Question to EURCAW-Aqua: Welfare impacts for decapod crustaceans being dipped live in various solutions

Question received: 9 December 2024
Question answered: 21 March 2025

EURCAW-Aqua received the following query from an NCA in one of the Member States.

Information and background context provided by the solicitor

According to EFSA [1] the largest decapod crustaceans have complex behaviours and appear to have some degree of awareness. For instance, they experience pain and are capable of learning. EFSA therefore recommends that these animals should be in Category 1[1]. For animals in this category, scientific evidence clearly indicates, either directly or by analogy, with animals in the same taxonomic groups that these animals are able to experience pain and distress, and therefore should receive protection against pain and suffering, when used for experimental and scientific purposes.

A preservation method used in the fishery Norwegian lobsters (*Nephrops norvegicus*) involves dipping the live animals in a solution containing sulphite to minimize pigmentation and to prevent growth of bacteria. However, the potential animal welfare consequences of this method are unknown to the National Competent Authority (NCA) that send the query. Similarly, dipping lobsters (*Homarus gammarus*) in solutions containing other types of additives, such as 4-hexylresocrinol (E 586, antioxidant) also raises concerns.

Question

> *"The NCA kindly requests EURCAW-Aqua's scientific opinion on the welfare impacts of these methods. Your answer should specifically describe the welfare impacts for these decapod crustaceans (primarily lobsters and Norwegian lobsters) of being dipped live in solutions containing sulphites or other types of additives and whether these methods are considered acceptable in terms of animal welfare".*

Experts from EURCAW-Aqua wrote a reply. The EURCAW secretariat did the final editing.

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[1] Category 1 - "The scientific evidence clearly indicates, either directly or by analogy with animals in the same taxonomic groups, that animals in those groups are able to experience pain and distress"

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ANSWER

Capture fisheries and aquaculture lobsters' production

EURCAW-Aqua addresses challenges in aquatic animal welfare by developing and disseminating knowledge and tools to aid Member States in official controls. It focuses on farmed fish, and decapod crustacea species across diverse farming systems and environments.

Aquaculture production of lobsters in Europe is relatively limited, with most lobsters sourced through capture fisheries rather than farming [2]. Capture fisheries play a significant role in supplying lobsters across Europe, with United Kingdom leading fisheries, holding a dominant share of 47.76% of the market in 2023, followed by France with 15.31% and Denmark with 11.8%. Specific data on lobster aquaculture production volumes by country are scarce, indicating that lobster farming is not a widespread practice within the European Union (EU). A Norwegian lobster farm [3] has established a commercial-scale land-based farming of lobster juveniles and plate-sized lobster (20 cm, 250-300 g) with an annual production capacity of around 3 metric tons. In United Kingdom, the National Lobster Hatchery [4] (Padstow, England), since its opening in 2000, has released over 100,000 juvenile European lobsters (*Homarus gammarus*) into the wild between 2000 and 2014, aiming to enhance local lobster populations and support coastal fishing communities. Whitby Lobster Hatchery (North Yorkshire, UK), launched in 2021, aims to release approximately 100,000 juvenile lobsters annually into the North Sea [5]. The Firth of Forth Lobster Hatchery [6] (North Berwick, Scotland), established in 2010, focuses on enhancing lobster stocks to support local fishing traditions, on providing educational programs to raise awareness about marine conservation, and on providing juvenile lobsters to research organisations. Farming of European lobster in Iceland, using natural geothermal sources was recently reported [7].

Pain perception in the European and Norwegian lobsters

Research specifically on pain perception in the European (*Homarus gammarus*) and Norwegian (*Nephrops norvegicus*) lobsters is limited. However, studies on decapod crustaceans, a group that includes lobsters, crabs, and shrimps, provide insights that may be relevant.

In invertebrates, several studies revealed a neuroendocrine system analogous to the hypothalamic-hypophysial system of vertebrates with substances closely resembling vertebrate neuropeptides and hormones [8]. In a study reviewing potential pain experiences in both fish and decapods, it highlighted that responses in these animals go beyond simple nociceptive reflexes, suggesting central processing and a possible experience of pain [9]. Crustacean responses to noxious stimuli (such as tissue damage, heat, acid, alkaline, or electric shock) show many of the traits seen in vertebrates [10,11]. In a review by Broom [12], it was stated that: "*there is evidence from some species of fish, cephalopods and decapod crustaceans of substantial perceptual ability, pain and adrenal systems, emotional responses,*

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long- and short-term memory, complex cognition, individual differences, deception, tool use, and social learning. The case for protecting these animals would appear to be substantial".

Collectively, several studies indicate that decapod crustaceans, including species like lobsters, are sentient beings [13], that may possess the capacity to experience pain. However, more targeted research at the species level [12] is needed to have robust validation about its pain perception.

Dipping live lobsters into solutions containing sulphites or other types of additives

The practice of dipping live shellfish, particularly shrimp and prawns, in sulphite solutions is relatively common in the seafood industry [14]. This is also the case for Norwegian lobsters where sulphite-based solutions are commonly employed to prevent melanosis [15], also known as "black spot", which affects the visual quality and marketability of these crustaceans.

The most prevalent methods involve spraying or soaking the lobsters in a sodium metabisulphite (E 223) or alternatively sodium hydrogen sulphite (E 222) solution. These treatments are typically conducted immediately after harvesting, often on fishing vessels or at aquaculture sites, to inhibit the action of polyphenoloxidases and thus prevent melanosis. An alternative approach involves dusting the lobsters with a commercial sulphite-based anti-melanosis formulation. Non-sulphite alternatives (e.g., the antioxidants E 586) are also used.

The application of sulphites has raised health concerns, particularly for individuals with sensitivity or allergies to these compounds. Consequently, regulations have been established to limit residual sulphite levels in food products to ensure consumer safety. For instance, in the European Union, (EU) No 1169/2011 [16], has made allergen labelling a requirement for all sulphite treated foodstuffs, when concentrations exceed 10 mg per kg or 10 mg per litre in terms of the total SO_2. Residues of 4-hexylresorcinol (C12H18O2) (E 586), in crustacean meat are not permitted to exceed 2 mg kg^{-1} [17].

In summary, while dipping live shellfish in sulphite solutions is a common practice aimed at preserving product quality, it is subject to regulatory oversight to balance industry needs with consumer health considerations.

Welfare impacts of dipping live lobsters into solutions containing sulphites

Sulphite and other chemical additives are often used to remove biofouling, improve appearance, preserve the quality or extend shelf life by reducing bacterial growth of shellfish.

Currently, there is a lack of published scientific studies specifically investigating the welfare implications of dipping live shellfish in sulphite or other additive solutions. Existing research primarily focuses on the efficacy of these treatments in preventing melanosis and their impact on human health due to residual sulphite levels.

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Dipping live lobsters into sulfite solutions raises welfare concerns, particularly considering that:

- Decapod crustaceans, including lobsters, have been shown to respond to noxious chemical stimuli in ways that suggest pain perception [18].
- Studies on crabs exposed to noxious chemicals (e.g., acetic acid) have demonstrated prolonged avoidance behaviors and physiological stress responses, suggesting that chemical exposure may be distressing [19,20,21].
- Lobsters' gills, like other decapod crustaceans, are highly permeable, therefore, exposure to sulfites could interfere with oxygen uptake and lead to osmoregulation disturbances and respiratory distress [22].

Conclusions

Research specifically on pain perception in the European (*Homarus gammarus*) and Norwegian (*Nephrops norvegicus*) lobsters is limited. While the extent of suffering is debated, exposure to potentially harmful chemicals may cause distress, metabolic and physiological harm. More research is needed to get better knowledge and a higher degree of confidence in dipping live lobsters into sulphite solutions. Given the likelihood of pain, respiratory and metabolic stress, it is essential to assess whether this practice significantly impairs welfare. Additionally, possible mitigation measures should be explored, including stunning lobsters prior to treatment.

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