplied by open-circulation borehole aerated sea water.

Four experimental diets were formulated to be isonitrogenous and isoenergetic: HBP0 (without HBP), HBP 1, HBP 2.5 and HBP 4 (with 1, 2.5 and 4% of HBP inclusion level, respectively). At the end of trial (89 days), the following performance indexes were calculated: individual weight gain (WG % IBW), specific growth rate (SGR), feed conversion ratio (FCR), protein efficiency ratio (PER). Twelve fish per treatment were killed by over anaesthesia and individually weighed. Fish length was measured to calculate the Fulton's condition factor (K). The fish were dissected to determine the hepatosomatic index (HSI), viscerosomatic index (VSI) and the gut length. All data were processed by ANOVA (SAS). The orthogonal contrast analysis was also performed to test the linear, quadratic and cubic effect among the means. All the growth parameters were significantly influenced by the diet. Feed intake increased as pollen inclusion in the diet increased ( $p < .01$ ), while final weight ( $p < .0001$ ), FCR ( $p < .001$ ), SGR ( $p < .01$ ), PER ( $p < .001$ ) and WG %ABW ( $p < .01$ ) were negatively linearly affected by