



Comparative studies on variation in stocking density of common carp *Cyprinus carpio*

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Abstract

The influence of increased stocking density on haematology of *Cyprinus carpio* at various stocking densities was investigated. The groups were reared in the density of 5, 10, 15 and 20 individuals/ aquarium /cage. The aim of the study was to determine the response of *Cyprinus carpio* on red blood cells white blood cells, haemoglobin and haematocrit during increased stocking densities in cages and in aquaria. Results indicated that red blood corpuscles and haematocrit showed increase, where as white blood corpuscles showed decrease. However haemoglobin has not shown much variation. The response of carp to mild stress and the effect of increasing stocking on various blood parameters of fish is discussed in detail.

Keywords: common carp, stocking density, red blood corpuscles, white blood corpuscles, hemoglobin, haematocrit

Introduction

Living organisms have developed many strategies to survive and cope with environmental changes to which they are exposed. These environmental constraints known as stressor stimuli, induce short-term predictable physiological changes, particularly in fishes that are ubiquitous inhabitants of the aquatic environment of all latitudes. Stressors can include many kinds of environmental changes; PH (Giles, Majewski and Hibden 1984; Tam Birkett, Makarana, Payson, Whitney and Yu-ck 1987) [6, 10] handling and transportation (Robertson, Thomas and Arnold 1988) [8] Osmotic stress (Stairness, Rainuzzo. Sigholt and Jorgenson 1994) [9] and high stocking stress (Vijayan, Ballantyne and Leatherland 1990) [13]. The typical primary physiological stress response is increased secretion of catecholamines (epinephrine) and corticosteroids (cortisol) by the hypothalamic pituitary adrenal axis (Cech, Bartholow, Young and Hopkins 1996) [2]. This response is generally independent of the type of stressor, but the quantitative aspect of the response depends on the intensity and duration of the stressor (Mazeaud, Mazeaud and Donaldson 1977) [7]. The initial endocrine responses bring several metabolic adjustments including changes in plasma osmolyte, glucose, and lactate concentrations. Cortisol, the most important corticosteroid in teleosts, contributes to the regulation of gluconeogenesis and/or glycogenesis. The high concentration of cortisol causes glucose mobilization, providing a substrate for rapid threat response (Vijayan and Moon 1992) [12].

Hypersecretion of catecholamines and corticosteroids also induces hematological changes (Mazeaud, Mazeaud and Donaldson 1977) [7]. Decreases in haematocrit and hemoglobin have been reported in fishes subjected to an acute cold stress (Chen, Sun, Lee and Chang 1995) [3].

The purpose of this study is to understand fish hematology and physiological response to stress. We used various stocking densities to induce changes in blood glucose, hemoglobin, haematocrit of *Cyprinus carpio*. The species has wide

environmental adaptation results indicated that higher stocking density influences physiology.

Material and methods

Common carp (*Cyprinus carpio*) were collected from Dal Lake Kashmir. The fishes were then acclimatized in laboratory conditions with minimal stress. Test fishes were divided into four density groups with 5, 10, 15 and 20 individuals / aquarium with 60 L water capacity. All aquaria were uniformly aerated (Sobo aerator). Each aquaria drained and filled with fresh water weekly.

Blood parameters

The blood samples collected from caudal vessel and blood samples (0.5ml) were taken into vials containing EDTA 0.5gm. Hemoglobin concentration in blood (gm/dl) was determined by Sahli's method, haematocrit was determined by micro haematocrit method. Red blood corpuscles and white blood corpuscles counted by Neubauer's chamber.

Results

Changes in blood glucose, hemoglobin and haematocrit concentration for stressed fish are presented Fig A to C respectively. Data shows that plasma glucose tends to increase in fish subjected to high stocking density. Hemoglobin and haematocrit tends to decrease with increase in stocking density. Red blood corpuscles increased with the increase in stocking density, where as white blood corpuscles decreased.

Table 1: Effect of Stocking Density on haemoglobin of *Cyprinus carpio* in nature and in captivity. (Hb/dl)

Month	In nature (cages)				In captivity (aquaria)			
	Cage 1	Cage 2	Cage 3	Cage 4	AQ 1	AQ 2	AQ 3	AQ 4
winter	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
spring	7.2	7.6	7.0	6.9	6.9	6.9	7.1	7.2
summer	6.9	7.6	6.8	7.0	7.1	7.2	6.9	6.8
autumn	7.2	6.6	7.6	6.9	6.9	7.3	7.2	7.7

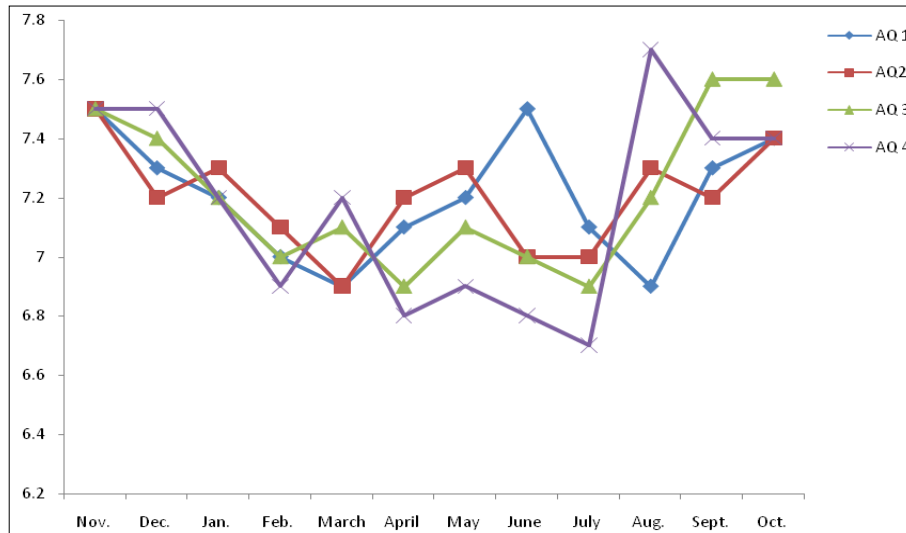


Fig 1

Table 2: Effect of Stocking Density on hematocrit of *Cyprinus carpio* in nature and in captivity. PCV (HCT%)

Month	In nature (cages)				In captivity (aquaria)			
	Cage 1	Cage 2	Cage 3	Cage 4	AQ 1	AQ2	AQ 3	AQ 4
winter.	40	40	40	40	41	41	41	41
spring	43	42	42	43	44	44	43	45
summer	45	44	43	46	46	45	46	47
autumn.	47	48	47	48	46	46	46	49

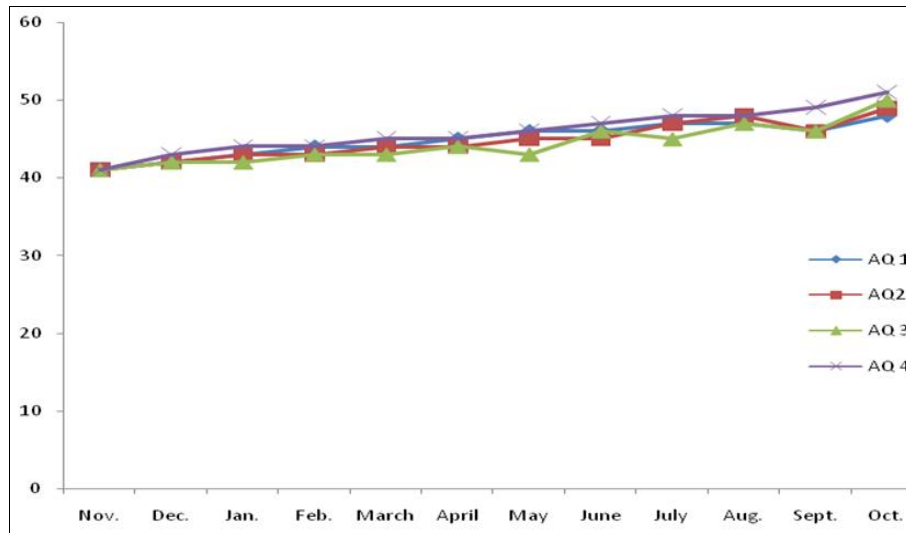


Fig 2

Table 3: Effect of stocking density on blood of carp (*Cyprinus carpio*) in nature

Month	Cage 1		Cage-2		Cage-3		Cage-4	
	RBCX 10 ⁶ /mm	TLCX 10 ⁴ /mm	RBCX 10 ⁶ /mm	TLCX 10 ⁴ /mm	RBCX 10 ⁶ /mm	TLCX 10 ⁴ /mm	RBCX 10 ⁶ /mm	TLCX 10 ⁴ /mm
winter	2.8	2.9	2.8	2.9	1	2.8	1	2.8
spring	2.9	2.6	2.9	2.4	2	2.9	x	3.0
summr	3.1	2.5	3.2	2.5	x	3.1	2	3.3
autum.	3.1	2.3	3.3	2.2	x	3.3	2	3.5

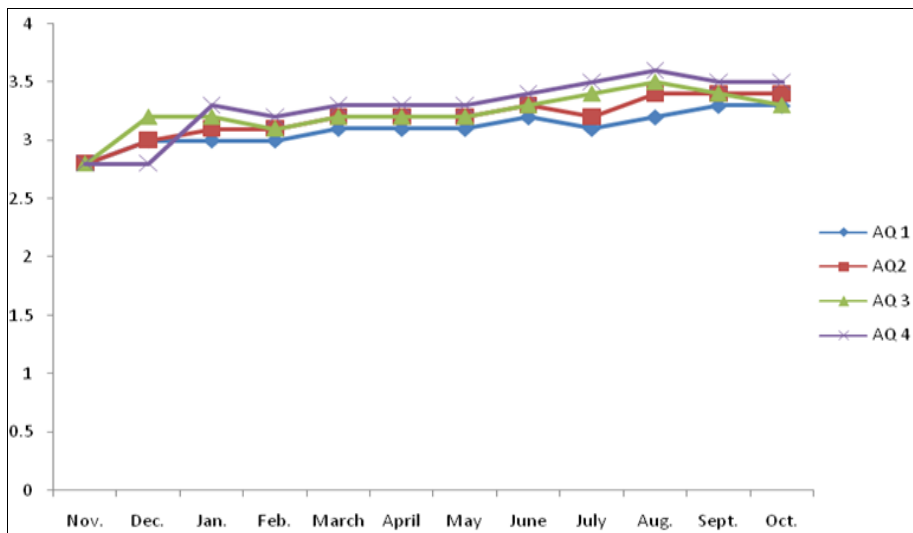


Fig 3

Table 4: Effect of stocking density on blood of carp (*Cyprinus carpio*) in captivity

Month	AQ 1		AQ 2		AQ 3				AQ 4		
	RBCX 10 ⁶ /mm	TLCX 10 ⁴ /mm	RBCX 10 ⁶ /mm	TLCX 10 ⁴ /mm	RBCX 10 ⁶ /mm	TLCX 10 ⁴ /mm	RBCX 10 ⁶ /mm	TLCX 10 ⁴ /mm	RBCX 10 ⁶ /mm	TLCX 10 ⁴ /mm	
					B			E	B		
winter	2.8	2.9	2.8	2.9	2	2.8	2.9	1	2	2.8	2.9
spring	3.1	2.6	3.2	2.5	x	3.2	2.3	3	1	3.3	2.3
summer	3.1	2.4	3.2	2.3	x	3.4	2.2	1	x	3.5	2.2
autumn	3.3	2.3	3.4	2.2	2	3.3	2.1	1	1	3.5	2.1

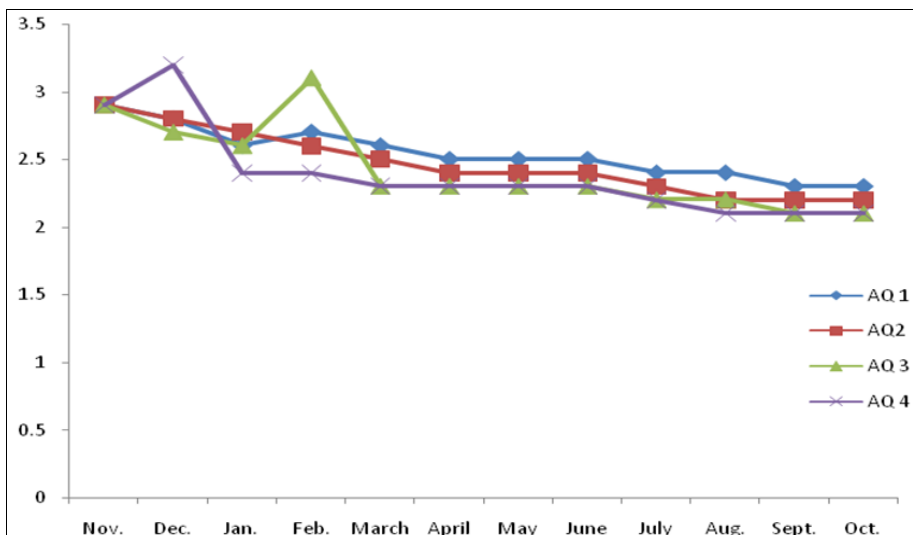


Fig 4

Discussion

As temperature decreases the osmotic concentration and blood viscosity increase. Coping with low temperatures requires the ability to maintain homeostasis. Hematological changes are good indicators of this performance (Chen *et al.*, 1995) [3]. The increase of blood glucose is the most studied response in this regard. It is the result of the activation of glycogenolysis that is under cortisol control (Vijayan *et al* 1992) [12]. Hyperglycemia during cold exposure has been reported in many species (Chen *et al* 1995; Staurnes *et al* 1994) [3, 9]. In cold treated fish, increased plasma glucose is used mainly as

an osmolyte. Salmonid fish including *Cyprinus carpio* survive at low temperature by concentrating their plasma and cellular fluid electrolytes (Na and it) and other osmolyte like glucose. Crowding is considered a common aquaculture related stressor and produces a wide variety of effects on fish such as reduced growth, health and feed conversion ratio's (wedemeyer 1997) [15]. Two factors can affect fish physiology under crowded conditions. The carrying capacity of water to provide oxygen and to dilute metabolic wastes can act as a stressor. Also the requirement for adequate space limits fish health. The rate of oxygen consumption and ammonia excretion are the factors

that limit carrying capacity of water (colt and Orwicz 1991)^[14]. Decreases in haematocrit and hemoglobin could be the result of blood osmo concentration, as sham by an increase in plasma osmolarity. This osmo concentration leads to hemodilution by body cell water. The decrease in hemoglobin concentration in cold treated fish could be also associated with a diminution of erythrocyte size (Bollard *et al* 1993)^[11]. The increase in osmolyte concentration in the plasma leads to water loss from erythrocyte and thus to their shrinkage. Hemolysis has been reported in common carp (*Cyprinus carpio*) during acute water temperature changes from 8c to 4 c. (Chen *et al.*, 1995)^[3].

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