THE SYNERGISTIC EFFECTS OF RIBOFLAVIN DEFICIENCY AND *TRICHINELLA SPIRALIS* INFECTION IN WISTAR RAT MODEL

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ABSTRACT

The objective of this study was to investigate the status of riboflavin deficiency; various hematological parameters; biochemical indices including blood glucose, blood total protein, blood urea nitrogen, blood uric acid, blood cholesterol and blood triglyceride; certain important erythrocyte antioxidant enzymes namely, catalase, superoxide dismutase (SOD) and glutathione peroxidase (GSH-Px); certain antioxidant minerals such as iron, copper and zinc and the pathological studies including body growth and the histology in Wistar rats treated with riboflavin deficiency and *Trichinella spiralis* infection as compared to the control group. It was demonstrated that rats were deprived of riboflavin at 8th week of the experiment with the erythrocyte glutathione reductase activation coefficient values $\geq$ 1.30, whereas there was no biochemical sign of riboflavin deficiency appeared in control and *T. spiralis*-infected rats. Therefore, *T. spiralis* infection was not definitely implicated in the riboflavin deficiency.

It was proposed that the riboflavin deficiency partly involved in the disturbance of process of erythropoiesis in the term of erythrocyte numbers and hematocrit in the 8th week of experiment even though such results were not clear in the 12th week of experiments. This was probable that the condition of the riboflavin deficiency was in the acute phase. However, the impairment of erythropoiesis was not attributed to *T. spiralis* infection. The interaction between the riboflavin deficiency and *T. spiralis* infection was not either synergistic or antagonistic in terms of hematological studies. In addition, the riboflavin deficiency could cause a significant increase in white blood cell numbers even though such a result was

inconsistent in Wistar rats provided with riboflavin deficiency diet and *T. spiralis* infection. It was also found that monocytes, eosinophils and neutrophils were insignificantly increased with a combination of the riboflavin deficiency and *T. spiralis* infection. Therefore, either the riboflavin deficiency or *T. spiralis* infection was implicated in the immunological system and both of such effects were negatively synergistic for immunology.

Having considered the metabolism of various energy sources, both blood glucose and cholesterol were not altered with the influence of either the riboflavin deficiency or *T. spiralis* infection or even of both effects. However, the riboflavin deficiency *per se* inversely caused an increase in blood triglyceride but this was not occurred in both combination effects. Therefore, the riboflavin deficiency effect on shifting of blood glucose to blood triglyceride was unclear in this study and such interaction between malnutrition and infection also seemed not to be synergistic.

It was found that blood total protein was enhanced in either the riboflavin deficiency or *T. spiralis* infection or even in the riboflavin deficiency plus *T. spiralis* infection. However, both of the two effects did not disturb the metabolism of urea. Furthermore, it was found that riboflavin deficiency *per se* caused an increase in blood uric acid. It was partly concluded that the deficiency of riboflavin had an effect on the metabolism of protein and nucleic acid breakdown in Wistar rats. This interaction between malnutrition and helminthic infection seemed not to be synergistic.

It was hypothesized that the activities of enzyme catalase, SOD and GSH-Px were the first line disturbed by the riboflavin-deficient, *T. spiralis*-infection and both effect of riboflavin-deficient and *T. spiralis* infection. This may be due to more free oxygen radical production in the consequence of riboflavin deficiency. However, in the group with combined effects of riboflavin deficiency and *T. spiralis* infection, the levels of three antioxidant enzymes tended to be insignificantly higher than that of the rats fed only riboflavin-deficient diet or *T. spiralis* infection alone. It was probably implicated in more *T. spiralis*-produced antioxidant enzyme *per se*, especially SOD and GSH-Px. It was probable *that T. spiralis* itself may have to cope with more additional free oxidants that underlying by stress from the riboflavin deficiency and *T. spiralis* infection. The interaction between the riboflavin deficiency and *T. spiralis* infection was not the synergistic effect.

Only plasma zinc was impaired by both the effects of riboflavin deficiency and *T. spiralis* infection and it was seemingly not disturbed by either the effect of riboflavin deficiency or *T. spiralis* infection. Furthermore, *T. spiralis* infection alone and both of two effects tended to be involved in a copper reduction but not be implicated on manganese and iron metabolisms. However, it could partly be hypothesized that such interaction between riboflavin deficiency and *T. spiralis* infection was a synergistic effect when regarding on only zinc metabolism.

Body growth of Wistar rats was retarded by the influence of the riboflavin deficiency in the diet, not by that of the *T. spiralis* infection. This was because the diet with the riboflavin deficiency had an adverse effect on their intake. *T. spiralis* infection did not involved much in growth retardation.

With gross organ investigation, many organs investigated were impaired, especially in the rats of riboflavin deficiency. Even though such effect had not much adversely defected in the tissues of investigation. Histological finding revealed the congestion appearance in spleen of Wistar rat treated *T. spiralis* infection and riboflavin deficiency plus *T. spiralis* infection and also the small aggregation of lymphocytes in the cardiac fiber of Wistar rats with *T. spiralis* infection. In addition, there was no adverse synergistic effect of riboflavin deficiency and *T. spiralis* infection on histological finding results.

Overall, it was suggested that the interaction between riboflavin deficiency and *T. spiralis* infection in this study was not synergistic. However, it was pointed out that such interaction was not occurred in this study owing to both acute deprivation of riboflavin deficiency and less numbers of *T. spiralis* larvae infected into Wistar rats. It was recommended herein that introduction of *T. spiralis* larvae into Wistar rats should be conducted at the beginning of riboflavin deficiency and more numbers of *T. spiralis* larvae should be introduced into the Wistar rats, and simultaneously study on synergistic effect of malnutrition and helminthic infection in chronic phase. If such an above manner of methodology design was conducted, the results will probably be demonstrated outcome of the negatively synergistic effects of both the riboflavin deficiency and *T. spiralis* infection in the future study.