DIPLOMA THESIS

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Supplementation of Iron and Zinc and the Effect on the Oxidant/Antioxidant Status in Guatemalan Schoolchildren

With Regard to Zinc

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5. Summary

In Guatemala, many children suffer from a deficiency in iron and zinc. This is due to a predominance of vegetarian diets high in fiber, tannins, and oxalates which inhibit the absorption of trace elements. As the traditional diet are maize and black beans, bioavailability is reduced.

The results of a supplementation of iron and zinc, with special regard to zinc, were examined in this diploma thesis. Because of the antioxidative capacity of zinc and the role of iron as a pro-oxidative element, the effect on the oxidant and antioxidant status were investigated. In total 40 girls and 37 boys, aged 8-11 participated in the study. The children lived in Guatemala city and came from low income families. Because of a dislike in the syrup´s taste, diseases during the study and at the day of the second blood sampling, 35 girls and 31 boys completed the study.

The subjects were systematically randomised and divided in four treatment groups. One group received a syrup containing 20mg iron, one group a syrup containing 40-45mg zinc, the third group a combined syrup with iron and zinc (20mg iron + 40-45mg zinc) and the fourth group received a placebo. The supplementation period was 40 week-days in eight weeks. Before and after the intervention venous blood was taken by a medic.

The measured parameters were haemoglobin, ferritin, zinc, TBARS and the vitamins retinol, α-tocopherol and β-carotene. Haemoglobin was measured with a photometric micro-method, ferritin and TBARS with ELISA, the vitamins with HPLC, and zinc with AAS.

At baseline, 22% of the subjects were anaemic, 68%showed zinc deficiency and another 68% had β-carotene levels below normal. Only 8% of the children had low retinol levels and none of the subjects had low α-tocopherol levels.

Changes in TBARS were significant only in the zinc group. The supplementation of this trace element resulted in increased TBARS. This is an interesting finding because zinc is thought to play a protective role against free radical damage. Many studies show increased TBARS levels in zinc deficiency and a decrease in oxidative stress caused by a supplementation of zinc (which leads to decreased

TBARS levels as well). In this study, the detected rise in TBARS might trace back to the high concentration of given zinc. Other studies support this supposition. And whether TBARS are a good marker for oxidative stress must be called in question as well. Beyond, TBARS did not change in the iron group, although it was expected, because of the pro-oxidative capacity of the metal.

The supplementation had no effects on α-tocopherol and retinol levels. The constant tocopherol levels are in contrast to the increased TBARS levels in the zinc group. Tocopherol as an antoxidative vitamin was presumed to be decreased in oxidative stress, too. Changes in retinol, respectively low retinol levels were expected in zinc deficient subjects because zinc influences aspects of vitamin A metabolism. The constant plasma retinol levels can be explained through the good homeostatic regulation which limits its quality as a marker.

With regard to the high percentage of zinc deficient subjects, a correction of the zinc status in Guatemalan children would be desirable. Intervention with a zinc containing supplement showed obvious success. Only 18.8% of the children were zinc deficient at the end of the study. A significant increase in all groups was shown. Because improvement of plasma zinc was highest in the combined group, it can be supposed that the presence of iron did not influence zinc absorption. Also, zinc did not influence iron metabolism. There was an increase in ferritin levels in the iron-, the combined- and also in the zinc group. Therefore, negative effects on absorption, even with high zinc concentration, can be excluded.

The increase of β-carotene and zinc in all treatment groups, also in the placebo group, is interesting. The improvement of β-carotene might be cohered with the start of the mango season (a fruit rich in β-carotene) at the end of the study. The "Hawthorne effect" which shows beneficial effects only because subjects are involved in a study might play a role as well. It is possible that children changed their nutritional habits during the intervention period, because parents were informed about the expected deficient status of their children caused by a one-sided nutrition. An interesting question is whether the rise in β-carotene is related with the improvement of the trace element status, because rise was minor in the placebo group. Absorption and transport into intestinal mucosa cells could be improved by an optimal zinc status, and zinc might play a role in the enzymatic

process of carotene metabolism. Effects of a zinc supplementation on the carotene metabolism can be hypothesised.

According to the results of this study, a combined preparation of iron and zinc is to be recommended. In addition, other minerals and vitamins for which deficiencies frequently occur could be administered. But food supply in Guatemala is rich and many sided. Therefore, a supplementation should always be connected with a rearrangement of the diet.