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# Preliminary Study on Mortality of Catfish (*Clarias macrocephalus*) Fry Transported in Plastic Bags.

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## ABSTRAK

*Anak ikan keli (*Clarias macrocephalus*) diangkut di dalam beg plastik dengan menggunakan air bersih dan oksigen tulen pada nisbah 1:3. Kenaikan suhu dan amonia semasa pengangkutan mempunyai hubung kait yang rapat dengan kepadatan ikan dan jangka masa mengangkut. Oksigen terlarut tidak menjadi masalah, malahan kepekatannya meningkat apabila gas oksigen mula terlarut ke dalam air semasa mengangkut. Kadar kematian semasa pengangkutan rendah, tetapi meningkat selepas pengangkutan selesai. Walau bagaimanapun, kadar kematian dapat dikurangkan dengan memasukkan garam (NaCl) ke dalam air.*

## ABSTRACT

*Catfish (*Clarias macrocephalus*) fry were transported in plastic bags using clean water and pure oxygen at a ratio of 1:3. The rise in temperature and total ammonia during transportation was related to transportation time and packing density. Though dissolved oxygen increased when pure oxygen began to dissolve in the water during transportation it did not pose a problem. Low mortalities were observed among the less densely packed fish but post-transporatation mortalities were fairly high. Mortalities, however, could be reduced with the addition of salt (NaCl) to the water.*

## INTRODUCTION

In Southeast Asia, fish are widely transported in sealed plastic bags with air replaced by pure oxygen (Sampson 1987). The convenience and associated low cost has resulted in its widespread use. Even though the plastic bag method of transporting fish is easy and economical (Frose, 1986), the hauling stress experienced usually results in poor fry survival (Sampson 1987). The senior author has experienced a 98% mortality of catfish (*Clarias macrocephalus*) fry transported in plastic bags. The fry died within 1 to 2 days after arrival and a post-mortem indicated transportation stress as the most probable mortality cause. This major problem slows down catfish farming in Perlis, Kedah, Penang, and Northern Perak where the low fry production from local hatcheries is further aggravated by high losses during transportation.

The plastic bag method generally involves packing a certain number or weight of fish in a plastic bag filled with clean water and pure oxygen at the ratio of 1:3 by volume (Sampson, 1987). Salt (NaCl) may be added to the water to reduce mortalities (Piper *et al.* 1982; Nikinmaa *et al.* 1983). However, there does not appear to be rules and it appears to be trial and error based rather than scientifically determined (Sampson 1987). This study investigates the effects of different packing densities, transportation time, and salt concentrations on mortality of catfish fry during and after transportation.

## MATERIALS AND METHODS

The experiments were conducted using plastic bags (71 cm × 56 cm), dechlorinated water and catfish fry with mean size of 146 mg ± 12 mg and 20 mm ± 1 mm long (total length), the size sold by most hatcheries. The plastic bags were thoroughly washed to remove any trace of chemicals present, and prior to the experiments, the fry were acclimatised for one week and starved for 12 h to clear their guts.

In experiment A, fry at four different packing densities (5, 10, 20, and 30 ind./l - each density replicated 5 times), were subjected to four different transportation times (0.25, 4, 8, and 12 h). Dissolved oxygen (D.O.) and water temperature were measured at specified time intervals using a Yellow Spring Instrument (Model 57) D.O. meter with a thermistor. Final total ammonia concentrations in the 8 and 12 h treatments for the 10, 20, and 30 ind./l densities were measured using the indophenol method (Boyd 1979), while the initial and final pH values were also recorded using a Hanna (HI 8314) pH meter. After the experiments,the fish were kept in aquaria (18 cm × 32 cm × 22 cm) filled with 3 l dechlorinated water and reared for one week to determine post-transportation mortality. During rearing, the water was fully aerated and changed every 2 days, and the fish were fed to satiation with *Tubifex* worms at 5% body weight 3 times daily. All mortalities were recorded.

In experiment B, fry (from the same group as in experiment A) at 5 and 30 ind./l densities were packed in plastic bags containing water at four different salt concentrations (0, 10, 15, and 20 mg/l – each concentration was replicated 5 times), and subjected to transportation times of 8 and 12 h, respectively. After the experiments, all fish were kept in aquaria filled with dechlorinated water for one week to determine post-transportation mortality. The water management and feeding of fish were as in experiment A.

## RESULTS

*Experiment A*

The temperature increased gradually during transportation (*Figure 1A*). However, for each packing density, the rise was small and the minimum and maximum values recorded were 26 and 32°C, repectively. There was also a gradual increase in D.O. (*Figure 1A*) and the minimum and maximum concentrations were 12.0 and 16.7 mg/l, respectively. For post-transportation rearing, the temperature was relatively constant but there were some fluctuations in D.O. especially for the 20 and 30 ind./l densities (*Figure 1B*). The final total ammonia-N concentrations for the 8 and 12 h transportation increased in relation to the packing densities (*Figure 2*). The concentrations for the 8 h transportation increased from 0.29 mg/l for 10 and 20 ind./l densities to 0.48 mg/l for 30 ind./l density, respectively. For the 12 h transportation the increase was from 0.20 mg/l for the 10 ind./l to 0.29 and 0.36 mg/l for the 20 and 30 ind./l densities, respectively. In all treatments the pH levels remained essentially circum-neutral, and declined slightly at the end of the study (*Figure 2*).

No mortalities were recorded during transportation for 5 and 10 ind./l densities but there were fairly low mortalities for 20 and 30 ind./l densities (*Figure 3*). Post transportation mortalities after one week of rearing were high for all the densities and all transportation times. For the 5 and 10 ind./l densities, the mortality rates increased with longer transportation times, whereas, the opposite occurred for the 20 and 30 ind.l/ densities (*Figure 3*).

*Experiment B*

The D.O. and temperature were stable during transportation as well as during post-transportation rearing. The average D.O. and temperature ranged from 11.6 to 15.3 mg/l and 29.8 to 33.3°C, respectively, during transportation. During post-transportation the average D.O. and temperature ranged from 2.0 to 6.6 mg/l and 25.5 to 28.6 C, respectively. There were no mortalities during transportation. The addition of salt, especially at 20 mg/l, during transportation reduced post-transportation rearing mortalities for both the 5 ind.l/ and 30 ind./l densities; however, lower salt concentrations were less effective (Table 1). During post-transportation rearing, mortalities occurred randomly whether in the first 3 or the last 4 days of rearing. If there were high mortalities in the first three days then the last 4 days would have lower mortalities and vice versa (Table 1).

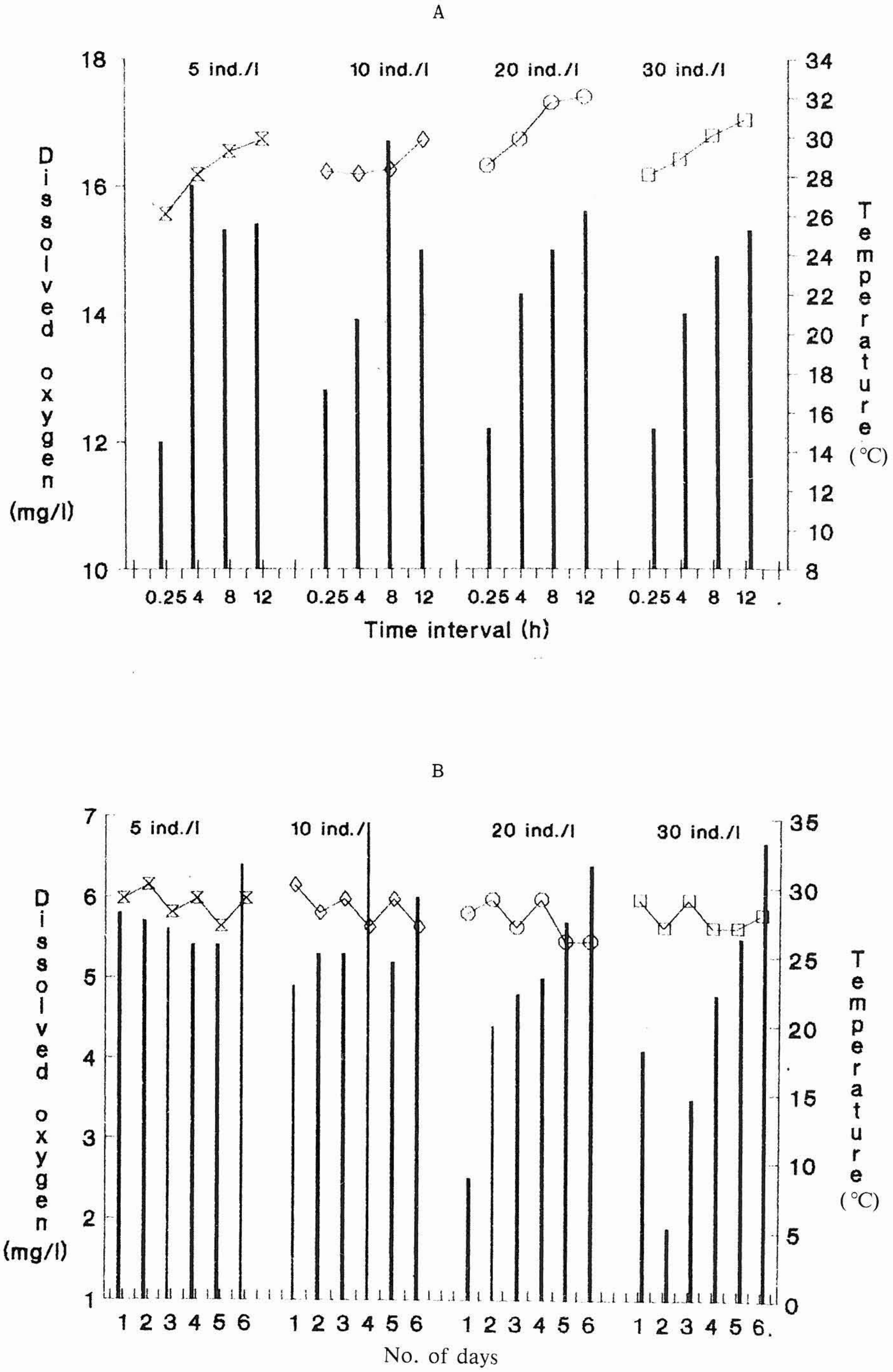


*Fig. 1 Temperature (line) and dissolved oxygen (bar) measured at different time intervals during transportation (A) and daily during post-transportation rearing (B).*

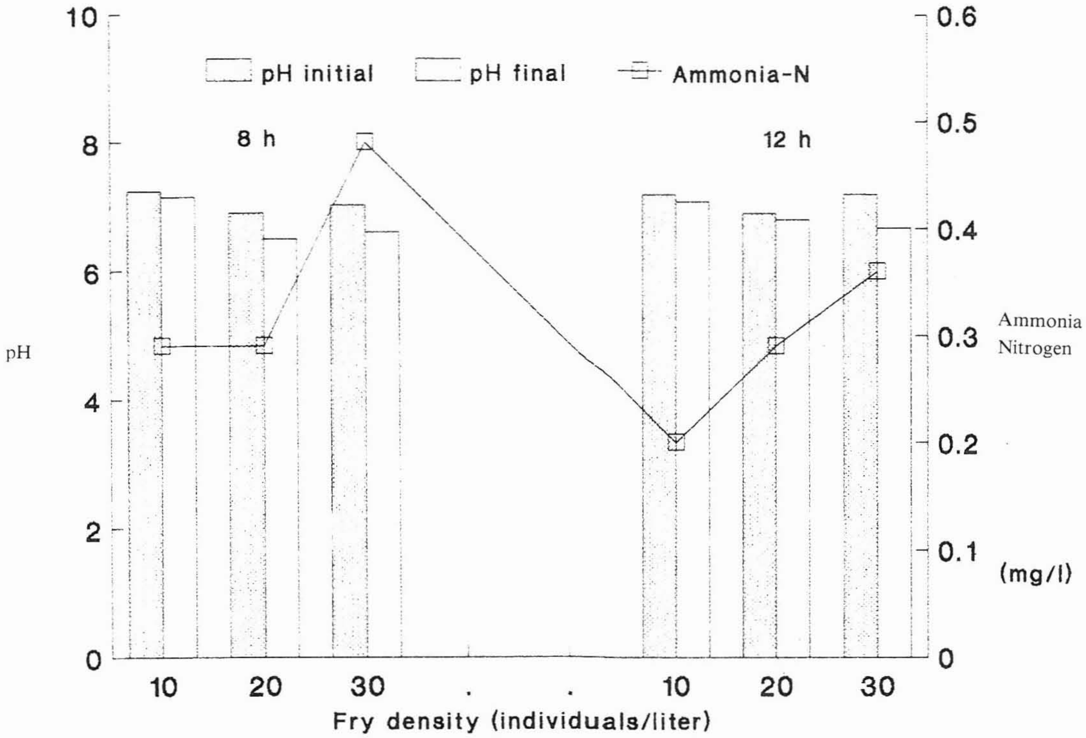


*Fig. 2 Final total ammonia-N concentrations (line) and pH levels (bar) for fry transported at two different time intervals and three different packing densities.*

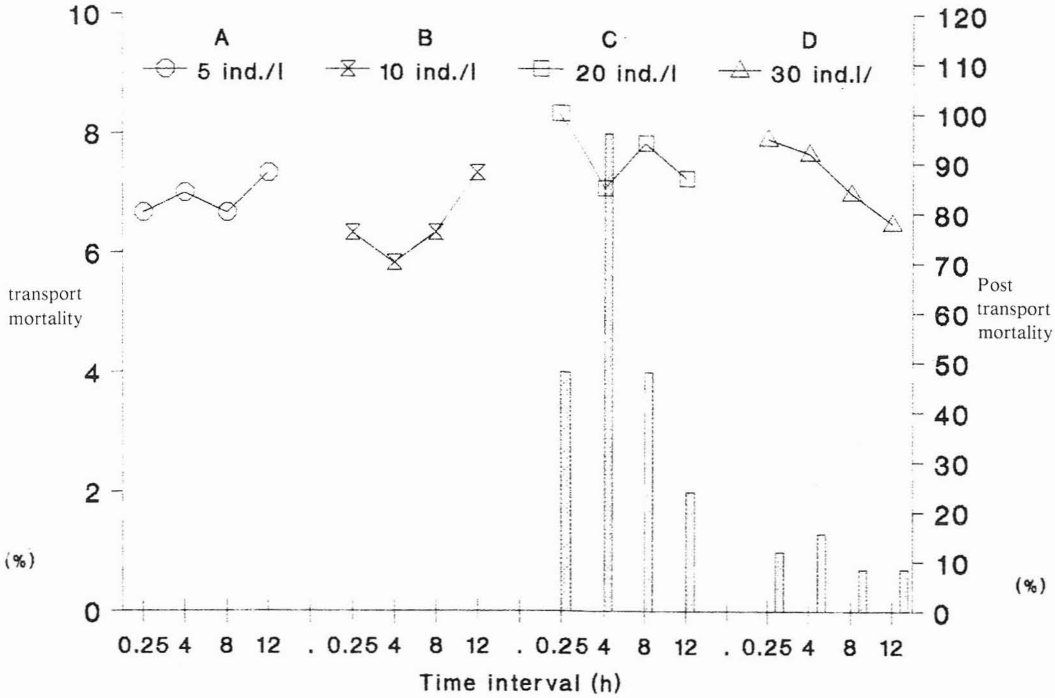


*Fig. 3. Total mortality rates (%), during transportation (bar) and post-transportation rearing of seven days (line), for fry transported at four different time intervals and packing densities.*

TABLE 1
Effects of different salinities (NaCl) on post-transportation mortality (%) of catfish (*Clarias macrocephalus*) fry packed at 5 and 30 ind./l densities and transported at two different transport times.

| Salinity (mg/l) | 5 individuals/l | | | | | | 30 individuals/l | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8 h | | | 12 h | | | 8 h | | | 12 h | | |
| | day3 | day7 | total | day3 | day7 | total | day3 | day7 | total | day3 | day7 | total |
| 0 | 32.0 | 8.0 | 40.0 | 0 | 36.0 | 36.0 | 44.7 | 33.3 | 78.0 | 18.7 | 46.7 | 65.4 |
| 10 | 0 | 44.0 | 44.0 | 32.0 | 32.0 | 64.0 | 16.0 | 46.7 | 52.7 | 4.0 | 61.3 | 65.3 |
| 15 | 16.0 | 80.0 | 96.0 | 12.0 | 12.0 | 24.0 | 58.7 | 20.0 | 78.7 | 71.3 | 13.3 | 84.6 |
| 20 | 4.0 | 32.0 | 36.0 | 12.0 | 8.0 | 20.0 | 8.7 | 30.7 | 38.7 | 5.3 | 19.3 | 24.6 |

## DISCUSSION

A rise in temperature during transportation is unavoidable. Even though catfish can tolerate temperature extremes in their natural environment (Ali and Ahmad 1988), the water temperature in the plastic bag must be allowed to equilibriate slowly with the water temperature of the place to be stocked to avoid shock that might kill the fry (Sampson 1987). Dissolved oxygen is not a problem since the pure oxygen used would dissolve with longer transportation time and lead to an increase in D.O. towards the end of transportation. If pure oxygen is not available, hydrogen peroxide may be used as an oxygen source (Taylor and Ross 1988) or atmospheric air can be used if the transportation time does not exceed 20 h (Frose 1986).

The main problem faced during transprotation is the change in water quality, primarily of pH and ammonia (Sampson 1987). The increase in carbon dioxide during transportation would increase carbonic acid and result in lower pH (Boyd 1979). The severity of the drop is related to packing density (Siraj *et al.* 1985), transportation time and the buffering capacity of the water (Sampson 1987). Concurrently, an increase in total ammonia concentrations as a result of excretion also occurred. The increase is also related to packing density (Siraj *et al.* 1985) but can be minimised by properly starving the fish prior to transportation. Properly starved fish would not regurgitate food, thus, lessening water fouling problem (Sampson 1987), while, ammonia toxicity during transportation can be reduced by the low pH and low water temperature (Colt and Tchobanoglosus 1976; Robinette 1983; Sampson 1987). In this study, the fairly high total ammonia-N detected is probably due to the short starvation period of 12 h, and ammonia at these levels can affect fish stamina (Robinette 1983) possibly leading to higher post-transportation mortality. Stress is an important factor affecting fish mortalities. Thus, different levels of stress could also be responsible for the higher ammonia-N levels for fish transported at 8 h compared to those transported at 12 h. During transportation, no mortalities occurred in the less densely packed bags but occurred in the 20 and 30 ind./l bags indicating the greater stress of higher packing densities. However, the transportation stress for the 5 and 10 ind./l densities finally manifested itself during post-transportation rearing with high fry mortalities, although, for the 20 and 30 ind./l densities, the mortalities were lower because most of the stressed fish had already died during transportation.

Nikinmaa *et al.* (1983) and Frose (1986) suggested adding salt to water during transportation to reduce post-transportation mortalities. The role of salt is primarily to reduce physiological stress by reducing the osmotic work needed to maintain stable ion levels (Nikinmaa *et al.* 1983). Depending on species, the suggested concentrrations range from 1 to 10 g/l (Frose 1986). Adult catfish have been successfully transported in water containing 3 g/l salt. However, no suggested concentration for fry is available. This study indicated that adding 20 mg/l salt to water during transportation could lower post-transportation mortalities among catfish fry packed at both 5 ind./l and 30 ind./l densities. However, lower salt concentrations have less noticeable effects.

## CONCLUSION

The use of plastic bags to transport fish should be encouraged. However,further research should be done to "fine tune" the technique to make it more reliable. Since it is difficult to maintain optimum water quality condition during transportation, fish should be treated with care prior to, during and after transportation in order to reduce losses. Adding salt to water during transportation can reduce mortalities, but rough handling of fish should be avoided at all times (Frose 1986). Proper conditioning before transportation would help to identify weaker fish for removal, thus, reducing mortality during and after transportation (Sampson 1987). Adequate starvation before transportation also helps to reduce the problem of water fouling and ammonia toxicity (Sampson 1987). Packing procedure suggested by Frose (1986) is recommended.

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