FISHERY SCIENCE I

**CIRCULATORY PHYSIOLOGY**

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**CIRCULATORY PHYSIOLOGY**

* Heart :-
* 2 chambered heart
* They have one atrium and ventricle
* Heart resembles the embryonic condition of all other vertebrates
* Afferent branchial arteries develop from aortic arches 3,4,5

& 6 to supply blood to the gills

* Conus arteriosus is muscular extension of the ventricle which lead into the ventral aorta
* Posterior end of the heart is sinus venosus, a thin walled space where blood from the veins gathers before entering the atrium





* Heart have 3 layers

1.Epicardium – outer epithelium layer

2.Myocardium – composed of straited muscle ( inner spongy & compact)

3.Endocardium – blood vessels & nerves areb present

Shape of the heart:-

* Ventricle have pyramid shape in active swimming species, eg:- salmonids
* Others are elongated , tubular ,or rounded



The fish heart -pump

* The heart is pump that generate the driving pressure for the circulation of blood ( arterial pressure)
* 2 chambered heart- 1 atrium & 1 ventricle, 2 other chamber – sinus venosus & bulbus arteriosus
* Blood from the body , which is low oxygen enter atrium via sinus venosus, which contain pacemaker cells initiate the contraction
* Then pumped into ventricle from atrium ( thin walled muscular chamber)
* Blood pumped into bulbus arteriosus by the ventricle ( thick walled) chamber with cardiac muscle
* Ventricle is responsible for the generation of blood pressure
* The last chamber, bulbus arteriosus reduce blood pressure
* After BA, are the gill organ ( thin walled & may be damaged)
* BA contain elastic components



* Heart is composed of typical vertebrate cardiac muscle
* Cholinergic fibers innervate the heart except in hagfish which have aneural heart (fish lack sympathetic innervation)
* In fishes, the heart only has 1 atrium and ventricle
* Oxygen depleted blood returns from the body enters atrium  ventricle  gills  body
* Atrium collects blood that has returned from the body pass to the ventricle and they enter into the gills where gas exchange occur & blood re-oxygenated ( gill circulation)
* Blood then continues through the rest of body and pass to the atrium ( systemic circulation)
* Function of circulation :- distribute nutrients, oxygen and hormones and remove the metabolic wastwe which are carried to excretory organs
* Veins or arteries has 3 layered
1. Outer layer is Tunica adventia – connective tissues
2. Middle – Tunica media – connective tissues & muscle – absent in some veins
3. Inner layer is Tunica intima- endothelium



Blood composition of fish

* RBC
* WBC
* THROMBOCYTES

\*Plasma :-

* Plasma consist of water – it act as solvent –lymph is the part of plasma
* The marine teleosts in polar, contain antifreezing protein (AFP) / Antifreezing glycoprotein(AFGP)
* Plasma contain albumin- control osmotic pressure
* It contain lipoprotein- to transport lipids
* Ceruloplasmin- copper binding protein
* Fibrinogen & iodurophorine
* Total plasma protein in fish- 2-8g/d
* T3 & T4 present – thyroxine bind to vitellogenin in several cyprinid species





* RBC:-
* RBC cytoplasm coppery purplish , coppery pinkish or light bluish in indian fresh water teleosts
* Mature erythrocytes contain abundant haemoglobi and are pink / yellowish on preparation stained with Giesma
* Cytoplasm take eosin stain due to haemoglobin and basophilia due to staining of ribosomes
* Double staining cell- polychromatophilic erythroblastreticulocytes
* In adult teleosts, immature red cells – Proerythrocytes present- it varies species as well as the age of individual, season and environmental conditions
* Nucleus is round / oblong in shape
* Larger in elasmobranchs
* Brackish water species have smaller blood cells than FWF
* Erythrocytes smaller in active species
* In deep sea teleosts, size of RBC larger
* Clarias batrachus– round shape , Labeo rohita- oval /oblong
* WBC:-

\*Agranulocytes – no granules, unlobed

1. Lymphocytes – numerous type, round/oval shape, rich in chromatin

Function- produce immune mechanism by the production of antibodies, T&B lymphocytes present

2. Monocytes – much less propotion, often absent in few fishes, nucleus fairly large & varied shape

Function- phagocytic

• MACROPHAGE:- phagocytosis of RBC which undergo degradation

\* Granulocytes :- granules present

1. Neutrophil (5-9%)- numerouas in no., 25% of leucocytes inn brown trout , multilobed shape of nucleus , granules pink, red, or violet in blood smear
2. Eosinphils- low percentage
3. Basophil:- round/ oval, absent in anguilled and place

• THROMBOCYTES/ SPINDLE CELLS – - 82% of WBCin herring

* Round, oval/ spindle shaped cells
* .7% in other teleosts
* Helped to blood cloting

haemopoiesis

* Spleen, lymph nodes and many organs are blood forming sites
* In elasmobranchs, erythrocytes& granulopoietic tissues are produced in the organ of Leydigs, epigonal organ and kidney
* If spllen, removed , Leydig take over RBC production
* In teleosts, both RBC & granulocytes are produced in kidney ( pronephros ) and spleen
* Spleen – red outer cortex- & white inner pulp medulla
* In RBC, thrombocytes are made from cortex
* Granulocytes from medulla
* In bony fishes( actinopterygii) RBC destroyed in spllen
* In Chondrichthyes anf Lung fishes, intestine spiral valve – WBC production
* Function of blood cells:-
* Respiration
* Nutrition - Excretion
* Haemostasis
* Hormones transport
* Humoral agent