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Effects of Packing Densities in Plastic Bags on Survival of Larvae and Fry of *Helostoma temmincki* (C&V)

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ABSTRAK

Rega-rega Helostoma temmincki *(C&V) berukuran 4.6 ± 0.6 mm diisi ke dalam beg-beg plastik yang mengandungi oksigen dengan kepadatan muatan 0, 250, 500, 1000 dan 1500/liter. Anak ikan yang berukuran 2.0 ± 0.2 dengan cara yang sama, diisi dengan kepadatan 0, 125, 250, 500 dan 750/liter. Pemerhatian untuk kadar kematian dijalankan ke atas anak-anak ikan tersebut dengan jangka masa 10 minit, 24 jam dan 48 jam, selepas diisikan ke dalam beg plastik. Parameter-parameter mutu air, suhu, oksigen terlarut, amonia-N, karbon dioksida terlarut, pH dan kadar kealkalian ditentukan pada 0 jam untuk beg-beg kawalan dan selepas 48 jam diisikan bagi kesemua beg. Tiada kematian berlaku bagi kesemua beg dalam masa 10 minit selepas pembungkusan. Selepas 24 jam, kematian pada rega yang diisi dengan 500, 1000 dan 1500/liter adalah kurang daripada 2%, sementara beg-beg yang berisi anak ikan tiada kematian berlaku. Selepas 48 jam kadar kematian adalah sama ($P > 0.05$) iaiu pada kadar kurang daripada 2% bagi kesemua beg. Kadar kematian pada rega yang diisi dengan kepadatan 125, 250 dan 500/liter adalah sama ($P > 0.05$) dan kurang daripada 2% sementara kadar kematian bagi anak ikan 750/liter adalah dengan keertian berbeza ($P < 0.05$).*

ABSTRACT

Helostoma temmincki *(C&V) larvae measuring 4.6 ± 0.6 mm total length were packed in plastic bags with oxygen at stocking densities of 0, 250, 500, 1000 and 1500/litre. Fry measuring 2.0 cm ± 0.2 were similarly packed at densities of 0, 125, 250, 500 and 750/litre. The fish were observed for mortality 10 minutes, 24 hours and 48 hours after packing. The water quality parameters — temperature, dissolved oxygen, ammonia-N, dissolved carbon dioxide, pH and alkalinity — were determined at 0 hours for control bags only and for all bags at 48 hours after packing. There was no mortality in all bags 10 minutes after packing. After 24 hours, mortality of larvae packed at 500, 1000 and 1500/litre was less than 2% whereas no mortality was observed in the bags with fry. At 48 hours, mortalities of larvae were similar ($P > 0.05$) in all bags and were less than 2%. Mortalities of fry packed at 125, 250 and 500/litre were similar ($P > 0.05$) and less than 2%, whereas mortality of fry packed at 750/litre was significantly different ($P < 0.05$).*

INTRODUCTION

Fish seeds are commonly transported from hatcheries to grow-out sites. There are various ways of transporting young fish, depending on species involved, sizes of fish and distance to be transported. They may be transported under damp conditions with little water, in containers open to the atmosphere, or in sealed plastic bags with oxygen under pressure (Fry and Norris, 1962). Transporting fish in plastic bags has been in practice for many years. The primary advantages of this method are firstly reduction in volume of water and secondly, reduction in injuries resulting from fish striking rigid walls.

Hora and Pillay (1962) have pointed out that oxygen is the main requirement in transporting fry. In water provided with an unlimited amount of oxygen, a fish at rest will consume a minimum amount of oxygen. In a fish transport system, the fish will require more than the minimum amount since they are not at rest. They may even consume at nearly maximum rates if they are excited or disturbed during transport (Johnson, 1979). Fry could die in large numbers not only when the oxygen content of water is low, but also when its carbon dioxide content increases (Hora and Pillay, 1962).

Other factors of concern when transporting live fish are temperature, the accumulation of nitrogenous excretory products, the increase in biochemical oxygen demand due to the decay of dead fry or larvae, the increase in the bacterial load of the water and the density of larvae or fry in the transporting bags. Snow (1978) found that for largemouth bass, *Micropterus salmoides,* fry (1 to 3 days of age) a density of 3,000/litre is most likely to result in both satisfactory survival to destination and economical use of shipping container space.

A study was conducted on packing of *Helostoma temmincki* larvae and fry to determine the survival rate and associated water quality changes at differing packing densities.

MATERIALS AND METHODS

Two experiments were conducted using two different life stages of *Helostoma temmincki.* Larvae after completion of yolk sac absorption (experiment I) and feeding fry (experiment II) of *H. temmincki* were obtained from the hatchery of the Faculty of Fisheries and Marine Science and used in the study. The larvae and fry averaging 4.6 ± 0.1 cm and 2.0 ± 0.2 cm in total length, respectively, were starved for a day before being used for the study.

The fish were counted and packed in plastic bags, each containing 1 litre of aged water filtered through a No. 10 plankton net and 3 litres of oxygen under pressure, at densities of 0, 250, 500, 1000 and 150/litre for larvae and 0, 125, 250, 500 and 750/litre for fry. The bags were sealed with heavy rubber bands and kept at room temperature for observation for 48 hours. These were done in 3 replicates. Larvae and fry mortality was observed at 10 minutes, 24 hours and 48 hours after packing. The water quality in the fish-packed bags were determined at 48 hours whereas that in the control bags was determined both at 0 and 48 hours. The temperature was measured using a Globe thermometer with range — 10°C to 100°C. Dissolved oxygen, pH dissolved carbon dioxide were analysed using a Hach Kit (Model Dr/EL/2). Ammonia nitrogen was determined using La Motte Kit Models NANR and pan, and total alkalinity was measured by the titration method with methyl orange indicator.

RESULTS AND DISCUSSION

Experiment I: Packing of Larvae

The mortality and water quality data are presented in Table 1. There was no mortality 10 minutes after packaging, indicating that the larvae were tolerant of the handling stress while the fish were being packed. The mortality rate in bags with larvae was very low, averaging 2.01 ± 1.19% even at the highest density of 1500/litre. There was no significant difference in mortality rates either at 24 hours or 48 hours ($P > 0.05$).

The water temperature, which was initially 27.0°C rose to as high as 31.7°C after 48 hours. As packing density increased, the dissolved oxygen content decreased. The values were significantly different ($P < 0.05$). Even though the carbon dioxide content for the stocking density of 1500/l was high (10.0 m/l), the larval mortality rate was low because of high oxygen content (11.73 mg/l). Significant increases were also observed in carbon dioxide and total ammonia levels as the packing density increased. pH was lower at higher stocking densities (7.1 at 250/l to 6.7 at 1500/l). This was probably due to the formation of carbonic acid (H_2CO_3), as carbon dioxide dissolved in water (Boyd, 1979). Carbonic acid further dissociates to release carbonate hydrogen ions thus causing a reduction in pH.

TABLE 1

Mean and standard deviation values of water quality parameters and cumulative mortality in bags loaded at different density of *Helostoma temmincki* larvae

Amount of fish (no)/litre	Temperature °C	Dissolved oxygen (mg/l)	Carbon dioxide (mg/l)	Ammonia-N (mg/l)	pH	Alkalinity	Cumulative Mortality %		
							0	24 Hours	48
0 (0 hours)	27.0 ± 0.00	18.0 ± 1.00	2.0 ± 0.00	0.0 ± 0.00	7.7 ± 0.14	3.0 ± 0.10	—	—	—
0 (48 hours)	30.0 ± 0.00	15.6 ± 0.80	2.0 ± 0.00	0.0 ± 0.00	7.4 ± 0.00	3.0 ± 0.00	—	—	—
250 (48 hours)	30.0 ± 0.00	15.5 ± 0.58	4.0 ± 0.00	0.00 ± 0.00	7.1 ± 0.06	3.8 ± 0.03	—	—	0.4 ± 0.00
500 (48 hours)	30.0 ± 0.50	14.7 ± 0.58	4.0 ± 0.00	0.02 ± 0.02	6.9 ± 0.10	3.9 ± 0.18	—	1.3 ± 0.50	1.6 ± 0.64
1000 (48 hours)	31.7 ± 0.50	12.0 ± 2.65	6.0 ± 0.00	0.03 ± 0.00	6.9 ± 0.00	4.1 ± 0.29	—	0.9 ± 0.56	1.1 ± 0.70
1500 (48 hours)	30.0 ± 1.15	11.73 ± 1.15	10.0 ± 0.09	0.03 ± 0.09	6.7 ± 0.06	3.7 ± 0.43	—	1.9 ± 1.17	2.1 ± 1.19

TABLE 2

Mean and standard deviation values of water quality parameters and cumulative mortality in bags loaded at different densities of *Helostoma temmincki* fry

Amount of fish (no)/litre	Temperature °C	Dissolved oxygen (mg/l)	Carbon dioxide (mg/l)	Ammonia-N (mg/l)	pH	Alkalinity	Cumulative Mortality %		
							0	24 Hours	48
0	31.0 ± 0.00	12.7 ± 1.15	2.0 ± 0.00	0 ± 0.00	7.3 ± 0.05	2.0 ± 0.05	—	0.00 ± 0.00	—
125	31.0 ± 0.00	6.3 ± 1.15	18.7 ± 1.00	15.0 ± 0.00	6.3 ± 0.01	3.9 ± 0.22	—	—	0.27 ± 0.46
250	30.7 ± 0.29	6.3 ± 1.15	52.1 ± 0.83	26.0 ± 1.11	6.1 ± 0.06	7.3 ± 1.41	—	—	1.47 ± 2.54
500	30.5 ± 0.50	6.7 ± 0.58	117.3 ± 0.90	26.0 ± 0.56	6.1 ± 0.06	7.3 ± 1.41	—	—	2.20 ± 0.20
750	28.0 ± 0.00	5.0 ± 0.0	117.3 ± 1.12	26.0 ± 1.01	6.4 ± 0.13	7.1 ± 0.13	—	—	6.83 ± 0.4

Experiment II: Packing of Fry

The mortality and water quality data are presented in Table 2. In the second experiment, low mortality was also observed, averaging 6.83 ± 0.4% at the highest fry density of 750/litre and this was significantly above the other levels ($P < 0.05$). Temperature decreased slightly with stocking density. The dissolved oxygen concentration was relatively high and at a compensatory level (mean, 5.0 mg/l) to counter the high concentration of carbon dioxide (mean, 120 mg/l) and total ammonia (mean, 26.0 mg/l). Significant differences were evident in dissolved oxygen, carbon dioxide, total ammonia and total alkalinity levels as the packing density increased. There was a progressive decrease in pH in relation to packing density. This is probably due to stress imposed on the fish when packing and the size of fish as reflected by the increase in carbon dioxide and decrease of dissolved oxygen levels in the bags.

The dissolved oxygen contents observed in both experiments was at a suitable level to fulfill the physiological needs of fish. This is in agreement with a report by Hora and Pillay (1962), who found that larvae and fry of the major carps of India and Pakistan cannot live in oxygen concentrations below 0.5 mg/l, but at a concentration of 0.5 to 1 mg/l they can survive for over 24 hours. While carbon dioxide may be lethal at concentrations as low as 2.5 mg/l for larvae and 10 – 15 mg/l for fry when the oxygen concentration is at a low level of 0.5 mg/l to 1 mg/l, it becomes lethal only at 100 mg/l to larvae and 250 mg/l to fry at oxygen concentrations of 2 mg/l or above.

Dissolved oxygen, carbon dioxide, ammonia, alkalinity and pH are factors of concern in live fish transport (Hattingh *et al.*, 1975; Johnson, 1979; Ramachandran, 1969; Fry and Noris, 1962). Low pH, high carbon dioxide, high alkalinity and high ammonia levels affect the ability of haemoglobin to combine with oxygen and any increase in water temperature considerably accelerates the metabolic rate of fish and consequently their rate of oxygen consumption (Ramachandran, 1969). However in the present study none of the measured changes in water quality affected the survival of the larvae or fry.

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