

## Research Article

## Pattern Morphology of Eye Region and Lactic Dehydrogenase and Glucose-6-Phosphate Dehydrogenase Isoenzyme Fractions in Some Freshwater Fishes

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**Abstract:** The study was undertaken to illustrate the variation of eye size, its relative area in relation to the head and genetic variations of the isoenzymes of lactic dehydrogenase and glucose-6-phosphate dehydrogenase in three freshwater fishes. These are *Bagrus bajad* (Forsskål, 1775, order: Siluriformes and Family: Bagridae), *Labeo niloticus* (Forsskål, 1775, order: Cypriniformes and Family: Cyprinidae) and *Lates niloticus* (Linnaeus, 1758, order: Perciformes and Family: Centropomidae) were captured from River Nile of Egypt and investigated for position of eye and their surface area in relation to head region as well as investigated the retina iso-enzyme electrophoresis to predicted the activity and genetic variations. The study revealed that the average percentage of eye size was increased in *Bagrus baja* in comparison with *Lates niloticus* and *Labeo niloticus*. *Bagrus bajad* is nocturnal fish. The protrusion and localization of eye in the front of the head region reflected the accommodation to its carnivorous feeding. The isoenzyme fractions of lactic dehydrogenase and glucosde-6-phosphate dehydrogenase varied between the studied fishes. Finally the author concluded that the eye's size and position in the head region represented the habit of feeding and accommodation to the environment. Also, the expression of lactic dehydrogenase and glucose-6phosphate dehydrogenase retinal isoenzymes represented the genetic differences between the studied fishes.

**Keywords:** Freshwater fishes, eye, isoenzymes, lactic dehydrogenase, glucos6-pghosphate dehydrogenase.

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## INTRODUCTION

The eye is the primary organ that transmit all environmental data and enables individuals to perform the vital function [1, 2]. The size of the eye reflected its role in visual acuity of the fishes taking into account their contents of retinal photoreceptors and ganglion cell. Studies of both diurnal and nocturnal cardinal fish showed increased eye diameter in nocturnal fishes more than diurnal one (*Apogonidae*) [3]. Carnivorous fish also, have apparent large eye size than herbivorous ones [1].

On the other hand, the isoenzyme expression of lactic dehydrogenase and glucose 6 phosphate dehydrogenase reflected the genetic variations of the fishes. The were two structural genes in vertebrate somatic cells ; Ldh H and Ldh M that involved the expression of lactate dehydrogenase [4].The two genes, are involved two polypeptides H and M, respectively, but are independently regulated. Five isoenzyme fractions are produced if both genes are active within the same cell, which are identified by electrophoresis as Hq, H3M, H2M2, HM\$, and M by electrophoresis [5].

Also, it is also established that the regulation of blood glucose levels in both omnivorous and

herbivorous fish is carried out by increased glycolysis and lipogenesis and decreased gluconeogenesis compared to carnivorous fishes [6]. Glucose-6-phosphate dehydrogenase is a pentose phosphate pathway managed for the breakdown of glucose and energy production [7]. It is known that G6PDH is involved in pentose pathway oxidation, and the production of nicotinamide adenine dinucleotide phosphate (NADPH) [8, 9], which modulated glutathione (GSH) in its reduced form facilitating scavenging the reactive oxygen species [10, 11].

Little is known about the correlation between the size and localization of enye in head region of freshwater fishes as well as the retinal lactic dehydrogenase and glucose-6-phosphate dehydrogenase isoenzyme fractions. The present study illustrate the variations of eye regions in three fresh water fishes; *Bagrus bajad*, *Labeo niloticus* and *Lates niloticus*.

## MATERIALS AND METHODS

Five individuals from freshwater fishes including *Bagrus bajad* (Forsskål, 1775, order: Siluriformes and Family: Bagridae), *Labeo niloticus* (Forsskål, 1775, order: Cypriniformes and Family: Cyprinidae) and *Lates niloticus* (Linnaeus, 1758, order:

Perciforms and Family: Centropomidae) were captured from River Nile, euthanized and their localization of eye region in relation to head as well as diameter area of eye region in relation to the head area. The diameter of eye ball is determined in relation to eye region and recorded. The retinas were separated, homogenized in tris buffer and protein was separated and run for gel electrophoresis [11, 12]. Lactic dehydrogenase: LDH isoenzyme was determined according to Sarkar *et al.*, [13]. Also, glucose 6 phosphate dehydrogenase was determined using a method based on Gaal *et al.*, [14].

## RESULTS

### Macroscopic Analysis of Eye Region

The studied fishes showed different measurements of eye region in relation to the head. The *Lates niloticus* possessed characteristic localization of the eye ball in the proximal head region near the mouth opening. In the proximal head region near the mouth opening, the *Lates niloticus* had a distinctive localization of the eye ball in comparison with the other studied fishes. The relative percentage of eye ball/head surface diameter is markedly increased in *Lates niloticus* more than *Bagrus bajad* and *Labeo niloticus*. The eye pupil surface area is less increased in *Labeo niloticus* and *Bagrus bajad* more than *Lates niloticus*. *Bagrus bajad* is a nocturnal fish and characterized by more circular eye pupil in comparison with the diurnal

*Labeo niloticus* and *Lates niloticus*. This pattern shape of the pupils reduced their aphakic gaps and adapted for increasing visual sensitivity in the dark environment. Also, relative average large eyes and eye pupil facilitated gathering of light. The studied fishes possessed dark colour pupil outlined by irideal pigmentation orange ring, comparatively more enlarged in *Bagrus bajad* more than *Lates niloticus* and comparatively small in *Labeo niloticus*. *Lates niloticus* showed characteristic protrusion of eye ball with distinct eye lid and pupil opening in comparison with the other studied fishes. *Bagrus bajad* is a nocturnal fish and characterized by more circular eye pupil in comparison with the diurnal *Labeo niloticus* and *Lates niloticus* (Figure-1).

### Retina isoenzyme electrophoresis:

LDH isoenzymes showed a close similarities of the studied species and composed of three isoenzyme fractions. The first and second isoenzyme fractions are similar in the studied fishes. However, fraction three showed high flow rate in *Labeo niloticus* and decreased flow rate in *Lates niloticus* in comparison with *Bagrus bajad* (Figure-2). On the other hand, G-6PDH expressed four isoenzyme fractions with nearly similar intensities and distribution in the studied fishes (Figure-2).

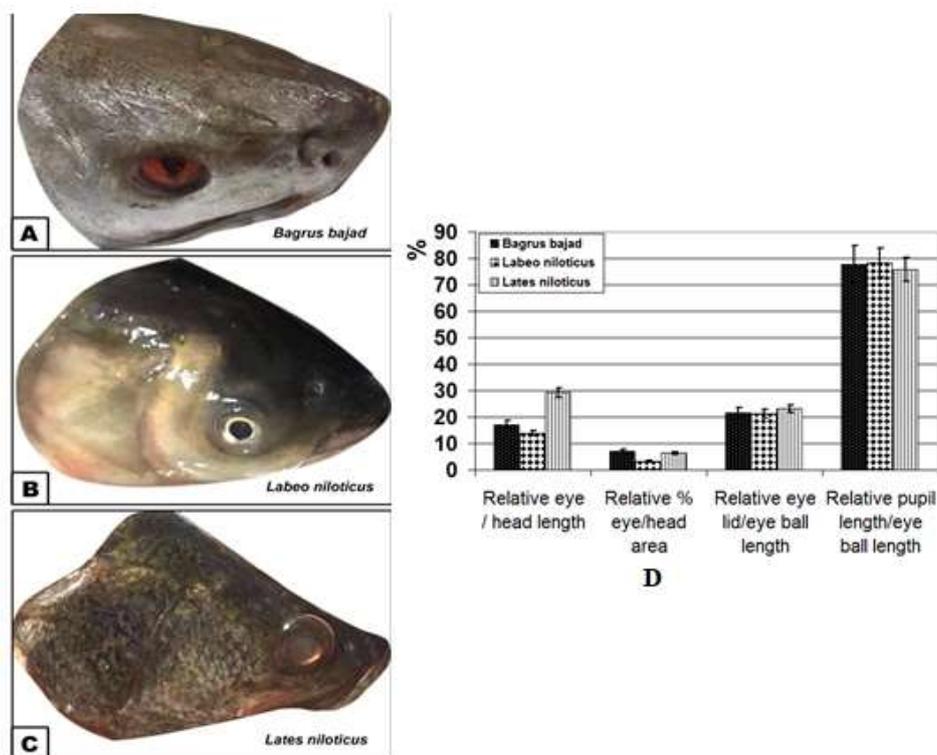
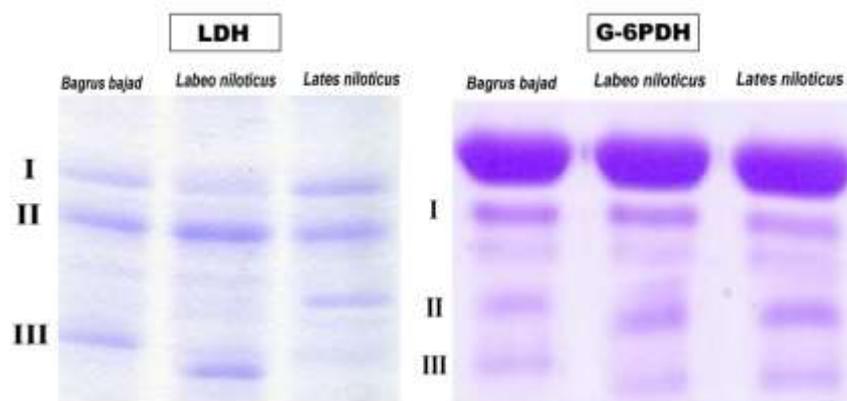


Fig-1: Photomicrographs of head region of studies fishes illustrated the position and size of eye in relation to head region. Note proximal localization of eye ball in *Lates niloticus* compared to medial housing in *Labeo niloticus* and distal localization in *Bagrus bajad*. Eye ball is comparatively larger in *Bagrus bajad* in comparison with the other species. D.. Chart illustrating percentages of correlation between eye and head region of the studied fishes



**Fig-2: Isoenzyme electrophoresis of G-6PDH and LDH of retina in *Bagrus bajad*, *Labeo niloticus* and *Lates niloticus* showing expression of three isoenzyme fractions of lactic dehydrogenase and four isoenzyme fractions for glucose -6-phosphate dehydrogenase**

## DISCUSSION

The studied fishes showed different measurements of eye region in relation to the head. The *Lates niloticus* possessed characteristic localization of the eye ball in the proximal head region near the mouth opening. In the proximal head region near the mouth opening, the *Lates niloticus* had a distinctive localization of the eye ball in comparison with the other studied fishes. The relative percentage of eye ball/head surface diameter is markedly increased in *Lates niloticus* more than *Bagrus bajad* and *Labeo niloticus*. The eye pupil surface area is less increased in *Labeo niloticus* and *Bagrus bajad* more than *Lates niloticus*.

The circular pattern of eye was also recoded in nocturnal fishes reef fishes [1, 15].

*Bagrus bajad* is a nocturnal fish and characterized by more circular eye pupil in comparison with the diurnal *Labeo niloticus* and *Lates niloticus*. This pattern shape of the pupils reduced their aphakic gaps and adapted for increasing visual sensitivity in the dark environment. Also, relative average large eyes and eye pupil facilitated gathering of light.

The present findings of nocturnal fishes are in accordance with the study carried out on eyes of zooplanktivorous labrid fishes [15] and some species of cardinal fishes [2, 16].

It is known that LDH enzyme catalyzed the reversible lactate oxidation and pyruvate reduction [17].

The expression of lactic dehydrogenase isoenzymes differed between fish species, with only one isoenzyme fraction in flatfish [18], meanwhile in longnose and blacknose dace (*Rhinichthys cataractae* and *R. atratulus*) and some of the carp and the barb (*Cypriniformes*), five isozymes fractions were expressed in heart and muscle [19, 20]. The varied expression also reflected the metabolism in body organs which are quite different.

Studies conducted by El-Alfy *et al.*, [21] on tilapiine fishes indicated that 3-5 isoenzyme fractions. On the basis of one of the two following alternatives: these narrow 205 banded pattern may be clarified; the first is the evolutionary divergence after genome replication between the two *Ldh* loci.

While the green sunfish (*Lepomis cyanellus*), have three LDH loci, A, B, and C, due to the presence of three different polypeptides, more than three isoenzyme bands are expressed in their tissues [22]. The changes in isoenzyme expression was primarily due to the different rates of synthesis polypeptide rather than catabolism of the isoenzyme fractions [23].

Concerning glucose-6-phosphate dehydrogenase, different intensities of the isoenzyme fractions were shown in the current findings. This findings supported the findings of Darwish *et al.*, [24] in retina of marine fishes *H. hippocampus* and *S. pilchardus*. These may reflect the high demand of energy for vision which required high activity of G6PD isoenzymes activities [24]. Also, the present findings agree with the work of Sabry and El-Badry [25] in retina of *Clarias gariepinus*.

Finally the author concluded that the eye's size and position in the head region represented the habit of feeding and accommodation to the environment. Also, the expression of lactic dehydrogenase and glucose-6-phosphate dehydrogenase retinal isoenzymes represented the genetic differences between the studied fishes.

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