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INDUCED THERMOTOLERANCE OF *Cyprinus carpio* FINGERLINGS
FOLLOWING NON-LETHAL HEAT SHOCK

By
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Research Report submitted in partial fulfillment of
the requirements for the degree of
Bachelor of Agrotechnology Science (Aquaculture)

Department of Fisheries Science and Aquaculture
FACULTY OF AGROTECHNOLOGY AND FOOD SCIENCE
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FAKULTI AGROTEKNOLOGI DAN SAINS MAKANAN

UNIVERSITI MALAYSIA TERENGGANU

PENGAKUAN DAN PENGESAHAN LAPORAN

PROJEK ILMIAH I DAN II

Adalah ini diakui dan disahkan bahawa laporan ilmiah bertajuk:

Induced thermotolerance of *Cyprinus carpio* fingerlings following non-lethal heat shock oleh Syarifah Nor Syahirah bt. Syed Muhazani, No.Matrik UK13459 telah diperiksa dan semua pembetulan yang disarankan telah dilakukan. Laporan ini dikemukakan kepada Jabatan Sains Perikanan dan Akuakultur sebagai memenuhi sebahagian daripada keperluan memperoleh Ijazah Sarjana Muda Sains Agroteknologi (Akuakultur), Fakulti Agroteknologi dan Sains Makanan, Universiti Malaysia Terengganu.

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DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged.

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Date : 17 March 2009

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ABSTRACT

This study examined the effects of a non-lethal heat shock (NLHS) towards resistance of a subsequent lethal heat stress or in other words, induced thermotolerance (ITT) of the common carp, *Cyprinus carpio* fingerlings. Prior to testing the ITT, the lethal heat treatment (LHT) of this species was determined. Fish acclimatized at 28°C were heat shocked to 34°C, 36°C, 38°C, 40°C and 42°C for 30 min, and given a subsequent recovery of 24 h at 28°C. The survival was determined after 24 h by counting actively swimming animals. Mortality was not observed when fish were heated to 36°C. A slight decrease in survival occurred when fish were exposed to 38°C while 39°C resulted in 50% mortalities, the latter characterized as LT₅₀. Heat shock at 41°C killed all animals indicating that this temperature was lethal and thus was considered as the lethal heat treatment (LHT). To test ITT, fingerlings were exposed from 28°C to NLHS of 32°C, 34°C, 36°C and 38°C for 30 min and given a recovery of 8 h. Fingerlings were exposed to LHT for 30 min to determine whether thermotolerance is induced. It is found that all NLHS temperatures confer tolerance of fingerlings against LHT compared to those of the non-heat shocked controls, where total mortalities occurred in the latter treatments. The highest protection was achieved at 38°C, with an approximately 43% survived incubation, perhaps due to the upregulation of heat shock proteins, a group of protein that are responsible for protection against extreme forms of stress. Further studies such as immunoblotting are required to substantiate the putative role of Hsps on ITT of *Cyprinus carpio*.

ABSTRAK

Kajian ini mengenalpasti kesan-kesan kejutan haba yang tidak menyebabkan kematian ke atas ketahanan terhadap stress haba yang boleh menyebabkan kematian atau dalam perkataan lain, ransangan toleransi haba dalam kap, *Cyprinus carpio* juvenil. Sebelum menguji ransangan toleransi haba, rawatan haba yang menyebabkan kematian pada semua organisma kepada spesies ini ditentukan. Ikan yang disesuaikan pada 28°C dikenakan kejutan haba pada 34, 36, 38, 40 dan 42°C untuk 30 min dan seterusnya diberi pemulihan selama 24 jam pada 28°C. Juvenil yang masih hidup ditentukan selepas 24 jam dengan mengira ikan yang berenang aktif. Tiada kematian diperhatikan apabila ikan dipanaskan pada 36°C. Sedikit penurunan dalam jumlah juvenil yang masih hidup berlaku apabila ikan didedahkan kepada 38°C sementara 39°C menyebabkan 50% kematian yang kemudiannya dikenalpasti sebagai LT₅₀. Kejutan haba pada 41°C membunuh semua ikan menunjukkan bahawa suhu ini menyebabkan kematian dan oleh itu dikatakan sebagai rawatan haba yang menyebabkan kematian pada semua organisma. Untuk menguji ransangan toleransi haba, juvenil didedahkan daripada 28°C kepada suhu yang tidak menyebabkan kematian iaitu 32, 34, 36 and 38°C untuk 30 min dan diberi pemulihan selama 8 jam. Juvenil didedahkan kepada rawatan haba yang menyebabkan kematian pada semua organisma selama 30 min untuk menentukan sama ada toleransi terhadap haba diransangkan. Didapati bahawa semua suhu yang tidak menyebabkan kematian telah melindungi juvenil daripada rawatan haba yang menyebabkan kematian pada semua organisma, dibandingkan dengan kawalan, di mana kematian yang banyak berlaku pada rawatan seterusnya. Perlindungan yang tertinggi diperolehi pada 38°C dengan anggaran 43% hidup, mungkin disebabkan penghasilan 'heat shock protein', sekumpulan protein yang bertanggungjawab member perlindungan kepada stress yang ekstrem. Kajian lanjutan seperti immunoblot diperlukan untuk mengesahkan peranan 'Hsp' semasa ransangan toleransi haba dalam *Cyprinus carpio*.