Electrical stunning of edible crabs (Cancer pagurus): from single experiments to commercial practice

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Abstract

To determine the optimal electrical stunning conditions for edible crabs (Cancer pagurus) their impedance was investigated along with currents with the potential to render the animal insensible within 1 s. This information was used to develop a commercial stunner and determine conditions that both stun and kill the animals instantaneously. Results show that the crabs’ impedance is dependent on the current frequency with the optimum outcome seen at net frequencies of 50–60 Hz. The proportion of animals stunned was dependent on the potential difference with 220 V required to stun an animal unconscious within 1 s. Any attempts to kill the crab with asphyxia after a 10-s exposure to electricity failed as 30% of crabs recovered within an hour. A thermal shock, pre- or post-dependent on the potential difference with 220 V required to stun an animal unconscious within 1 s. This information was used to develop a commercial stunner with currents with the potential to render the animal insensible within 1 s. This information was used to develop a commercial stunner and determine conditions that both stun and kill the animals instantaneously. Results show that the crabs’ impedance is dependent on the current frequency with the optimum outcome seen at net frequencies of 50–60 Hz. The proportion of animals stunned was dependent on the potential difference with 220 V required to stun an animal unconscious within 1 s. Any attempts to kill the crab with asphyxia after a 10-s exposure to electricity failed as 30% of crabs recovered within an hour. A thermal shock, pre- or post-stunning prevented this recovery. Autotomy was not avoided and approximately 4–7% of crabs lost one or more appendage. Electricity caused localised over-heating, but a current of 10-s duration did not cause heating of the carapace. We conclude that electrical stunning used in combination with a thermal shock may stun and kill the animal instantaneously.

Keywords: animal welfare, crab, crustacean, electricity, slaughter, stunning

Introduction

Unlike invertebrates, the welfare of poultry and mammals as regards slaughter procedure is regulated in most European countries following recommendations from the EU (EFSA 2004). Similar recommendations also apply for farmed fish (EFSA 2004). For farmed fish, the welfare is only regulated for scientific purposes (EFSA 2005). A number of countries, including Norway, have integrated the welfare of decapods and cephalopods into the same laws as vertebrates (Anon 2009), as they are animals considered to learn from their experiences. To the authors’ knowledge there are yet to be any laws or regulations protecting the welfare of decapods during slaughter, put into action. Decapods, such as the edible crab (Cancer pagurus), tend to be processed in one of two ways; they are either killed using freshwater (Edwards 1979) — which is both time-consuming and space intensive — or are processed in a live state. Since processing of live crabs often entails carving without destruction of ganglia, the potential exists for crabs to experience an unpleasant sensation over a considerable period of time. Similarly, with crabs inserted live into boiling water, up to 2 min are needed before the internal temperature reaches the range where responses are lost (Roth & Øines 2010). This treatment provokes an ethical debate. Recent studies, both on hermit (Pagurus bernhardus) (Elwood & Appel 2009) and shore crabs (Carcinus maenas) (Magee & Elwood 2013) suggest that decapods have the ability to experience, learn and avoid a painful stimulus. Therefore, the concept of stunning decapods instantaneously into an irreversible insensible state prior to processing may be an important step towards improving welfare.

Previous studies into the stunning and killing of edible crabs have shown that any attempt to kill or stun the crabs using gas or a thermal shock requires time before the crabs can be considered unconscious (Baker 1955; Roth & Øines 2010). From that perspective the use of electricity is a promising stunning method, since the animals can be stunned almost instantaneously (Baker et al 1975; Baker & Dolan 1975; Robb 1999; Ogawa et al 2007; Roth & Øines 2010). The stunning efficiency is dependent, initially, on the amperage flow through the crab, caused by the potential difference across it and then the current duration (Baker 1975; Baker & Dolan 1975; Robb 1999; Ogawa et al 2007; Roth & Øines 2010). Any attempts to electrocute and kill the animals have so far failed, suggesting that electricity can only be used to stun the animal unconscious (Baker et al 1975; Robb 1999; Roth & Øines 2010). In fish, it is known that thermal insult following an electrical stun can prevent recovery (Lambooj et al 2008, 2013) and the same may apply for decapods.