

Seasonal LDH Stress on Protein Metabolism in Common Carp

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Abstract:

Summer season $30^{\circ}\text{C} \pm 2^{\circ}\text{C}$ is taken as control, where as rainy season with $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$ is taken as cold stress, and winter season with $15^{\circ}\text{C} \pm 2^{\circ}\text{C}$ is taken as cold adaptation. Common carp i.e., *Catla Catla*, *Labeo rohita*, *Cyprinus carpio* is taken as an experimental animals. In relation to seasonal variations, tissue variations, and species variations has been studied under LDH Stress on Total Protein Metabolism under three seasons. From summer season to rainy season the LDH activity decreases due to cold stress. During summer season due to high temperature, meager amount of Oxygen and high salinity due to strenuous activity of the fish the LDH content increases ad total protein content decreases. Where as during rainy season due to cold stress with plenty of oxygen and less temperature LDH activity decrease leading to raise in protein content. The rainy season is considered as the growth period in Common carp. Due to cold adaptation the LDH activity once again increases and protein content decreases without causing any burdon on the part of the fish but it never reaches to control value.

Keywords: LDH, Proteins, Common carp, Cold stress, Seasons, Non-osmotic tissues, Osmotic Tissues.

Introduction:

Common carp i.e., *Catla Catla*, *Labeo rohita*, *Cyprinus carpio* is taken us experimental animals to study protein metabolism in relation to LDH stress. summer season with 30°C is taken as control, rainy season with 22°C is taken as cold stress and winter season with 15°C is taken as cold adaptation. Seasonal cold stress on lactate dehydrogenase (LDH) in relation to total protein metabolism has been studied in Common Carp. Since TCA cycle is the common meeting ground for the metabolism of carbohydrates proteins and lipids yielding large amount of energy source. All type of food is converted into simple sugars glucose. The glycolytic enzyme, lactate dehydrogenase is known to increase during conditions favoring anaerobic respiration to meet the energy demands when aerobic oxidation are disturbed or lowered, occurrence of glycolytic machinery including LDH has been demonstrated in several organs including skeletal muscle ion fishes (Hochachka 1967, K.Radhakrishnaiah 2006). Lactate dehydrogenase is hydrogen transferring enzyme that catalyzes the oxidation of L-Lactate to Pyruvate with the mediation of NAD^+ as hydrogen acceptor.

Materials and Methods:

The Common Carp i.e., *Catla catla*, *Lebeo rohita* & *Cyprinus carpio* were collected at 08:00 AM from fisheries departmental pond at Anantapuramu during the respective three seasons (Summer season, Rainy season, Winter season). They have been imported to lab for organ collection. The assay for LDH and total protein content has been carried out in the laboratory at -4°C adapting the method of Nachles et al., (1962) and suggested by Prameelamma and Swamy (1970) and Lowry et al., (1951).

Results and Discussion:

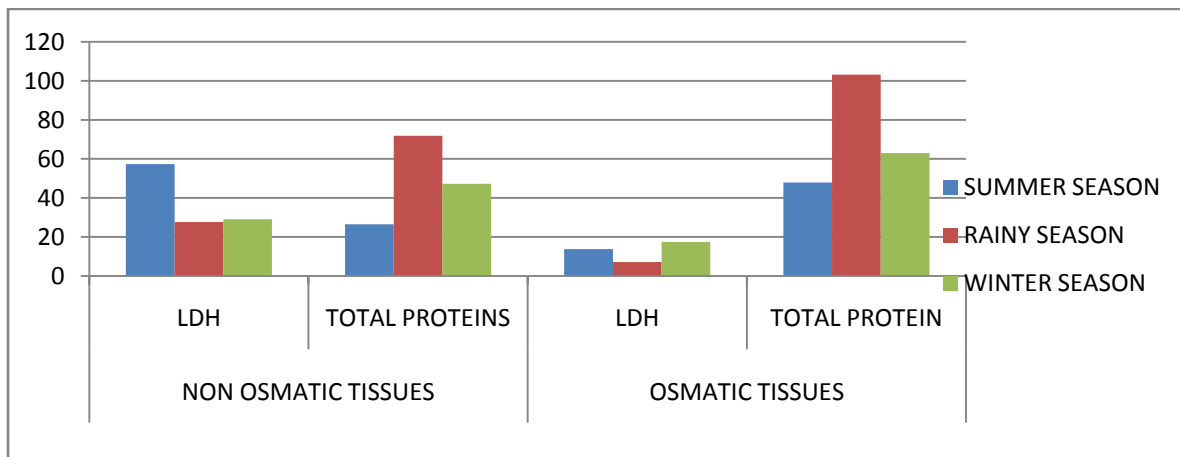
During summer season at (30°C) due to acidic stress with high temperature and PH with low oxygen content in the medium the forward reaction of LDH from pyruvate to lactate occurs. It is also to meet the high energy demands, when aerobic conditions are lowered (Martin et al., 1983) due to diminished TCA cycle enzyme activity. Increase activity of LDH is characteristic feature of a shift from aerobic to anaerobic metabolism leading to an elevated rate of pyruvate conversion into lactate resulting in Lactate acidosis (Garcia et al., 1996, Cittanova et al., 1996) and also to meet the high energy demands (Myrray et al., 1993). Due to acidic stress the breakdown of proteins dominates over synthesis under enhanced proteolytic activity (Harper et al., 1979). The increase in protease activity is due to the entry of protons into the tissues occur from blood. So the blood show acidic shift I lowering PH(Bhaskar et al., 1982). Protease hydrolyse proteins and peptide bonds resulting in the production of amino acids which are mobilized into the TCA cycle for energy releasing purpose to meet the

energy for strenuous activity of fish under LDH stress Table1, Figure1. The increase amino acids may be useful for the synthesis of new proteins and enzymes to face the stress imported by temperature (James et al., 1952). The LDH stress influences and leads to an increased protein catalytic activity as also reported by (Kunnemen and Precht., 1975) Table1, Figure1.

Table 1-Seasonal variation and Tissue variation in common carp on Total Protein content in relation to LDH stress

Seasons	Seasonal variation in common carp		TISSUE VARIATION IN COMMON CARP			
	LDH	Total Protein content	Non osmotic tissues		Osmotic tissues	
			LDH	Total Protein content	LDH	Total Protein content
Summer season	35.288	37.15	57.33	26.517	13.777	47.924
Rainy season	17.376	87.553	27.622	71.888	7.137	103.2
Winter season	23.121	55.33	29.06	47.22	17.466	63

Figure-1: TISSUE VARIATIONS IN COMMON CARP IN RELATION TO LDH STRESS(μ g of Formozan/mg protein/hour) and TOTAL PROTEIN CONTENT (mg/gram/Wet Weight)

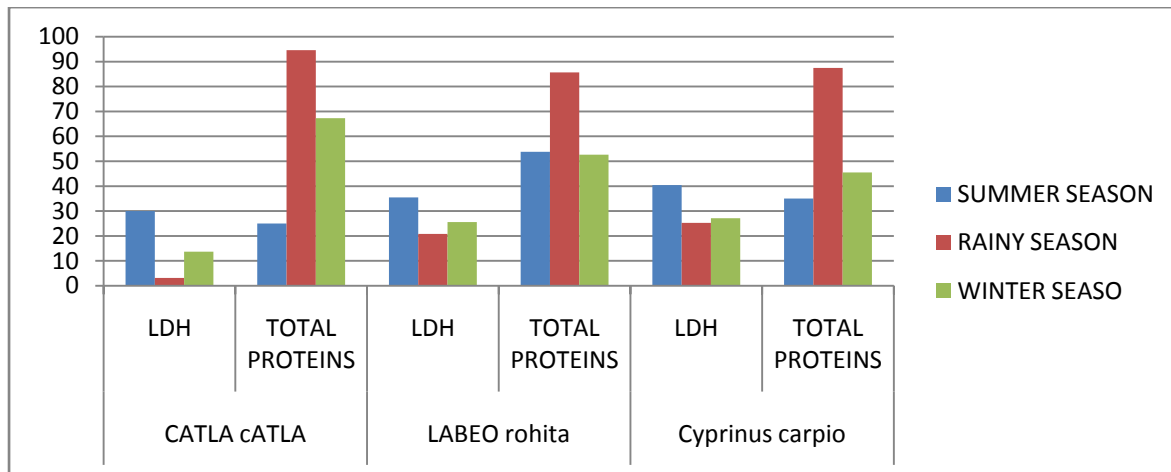


As for as tissue variation is considered in common carp the seasonal induced shifts in LDH activity the gill, kidney and intestine (osmo regulatory organs) or diametrically opposed to that of brain liver and muscle (Non-oso regulatory ornags). The LDH activity elevates in non-osmo regulatory organs which affects the stepping down of total proteins in osmo regulatory organs, the LDH activity step down which causes the total proteins to increase Figure1, Table1. The studies on distribution of muscle LDH isozyme pattern indicates that the glycolysis increase on high temperature perhaps an account of increased muscle activity (Somero, 1973, Bolaffi and Booke 1974). Brain tissue registered slightly low LDH activity than muscle.

Table-2 :Species variations in common carp with relation to Total Protein due to LDH stress

Season	Catla catla		Labeo rohita		Cyprinus carpio	
	LDH	Total Protein content	LDH	Total Protein content	LDH	Total Protein content
Summer season	30	24.99	35.47	53.8	40.4	35
Rainy season	3.161	94.6	20.8	85.66	25.27	87.5
Winter season	13.7	67.3	25.6	52.62	27.1	45.5

Figure-2: SPECIES VARIATIONS IN COMMON CARP IN RELATION TO LDH STRESS(μ g of Formozan/mg protein/hour) and TOTAL PROTEIN CONTENT (mg/gram/Wet Weight)



In case of species variation the LDH occurs in the following manner Table2, Figure2.

Cyprinus carpio > Labeo rohita > Catla catla

The LDH affects the total protein content in case of species variations occurs as follows

Labeo rohita > Cyprinus carpio > Catla catla.

During rainy season 20⁰C at cold stress in common carp with high amount of oxygen low salinity and moderate temperature the LDH activity in the organism decreases as the carp relies on oxidative metabolism, the krebs cycle increases involving preferentially channelizing of piravate into the TCA cycle (or) Krebs cycle (Somero,1973). Due to decrease of LDH at cold stress protein synthesis dominates over proteolytic activity causing increase in total protein content. There is an increase in structural proteins may help full for the animal to fortify its organs for development. The increase in soluble proteins may be helpful for the synthesis of enzymes necessary for development(Combs and Geoge, 1978). As for as tissue variation is considered the non osmotic tissues contain more LDH as glycolysis is more and less amount of total proteins. In case of osmotic tissues it contains less LDH and more amount of total proteins because at cold stress osmotic tissues are more actively respond for total proteins grater than non osmotic tissues.

As for as species variation is considered the LDH activity occurs as follows.

Cyprinus carpio > Labeo rohita > Catla catla

In case of total proteins the species variation as occurs as follows

Catla catla > Labeo rohita > Cyprinus carpio

During winter season (15⁰C) at cold adaptation with moderate amount of oxygen and salinity and low temperature in the water in the common carp there is an stepping up on LDH activity and decrease of total protein content due to increase protiolysis causing degradation of total proteins and increase of amino acids figure1, tale1. Total proteins decreases with out causing any metabolic burden on on the part of the fish. This increase amino acid level is partly helpful for the production of energy (Solinkka etal., 2000) and also for the synthesis of required proteins. Free amino acids also act as osmotic and ionic effectors (Cola 1977, Jwiss, 1980). As for as tissue variationis considered LDH is more in non osmotic tissues where as total proteins are less in non osmotic tissues. In case of osmotic tissues the LDh activity is less where as the total proteins content s high.

In case of species variations in the LDH it occurs as follows

Cyprinus carpio > Labeo rohita > Catla catla

In case of species variation for total proteins content it occurs as follows

Catla catla > Labeo rohita > Cyprinus carpio

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