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# Health comparison of farm-raised and wild-caught *Labeo rohita* (Cypriniformes: Cyprinidae)

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**ABSTRACT**

Freshwater fish are traditionally captured from rivers but due to their increasing demand fresh water fish culture is gaining popularity. The environmental changes in natural aquatic bodies due to ever-increasing input of pollutants in them adversely affect fish populations and also the pollutants get bio-accumulated in the aquatic food chain. The present study was undertaken to compare selected health parameters of farm-raised and wild-caught *Labeo rohita*. Twenty fish were taken from each of the two groups to perform kidney and liver enzymes profile and histological analysis. The results showed that the values concerning liver function enzymes were significantly altered in wild-caught fish as compared to farm raised fish. Also, significant difference was noted in serum creatinine and urea values between the two groups. Histology of liver and kidney tissues revealed signs of chronic damage in the wild captured fish as characterized by lymphocyte infiltration and altered morphology of functional units. It is concluded from findings of the present study that farm-raised *Labeo rohita* were healthier and safer to consume compared to the wild-caught fish.

**Keywords:** River Jhelum, *Labeo rohita,* Kidney, Liver, Histology

## INTRODUCTION

Fish is a magnificent source of nutrients for human beings; a considerable segment of world's population benefits from it for economical survival and health particularly in developing countries (Orr *et al*., 2012). Fish provides essential macronutrients and micronutrients, such as proteins, essential fatty acids, vitamins and minerals. Apart from providing food security, fisheries industry is involved in trade and revenue generation (Orr *et al*., 2012). Increased productivity from sustainable fisheries and aquaculture can be a driver for rural development by mitigating risks to livelihoods, contributing to income generation, employment opportunities, and consequently reducing hunger and poverty for millions of people in the developing world. Sustainable production of fisheries and aquaculture improve food security, promote economic growth and protect environmental and natural resources (Welcomme *et al*., 2010).For the sustainable supply of fish, it is important to avoid any disaster which can be in the form of environmental pollution, habitat disturbance or disease.

Pollution of aquatic habitats is of major concern due to input of contaminants from point and non-point sources, such as industries, agriculture, and rural and urban households. These contaminants pose danger to the survival of life in these water bodies (Benson *et al.,* 2007), and they not only reduce the survival of fauna and production efficiency of the water body but also get accumulated in the food chain leading to the development of various diseases and abnormalities (Canbek *et al.,* 2007).

River Jhelum is one of the affluent rivers of Indus River basin in Pakistan (Mirza *et al*., 2011). It is one of the largest rivers of Punjab and irrigates vast areas of eastern Pakistan. Along with other freshwater fauna, some important fishes belonging to the families *Cyprinidae* and *Channidae* inhabit this river (Mirza *et al*., 2011). *Labeo rohita* (a member of family *Cyprinidae*, commonly called "Rohu") is one of the most important commercial fishes of Pakistan and is extensively cultured in farms. However, the public demand and preference for wild Rohu is much more than the farmed fish and it has been observed that the local rivers are not able to cater this demand both in quantity and

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quality in the past few years. The water in Jhelum River gets contaminated by pollutants from some point and non-point sources, such as industries, household wastes and other human activities. Therefore the present study was conducted to compare selected health parameters of wild-caught *Labeo rohita* from River Jhelum with farm raised *Labeo rohita* to determine which is safer source of the fish for human consumption.

## MATERIALS AND METHODS

### Sampling sites

For sampling wild *Labeo rohita*in Jhelum River, Jammargal Dam site in the river was selected (Fig.1a). This location in the river is extensively used by fishermen for capturing fishes. The farm-raised fish samples were procured from Government of the Punjab, Department of Fisheries, Manawan, Lahore, Pakistan (Fig. 1b).


**Fig. 1a**


**Fig. 1b**

**Fig. 1**: Location of fish sampling sites taken from Google Maps: (a) Jammargal Dam; (b) Manawan Fish Hatchery, Lahore, Pakistan.

### Fish samples

Completely healthy fish (average weight, 922 ± 54 g and average length 37 ± 2 cm) collected from both the above-mentioned sources were used in this study. Approximately 25 specimens were collected from each site. After sampling, the fish specimens were brought to the laboratory for further processing following standard methods of handling and transportation to reduce the possibility of infection.

In the laboratory, the fish were kept in clean and disinfected aquaria to get them acclimated and prevent them from any stress. After acclimatization, blood was drawn from caudle peduncle using standard procedure (Lucky, 1977) and serum was separated. Thereafter, each fish was immediately dissected to obtain liver and kidney for histological studies.

### Serum evaluation

The serum of fish was tested for liver enzymes; Aspartate Aminotransferase (AST) and Alanine Aminotransferase (ALT) using commercial kits (Randox AS 1267 and AL 1205). Serum urea and creatinine levels were also measured to determine kidney health using Randox kits, UR 107 and CR 510.

### Histological studies

After dissection, the liver and kidney of each fish specimen were immediately put in the fixative (10% formalin) until further processing. These organs were processed for hematoxylin and eosin staining (H and E staining) for histological studies (as described by Gartner and Hiatt, 1997; Young and Heath, 2000).

### Statistical analysis

The collected data were analyzed by using student's *t*-test (Microsoft excel, 2017). *P* values were determined at 95% confidence level.

## RESULTS

Liver function test using AST and ALT was performed on the serum of both wild-caught and farm-raised fish. The outcome was a significantly higher value ($p < 0.0001$) of AST and ALT observed in the serum of wild-caught fish as compared to farm-raised fish (figure 2a, b).

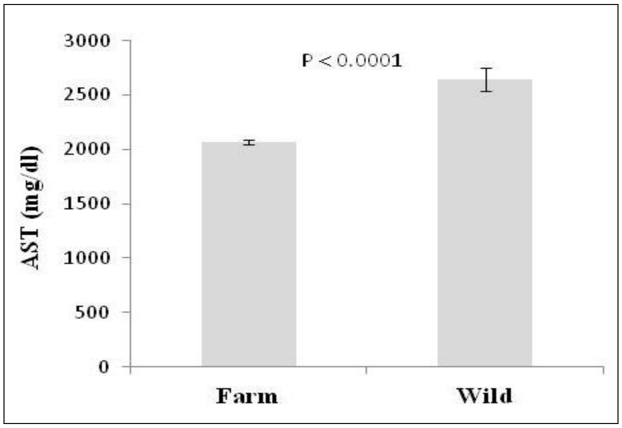


**Fig. 2a**

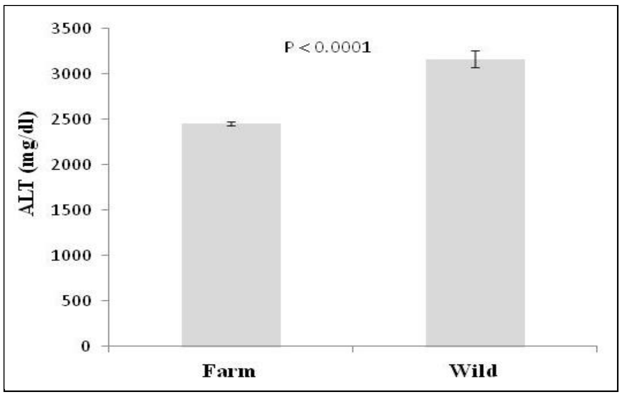


**Fig. 2b**

**Fig. 2:** Comparison of liver enzymes (a. AST; b. ALT) in serum of *Labeo rohita* samples obtained from the wild and farm-raised.

For the determination of kidney health, urea and creatinine levels were measured in the serum of wild-caught and farm-raised fish. The urea level was slightly higher in the farm-raised fish as compared to the wild-caught fish, whereas, creatinine level was higher in wild-caught fish (Fig. 3a,b).

Histological comparison of the liver and kidney of farm-raised and wild-caught fish showed significant differences. The liver of wild-caught fish had severe lymphocyte infiltration as compared to liver of farm-raised fish (Fig. 4a, b). The kidney of wild-caught fish had accumulation of lymphocytes and greatly reduced number of kidney functional units as compared to farm-raised reared fish (Fig. 5a, b).

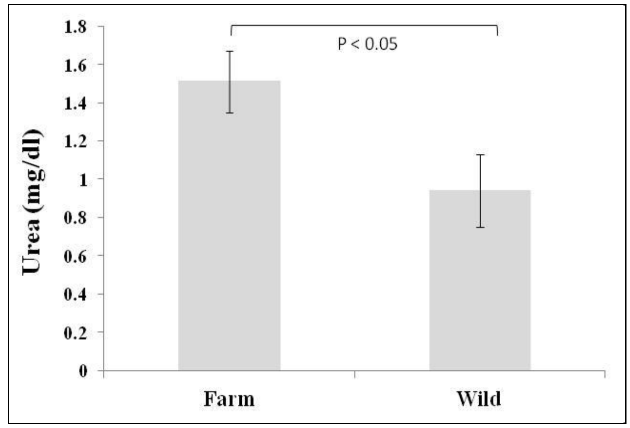


**Fig. 3a**

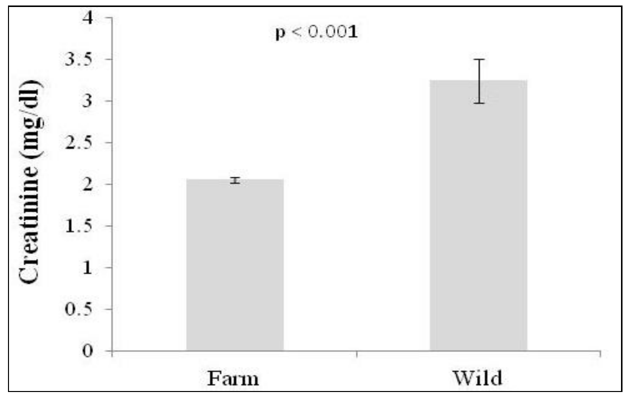


**Fig. 3b**

**Fig. 3:** Comparison of kidney urea (a) and creatinine (b) levels in serum of farm-raised and wild-caught *Labeo rohita*.

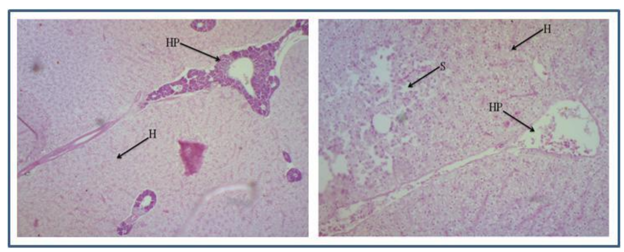


**Fig. 4a**

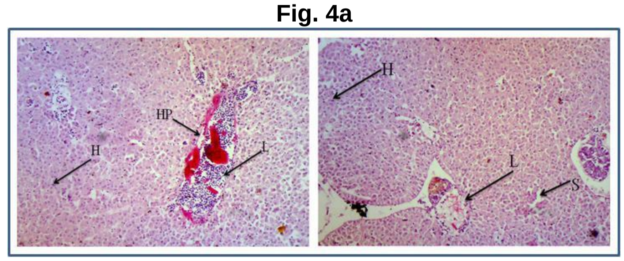


**Fig. 4b**

**Fig. 4**: Histology of liver a. farm-raised *Labeo rohita* showing normal liver structural units; b. wild- caught *Labeo rohita* showing lymphocyte infiltration; H (Hepatocyte), HP (Hepatic portal vein), S (Sinusoids), L (Lymphocyte infiltration) 40x.

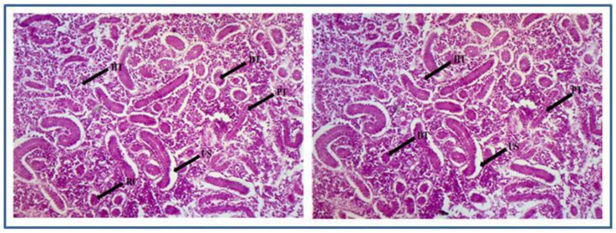

**Fig. 5a**

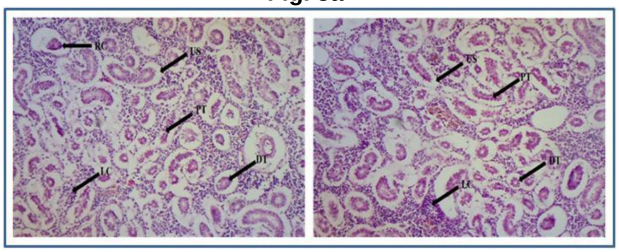

**Fig. 5b**

**Fig. 5:** Histology of kidney a. farm-raised *Labeo rohita* showing normal kidney structural units, b. wild-caught *Labeo rohita* showing lymphocyte infiltration and reduced number of kidney units.; HT (Hemopoetic Tissue), DT (Distal Tubule), PT (Proximal Tubule), US (Urinary Space), (Renal Corpuscle) LC (Lymphocytes) 40x.

## DISCUSSION

Accumulation of pollutants in the aquatic environments is making them insecure not only for the inhabiting fauna therein but also for humans in terms of fish consumption. Fish are very sensitive to any change in their environment and are often used as bio indicators of several pollutants (Nsikak *et al.,* 2007).In the present study, a comparison has been made concerning the health condition of an edible popular fish species, *Labeo rohita,* captured from the wild with its farm-raised synonym to determine its safety for human consumption.

River Jhelum is a tributary of Indus River and runs through various regions of Pakistan. During its course it is exposed to various sources of pollutants that deteriorate not only water quality but also pose threat to the survival of life therein. The disruption of aquatic habitats due to their exposure to toxic substances has led to declines in numbers and quantity of many species especially fish. The bioaccumulation of toxins and pollutants in aquatic animals occurs due to higher accumulation levels of these pollutants in their environment which, in turn, disturb the whole food-chain and eventually reach the bodies of human beings and play a role in development of various diseases (Giari *et al.,* 2007).

In fish as in many other animals, liver is an important organ involved in the metabolism of lipids, proteins, carbohydrates, detoxification and storage of glycogen and vitamins (Kmiec, 2001). It has been reported in several studies that liver is the highest toxins accumulating target organ and plays a crucial role in disease development. Serum AST and ALT levels are common biomarkers of l health of liver and their high levels indicate poor liver health (Wales, 1983). The liver health was compared in this study between farm-raised and wild-caught *L. rohita*. The serum levels of AST and ALT were found to be significantly elevated in fish captured from the wild (river). This significant increase of AST and ALT levels in the field-captured *L. rohita* indicated that liver of these fish were damaged which might have been due to their continuous exposure to pollutants. Higher serum levels of these enzymes also indicate cardiac and liver damage (Wales, 1983). Higher AST values are indicative of inflammation and it is supported by the increased infiltration of lymphocytes in the histology of liver of wild fish. The liver damage signs, such as abnormal enzyme values and histology in the field-captured fish are indicative of stress, injury, infection and disease, which might be in response to high toxin contents in the environment of these fish. The higher levels of toxins might be the result of runoffs of fertilizers and heavy metals and other pollutants into the River Jhelum from point- and non-point sources.

Along with liver, the kidney of wild-caught fish was also found damaged. The histological comparison showed less number of kidney functional units, increased urinary spaces and lymphocyte infiltration in kidney of fish captured from the wild as compared to farm-raised fish. These observations indicate kidney damage which is supported by amplified levels of creatinine in the serum of wild-captured fish. Creatinine is a nitrogenous end product of metabolism and is released continuously from kidneys. The proper removal of this product indicate proper kidney functioning. Increased creatinine level is indicative of problem in kidney filtration process and decreased kidney function (Ajeniyi and Solomon, 2014). The wild captured fish kidney damage is evident from the higher values of this kidney function biomarker and this increase might have been due to higher pollutant content in the environment of wild-caught fish. Exposure to toxins affects kidney function which results in elevated levels of creatinine in serum (Sawsan *et al*., 2017).

Urea, another metabolic waste, also determines kidney function. In the present study, urea levels were slightly higher in fish samples obtained from the farm as compared to wild-caught. It is likely that due to higher serum urea levels, farm-raised *L*. *rohita* may also be suffering from kidney damage; however, histological investigation showed no signs of damage. Serum urea level might have increased due to higher protein content in the diet, as urea is the byproduct of protein metabolism (Ajeniyi and Solomon, 2014). Serum urea level depends upon dietary protein content so farmed fish are prone to have higher urea content as they are fed protein-rich diets.

In conclusion, this study indicated that field-captured *Labeo rohita* from Jhelum River were suffering from chronic liver and kidney damage probably leading to decrease in its population. These damages are mainly due to poor water quality and increasing pollution levels in the fresh water bodies. Moreover, the farm-raised fish are safer and healthier for human consumption due to lesser exposure to pollutants than the wild-captured fish. It is recommended that measures should be adopted to keep the natural water bodies free of pollutants as much as possible to maintain the aquatic fauna and avoid extinction of species.


## ACKNOWLEDGEMENT

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