Note

The effect of the fish anaesthetic Benzocaine Hydrochloride on the quality of saline water

BARHAM, W.T., CAIGER, KATHERINE M. & VISSER, J.G.J.
Department of Zoology, University of Zululand, P/Bag Kwa Dlangezwa 3886, South Africa

Abstract

The fish anaesthetic benzocaine hydrochloride causes marked changes in the pH and alkalinity of sea-water. These changes are ascribed to the acidic nature of the anaesthetic and may be responsible for certain behaviour patterns as well as undesirable effects on the haematology of fish. Neutralization of benzocaine hydrochloride with sodium hydroxide prevents any changes in the parameters investigated.

Introduction

The use of anaesthetic in fisheries management has become routine procedure and facilitates tagging and marking, sexing, weighing and stripping operations and contributes to the successful transportation of live fish (McFarland, 1960). A recent addition to the list of anaesthetics suitable for use with fish is benzocaine hydrochloride, a derivative of ethyl 4-aminobenzoate which is prepared easily and relatively cheaply in the laboratory (Ferreira *et al*, 1979a).

Both MS 222 and benzocaine hydrochloride, however, induce changes in the quality of freshwater (Smit *et al*, 1977; Ferreira *et al*, 1979a) but this can be overcome by neutralizing the anaesthetic before use (Smit *et al*, 1978; Ferreira *et al*, 1979b).

This study was therefore aimed at evaluating the effect of benzocaine hydrochloride on salt water as well as the effect of neutralizing benzocaine hydrochloride with sodium hydroxide.

Materials and Methods

Sea-water, obtained from the Council for Scientific and Industrial Research (CSIR) Fish Research Station at Richards Bay, Natal, was aged overnight and benzocaine hydrochloride was added in concentrations of 50, 80, 100 and 150 mg/ℓ. A Polymetron Type 55B pH meter was used to measure water pH and conductivity was measured with a Dionic conductivity meter. Alkalinity was determined as described by APHA. (1971), using a Bausch & Lomb Spektrokit and chloride was determined with a Buchler-Cotlove direct reading chloridometer.

All values were measured in duplicate after 5, 30, 60, 90 and 240 min. This procedure was repeated with benzocaine hydrochloride dissolved in 50 ml of distilled water and titrated with 0,1N sodium hydroxide to the same pH as that of the sea-water to which it was subsequently added.

Results

The effects of benzocaine hydrochloride and neutralized benzocaine hydrochloride on sea-water are compared in Table 1. The unneutralized anaesthetic caused initial drops in pH values at all concentrations. There was a tendency for the pH to rise after 240 min.

The alkalinities of the various concentrations of unneutralized benzocaine hydrochloride showed initial decreases which returned to normal within 90 min in the 50 mg/ℓ and 80 mg/ℓ concentrations. At the high conductivities (4,6 S/m) occurring in seawater the conductivity meter was not sensitive enough to detect the small increases which probably occurred due to the addition of benzocaine hydrochloride.

When neutralized benzocaine hydrochloride was added to sea-water there were no changes in any of the values.

Chloride concentration in no instance varied significantly from the initial concentration of 486 mEq Cl^-/ℓ.

Discussion

The results indicate that benzocaine hydrochloride either directly or indirectly affects certain properties of sea-water. The results agree with those of Ferreira *et al* (1979b) for benzocaine hydrochloride in fresh water and those of Smit *et al.* (1977) and Smit *et al.* (1978) for MS 222. Benzocaine hydrochloride is a weak acid and the initial decrease in pH observed after addition of any concentration of this anaesthetic in unneutralized form was to be expected. Mackereth *et al.* (1978) state that the carbon dioxide dissolved in natural waters participates in interconnected equilibria that involve large quantities of the gas 'bound' as bicarbonate and carbonate ions. The initial drop in alkalinity recorded in all concentrations of unneutralized benzocaine hydrochloride and the subsequent increase suggest the operation of such equilibria. The substantial increases in pCO_2 values recorded by Ferreira *et al* (1979b) for benzocaine hydrochloride in fresh water supports this contention.

Neutralization with NaOH effectively prevents the above changes in water quality and will probably cause less change in haematological values in fish subjected to this anaesthetic (Smit, 1980). Further, Barham *et al.* (1979) have observed that the tilapia *Sarotherodon mossambicus* clamp their opercula shut in high concentrations of unneutralized benzocaine hydrochloride. Neutralized benzocaine hydrochloride may obviate this problem and further investigations are in progress.

TABLE 1

THE EFFECT OF (i) BENZOCAINE HYDROCHLORIDE AND (ii) NEUTRALIZED BENZOCAINE HYDROCHLORIDE ON pH AND ALKALINITY OF SEA-WATER

	Benzocaine Hydrochloride					Neutralized Benzocaine Hydrochloride					Concentration mg/ℓ
Time (Minutes)	5	30	60	90	240	5	30	60	90	240	
pH	8,10	8,10	8,10	8,10	8,10	8,00	8,00	8,00	8,00	8,00	0
	7,50	7,45	7,45	7,45	7,55	8,00	8,00	8,00	8,00	8,00	50
	7,20	7,20	7,20	7,20	7,20	8,00	8,00	8,00	8,00	8,00	80
	7,10	7,00	7,00	7,00	7,10	8,00	8,00	8,00	8,00	8,00	100
	6,70	6,70	6,70	6,70	6,80	8,00	8,00	8,00	8,00	8,00	150
Bicarbonate Alkalinity mg/ℓ	60	60	60	60	60	60	60	60	60	60	0
	60	40	40	60	60	60	60	60	60	60	50
	60	40	40	60	60	60	60	60	60	60	80
	40	40	40	40	40	60	60	60	60	60	100
	20	40	40	40	40	60	60	60	60	60	150

Since neutralized benzocaine hydrochloride does not affect water quality it is recommended that this anaesthetic always be used in the neutralized form.

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