THE EFFICACY OF CLOVE OIL AS AN ANAESTHETIC FOR CHANNEL CATFISH (*ICTALURUS PUNCTATUS* RAF.)

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EFIKASNOST ULJA KARANFILIĆA KAO ANESTETIKA ZA CVERGLANA (*ICTALURUS PUNCTATUS* RAF.)

Abstrakt

Cilj rada je bio da se odredi optimalna koncetracija ulja karanfilića potrebna za anesteziju i oporavak dvogodišnjeg cverglana. Eksperimenti su izvedeni u laboratorijskim uslovima. Ispitivano je dejstvo tri koncentracije: 0.02 ml.l-1, 0.04 ml.l-1 i 0.06 ml.l-1. Tokom procesa anesteziranja je praćeno i analizirano ponašanje riba. Koncetracija od 0.02 ml.l-1 je imala sedativan efekat na ribe i dovela do poremećaja ravnoteže. Pri koncentraciji od 0.04 ml.l-1 90% riba je bilo potpuno imobilisano u roku od 3.17 to 6 min. Pri najvišoj koncetraciji, od 0.06 ml.l-1, sve ribe su bile potpuno imobilisane u roku od 2 do 4 minuta.

Ključne reči: *cverglan (Ictalurus punctatus), ulje karanfilića, anestezija*

INTRODUCTION

For the induction of anesthesia on fish a relatively wide range of anesthetic substances can be used (M a r k i n g and M a y e r, 1985; G i l d e r h u s and M a r k i n g, 1987; C o y i e et al. 2004; H a m a c k o v a et al., 2004; H a m a c k o v a et al. 2006), however only a few of them find practical application like MS-222, hinaldin, benzocain, carbon dioxide etc. A great potential towards that purpose has the clove oil, which A n d e r s o n et al. (1997) consider as an alternative to the most widely used anesthetic in aquaculture – MS-222.

Clove oil is a natural product, which has been used for a long time in medicine and cosmetics, and in the food industry where it finds application as a food flavoring

agent. Its advantages to some other anesthetics are its low cost, pleasant aroma, quick induction and recovery of the fish from anesthesia, and the low values of the efficient concentrations. It also has antibiotic, antiseptic, antimycotic and antibacterial effect (H a m a c k o v a et al., 2006).

The studies carried out on the effect of clove oil on different fish species, show that the effects are mostly dependent on the species, body weight of the fish and water temperature, factors which are related in one way or another to the effective concentrations. The time for induction and the time for recovery of anesthesia depend also on the individual condition of each fish – the sick and weak fish are considerably more susceptible. Clove oil is tested as anesthetic on various fish species, like trout (A n d e r s o n et al., 1997; V e l i s e k et al., 2005; K e e n e et al., 1998; H o s k o n e n and P i r h o n e n, 2004), European catfish (V e l i s e k et al., 2006; H a m a c h k o v a et al., 2006); pike (P e a k e, 1998; H a m a c h k o v a et al., 2006; Z a i k o v et al., 2008), etc. Investigation on the effect of clove oil on juvenile channel catfish were carried out by W a t e r s t a t (1999), who established that at a concentration of 100 mg.l^{-1} the fish are anesthetized in 1 min, and recover in 4 min. Small (2003) compared the effects of several anesthetic substances, including clove oil, on the level of plasma cortisol of the channel catfish, and successfully applied it as an anesthetic at a concentration of 100 ppm.

The aim of this study was to determine the efficient concentrations for anesthetization and the time for recovery of two-summer-old channel catfish, when clove oil is applied as anesthetic.

MATERIALS AND METHODS

The experiments for studying the effect of clove oil on channel catfish (*Ictarius punctatus* Raf.) were carried out under controlled laboratory conditions in the net cage farm of Ovtcharitsa dam lake. The anesthetic effect of clove oil was tested at water temperature of 15^{o}C for 10 min. Three concentrations were experimentally tested, as follows: 0.02 ml.l^{-1}, 0.04 ml.l^{-1}, and 0.06 ml.l^{-1}. Prior to the preparation of the working solution, the clove oil was dissolved in ethyl alcohol (95%), at a ratio of 1:9, after which it was added into the experimental tanks, with volume of 20 l, while stirring vigorously. Each of the concentrations was tested on 10 catfish, their length and weight are indicated in Table 1. All fish were subjected to anesthesia individually. 30 catfish in total were used for testing the indicated concentrations.

For recovery from the anesthetic effect of clove oil, the fish were transferred in tanks with a volume of 1 m^3, and with the use of a stopwatch was measured the time for regaining equilibrium and normal locomotor activity.

Fish behavior was traced and analyzed according to anesthesia phases described by H a m a c h k o v a et al. (2006):

1. acceleration followed by slowing down of opercular movements, partial loss of reactivity to external stimuli
2. loss of equilibrium, decreased opercular movements, fish react to strong external stimuli
3. complete loss of reactivity, fish lie on the bottom and do not react to manipulations
4. complete cessation of opercular movements, the fish die if they remain for a longer period in the anesthetic solution.

During the recovery of the fish from anesthesia were reported two phases - uncoordinated locomotion and normal positioning of the body with recovery of the locomotor activity.

RESULTS AND DISCUSSION

The results obtained from the studies that were carried out are shown in Table 1. The data for the size of the catfish, used in the experiment, show that they are relatively equal in terms of body weight and length.

Table 1. Time for induction and recovery from anaesthezia in channel catfish (*Ictalurus punctatus* Raf.).

Dose ml.l^{-1}	Feature	Body weight (BW) (g)	Body length (TL) (cm)	Induction of anesthesia		Recovery from anasthesia	
				Total loss of equilibrium min	Imobilization min	Uncoordinated locomotion min	Normal position min
0,02	x	915,3	44,25	3,78			0,66
	SD	119,41	1,44	1,07			0,3
	Cv %	13,05	3,25	28,24			45,68
0,04	x	913,13	44,56	1,79	4,83	1,62	3,03
	SD	77,33	1,74	0,55	1,17	0,61	0,57
	Cv %	8,47	3,91	30,82	24,26	37,84	18,97
0,06	x	980,3	44,65	1,33	3,01	2,12	3,24
	SD	69,66	1,55	0,22	0,8	1,15	0,93
	Cv %	7,11	3,46	16,53	26,62	54,23	28,76

The catfish exposed to the lowest concentration of 0.02 ml.l^{-1}, do not reach complete immobilization (Fig.1). They lose equilibrium in a period of 1.72 to 5.6 min – an average of 3.78 min. Visually the effect of clove oil is established through a loss of equilibrium, at which the fish lie on their backs or their side, they move their fins without swimming and react to external stimuli. Regaining equilibrium and normal body positioning occurs very quickly, in a period of 0.25 to 1.33 min., or 0.66 min on average, but at the largest coefficient of variation (Cv% 45.68) compared to the other two concentrations (Fig.2). The dosage of 0.02 ml.l^{-1} has a sedative but not anesthetic effect on the studied fish. Similar data for the same and lower concentrations were announced by H a j e k et al. (2006) for carp. Z a i k o v et al., (2008, 2009, in print) established the sedative effect of the same concentration on pike and European catfish.

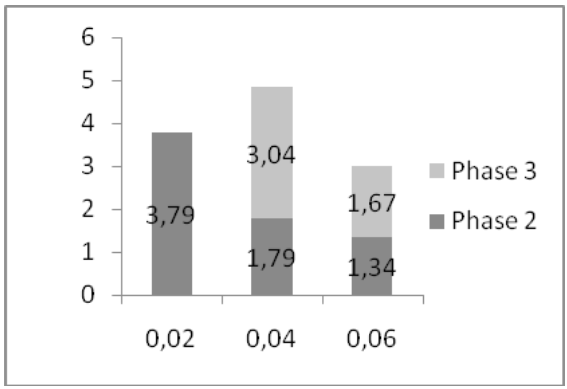

Figure 1. Time for reaching each of the phases of anesthesia of channel catfish using different clove oil concentration.

With the second concentration tested, 0.04 ml.l^{-1}, the effects on channel catfish occur faster (Fig.1). At that concentration the fish loose equilibrium in a shorter period compared to the former concentrate ion – from 1.42 to 3 min., and become completely immobilized in 3.17 to 6 min. (4.83 min. at an average). 90% of the fish passed to the next phase – complete immobilization (anesthesia). In this state various manipulations can be carried out on the fish without reaction to external stimulation.

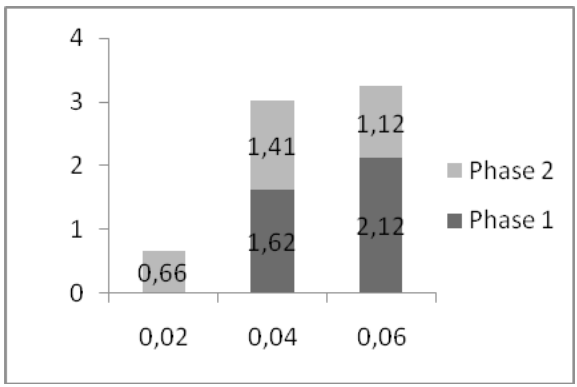

Figure 2. Time necessary for recovering and regaining equilibrium for channel catfish anesthetized at various concentrations of clove oil.

Recovery of the fish from anesthesia, after they have been transferred into clean water, occurs comparatively quickly, within an interval of 2 to 3.72 min (Fig.2). For a short period of time they lie on the bottom immovable, after which they start moving their fins and their body and begin making uncoordinated movements. At a certain moment they retake normal position of the body, recover their equilibrium and quickly regain normal locomotor activity – in 3.03 min. on average.

At the highest of the experimental concentrations – 0.06 ml.l^{-1} all the fish reach complete immobilization (Fig.1). They are completely anesthetized within 2 to 4 min., and their recovery and regaining of normal position takes longest – 2 to 5 min (Fig.2).

The close length and weight of the fish used for the experiment (Table 1), show that the influence of those factors on the anesthetic effect of the clove oil is eliminated, and thus only the concentrations used are taken into account.

At first, when placed in the working solution, the catfish react to the effect of the clove oil with more vigorous movements and producing their typical sounds, after which they calm down. In contrast to the pike (Z a i k o v et al., 2008), with the channel catfish the transition through the separate phases of the anesthesia and recovery are considerably more clearly expressed and easily notable.

The results obtained are in accordance with W a t e r s t r a t (1999) data for the channel catfish, as well as the data from other authors (H o s k o n e n and P i r h o n e n, 2004; K e e n e et al., 1998; H a m a c h k o v a et al., 2006; Z a i k o v et al., 2008, Z a i k o v et al., 2009) concerning other fish species, according to which clove oil anaesthetic effect increases with the increase of its concentration and the recovery process takes longer at higher concentrations.

CONCLUSIONS

The experiments carried out confirm the good possibilities for clove oil application as anesthetic during various manipulations on the channel catfish (*Ictalurus punctatus* Raf.).

The concentration of 0.02 $ml.l^{-1}$ has a sedative effect and leads only to disruption of the equilibrium of the catfish but not to loss of reactivity.

At a concentration of 0.04 $ml.l^{-1}$ 90% of the fish are completely immobilized, which does not guarantee the induction of anesthesia on all fish during manipulations.

The best expressed anesthetic effect of all concentrations tested, has the concentration of 0.06 $ml.l^{-1}$, at which the fish are immobilized in 3 min at an average, and recover in 3.24 min.

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