NUTRIENT AND ENERGY DIGESTIBILITY OF INSECT MEAL IN SEA BASS

Black soldier fly (Hermetia illucens) larvae © Dennis Kress

SUMMARY

This study evaluated and compared the nutrient and energy digestibility of sea bass diets in which 30% of fish meal was replaced by proteins from the insects *Tenebrio molitor*, *Hermetia illucens*, *Musca domestica*, *Zophobas morio* or *Alphitobius diaperinus*. The results indicate that the inclusion of *Musca domestica* and *Tenebrio molitor* had no adverse effects on the digestibility of the diets, and that fish meal can be successfully substituted by those insects in the diets of European sea bass at 30% replacement level. This study will be of particular interest to aquafeed producers who wish to use insects as an alternative food source.

KNOWLEDGE NEED

Fish farmers rely on sustainable feed that can make fish strong and healthy. The aquaculture industry is looking for alternative feed sources because the supply of key ingredients of fish feed found in fish meal and fish oil is limited. However, completely replacing these feed sources in a fish's diet can lead to adverse effects on its health, including decreased digestion efficiency and increased susceptibility to diseases and stress. Alternative fish feed sources with high biological value and low competitiveness with human food are needed, and their safe substitution levels must be established.

Common housefly (Musca domestica) larva © Pavel Krok

POTENTIAL IMPACT

- Substituting sea bass (and other species') diets with insect meal reduces the need for fish meal and oil, which are costly, volatile, and unsustainable sources, potentially leading to a more sustainable and competitive aquaculture sector.
- The establishment of insect meal as a suitable feed substitution for sea bass opens the door for further research into its applicability for other aquaculture species.
- The findings could contribute towards improving ecological and social sustainability of fish feeds, especially if applied to multiple species.

EATiP – Strategic Research and Innovation Agenda (SRIA) Thematic Area 4 - Sustainable Feed Production: Goal 1, Goal 2 and Goal 3; Thematic Area 2 - Technology & Systems: Goal 1. To see the full list and descriptions of the thematic areas and goals, please visit: **eatip.eu/?page_id=46**

UNDERLYING SCIENCE

This experiment evaluated and compared the nutrient and energy digestibility of diets in which 30% of fish meal was replaced by proteins from the insects *Tenebrio molitor*, *Hermetia illucens*, *Musca domestica*, *Zophobas morio* or *Alphitobius diaperinus*. 18 groups of 15 fish were placed into 18 indoor 250L cylindroconical tanks equipped with a settling column. Diets were designed to be isoproteic (containing comparable amounts of protein) and isoenergetic (containing comparable amounts of energy) and to meet the nutrient requirements of sea bass. The apparent digestibility coefficients (ADCx), which provide estimates of nutrient availability in feedstuffs, were determined using 1% celite® as an inert marker. The nutrients examined were dry matter, organic matter, crude protein, crude fat, acid detergent fibre and energy.

RESULTS

- The diets containing *Musca domestica* and *Tenebrio molitor* showed overall digestibility similar to each other and to the one of standard fish meal (without insect replacement).
- Despite the poor digestibility of the *Zophobas morio* diet in terms of dry matter, organic matter and energy, the protein and fat digestibility were similar to standard fish meal.
- Acid Detergent Fiber (ADC_{ADF}), the fraction of the diet containing chitin from the insects but also lignin from plant ingredients, was significantly higher in *Zophobas morio* and *Alphitobius diaperinus* diets. Some studies have shown that chitin can interfere with fat digestibility, however in the present study no differences were found in ADC_{CF}.
- Overall, the results indicate that the inclusion of *Musca domestica* and *Tenebrio molitor* meal had no adverse effects on the digestibility of the diets and that fish meal can be successfully substituted by those insects in the diets of European sea bass at a level of 30% replacement.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: Sea bass fish feed producers
APPLICATION: Developing and producing novel feed formulations based on alternative, safe and sustainable feed sources (like insect meal) with high biological value and low competitiveness with human nutrition.

END-USER 2: Sea bass farmers
APPLICATION: Feeding of aquaculture fish stocks with more sustainable (and potentially cheaper) fish feeds while keeping good production levels, leading to higher profits and reduced impact on the environment.

END-USER 3: Aquaculture marketing and lobby groups
APPLICATION: Supporting a sustainable, dynamic image of the aquaculture sector, working towards improving global food security while decreasing environmental impact.

END-USER 4: Aquaculture researchers
APPLICATION: Furthering knowledge relating to fish meal replacement and its effect on nutrient digestibility in sea bass and other fish species.

STATUS

Technology Readiness Level (TRL) 4 – the knowledge has been validated in a laboratory environment.

Further research is needed to:

- Establish the precise optimal *Musca domestica* and *Tenebrio molitor* substitution rate in sea bass diets.
- Investigate further effects of the *Musca* and *Tenebrio* diet substitution on other crucial elements such as digestive organs and their tissues, and microbiota composition.
- Understand changes in susceptibility to stressors under different diet compositions.
- Explore suitability for other species and/or life stages.
- Examine potential effects on the fish product, e.g. on texture, odour and taste.
- Perform feeding trials on a commercial scale (i.e. validated and demonstrated in an industrially relevant environment).

AT A GLANCE

TITLE: Nutrient and Energy Digestibility of Insect Meal in Sea Bass
KNOWLEDGE TYPE: Exploitable scientific result
WHERE TO FIND IT: Contact the output owner (details below)
STATUS: In progress
TNA FACILITY USED: Hellenic Centre for Marine Research (HCMR), Greece
CONTACT DETAILS: Stavros Chatzifotis, HCMR, Greece, stavros@hcmr.gr
PATENTS OR OTHER IPR EXPLOITATIONS: No

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