SUMMARY

Nutritionally balanced and quality controlled diets for fish production are crucial importance. The supplemental vitamins in feed are important to promote growth of fish. These are required in small amounts in the diet but play major role in growth, physiology and metabolism. Fish are extremely sensitive to vitamin C deficiency. It is necessary for production and maintenance of intercellular substances involve in wound repair, maturation of erythrocytes for normal blood haematology, and increase in resistance to infections. Three sources of ascorbic acid viz., L-ascorbic acid (AA), L-ascorbyl-2-monophosphate (AAP) and L-ascorbyl-2-sulfate have been tested for *H. fossilis* diets. Only about 81% of AA was retained during processing and storage when compared to about 98% of AAP and AAS. Because AA is much less stable during processing and storage. So L-ascorbic acid needs special caution with regard to the time allowed during processing of diet preparation and storage. Vitamin C is required in the diet of *H. fossilis* for normal growth and physiological conditions. More growth, survival and normal haemopoiesis were noticed in fish fed 100 mg AA and AAP diets and 1000 mg AAS diets. Quadratic regression analysis showed that the optimum requirement for maximal growth is 537.61 mg AA or the equivalent of 542.43 mg AAP or the equivalent of 986.82 mg AAS / kg diet. Blood, liver and or anterior kidney concentration of ascorbic acid changed on accordance with dietary concentration of ascorbic acid, the each value should represent the size of the body pool of ascorbic acid. AAP is markedly more effective in maintaining tissue concentration of ascorbic acid in *H. fossilis* than AA; whereas AAS, is relatively ineffective at the doses fed. The weight gain was normal and no deficiency signs were observed in several treatments when liver ascorbic acid levels were more then 20μg / g tissue. *H. fossilis* fed diets devoid of vitamin C
developed lethargy, hypersensitivity, erosion in fins, exophthalmia, cataract and degeneration of gills during the 9th week of the experimental period. At the end of the experiment, postmortem of the fish showed haemorrhages in intestine, kidney liver and muscle. Fish fed control diets showed intense blood cell anomalies. Erythrocyte fragmentation, poikilocytosis, anisocytosis, cytoplasmic clearing and smudge cells were often observed in fish fed control diets.

Folic acid is also required in the diet of *H. fossilis* for normal growth and physiological conditions. More growth, survival and normal haemopoiesis were recorded in fish fed 4 mg folic acid / kg diet. Quadratic regression analysis indicated that the optimum dietary requirement for maximal growth is 5.62 mg / kg diet. Internal microorganisms are a significant source of folate for *H. fossilis*, as indicated by marked reduction in growth, survival and haemopoiesis when sulfonamide was included in the diet. Fish without a supplement of folic acid showed leukopenia and lymphocytopenia. Feeding sulfonamide further reduced the concentration of lymphocytes and increase neutrophil concentrations. Morphological characteristic of blood cells in this study such as macrocytes, spectacle cells and the increased numbers of haemocytoblasts were similar to idiopathic anaemia in channel catfish.

Dietary vitamin E level of 50 mg / kg diet with selenium at level of 3.0 mg / kg diet enhanced the growth, survival and haemopoiesis of *H. fossilis*. Quadratic regression analysis showed that the optimum dietary requirement of vitamin E for maximal growth is 56.93 mg / kg diet. The gross vitamin E deficient signs such as dermal depigmentation, erratic swimming behaviour and ascites were observed in fish fed vitamin E deficient diets. However, certain other parameters measured in this study indicate that a dietary vitamin E level of 50 mg may be sufficient for
maintaining the health of fish. Fish fed no vitamin E diet showed anaemic condition. Microscopic examination of blood smear in fish fed neither vitamin E nor selenium diet showed erythrocyte fragility and more immature erythrocytes. Fish fed selenium deficient diet showed poor growth and it is conformed that both vitamin E and selenium are essential for *H. fossilis* diet. The postmortem of fish fed unsupplemented vitamin E diets showed fatty and ceroid livers.

Vitamin K is essential for normal growth and physiology of *H. fossilis*. The optimum requirement for maximal growth is 10 mg K/kg diet. However dietary vitamin K requirements for maximal growth determined by quadratic regression is 140.89 mg/kg diet. The γ-carboxy glutamic acid for calcium binding and it is essential for biological activity of vitamin K dependent protein. In the present study increased dietary vitamin K resulted in elevated levels of calcium deposition in *H. fossilis*. Fish fed unsupplemented vitamin K diet showed slow blood clotting, haemorrhage in fins and tetanus.