CHAPTER V

DISCUSSION

Cereals especially rice, corn and millet are staple food in many developing countries, particularly in South-East Asia and Africa (53). The average consumption per capita of cereals in these countries are very high. Rice, for example, is consumed as much as 364, 304, 260, 237 and 235 g/day/person in Taiwan, Japan, Bangladesh, Singapore and Philippines, respectively (32). And in Thailand rice is consumed as much as 340 g/day/person (54). The average consumptions of rice in these countries correspond to 35-65% of the total daily energy intake (32, 54,55). On the basis of the analytical results presented in Table 5, Zn and Cu contents in rice obtained are 23.6 μg/g, range from 17.5-28.8 μg/g and 2.3 μg/g, range from 1.1-3.3 μg/g, respectively. Therefore, it follows that the average consumption of rice can supply the individuals with an approximation of up to 8.6 mg Zn and 0.8 mg Cu daily. According to a WHO Expert Committee on Trace Elements in Nutrition, the daily requirements of Zn and Cu in adult males is about 2 mg each. For the countries where rice is a major staple food, it appears to be a fairly good source of dietary zinc, but a poor source of copper. With comparison to the study of Masironi *et al.* (32) which reported the levels of Zn and Cu in polished rice to be 7.1-20.6 μg/g and 0.7-6.7 μg/g respectively, the levels of

Zn obtained from the present study are relatively higher, while the levels of Cu obtained from the study of Masironi et al. were in the range of larger distribution. The reasons for the differences of these two studies might come from the fact that the levels of trace elements in cereals vary by the differences in soil type, fertilizer, water and other environmental contaminations. The degree of polishing and processing is another factor that alters the concentration of Zn and Cu in cereals. The Recommended Dietary Allowance, however, recommended the daily requirement of zinc to be 15 mg, but there is no recommendation for copper. Results from Table 6 show the levels of zinc and copper in glutinous rice to be 27.1 μg/g, range from 17.8-37.7 μg/g and 2.5 μg/g, range from 0.7-5.9 μg/g respectively. Table 8 reports the levels of zinc and copper in corn to be 28.5 μg/g, range from 15.0-56.0 μg/g and 2.2 μg/g, range from 0.9-3.7 μg/g respectively. From the results present in Table 6 and Table 8 glutinous rice and corn seem to be fairly good sources of zinc but not good sources of copper. The levels of zinc and copper in millet as shown in Table 7 are 45.2 μg/g, range from 26.2-67.5 μg/g and 6.8 μg/g, range from 4.9-10.4 μg/g respectively. It appears that millet could be a good dietary source of both zinc and copper.

Klevay has hypothesized from the result of the induction of hypercholesterolemia in rats by an increase in the ratio of zinc to copper, from 14:1 to 20:1, ingested,

that coronary heart disease is predominately a disease of imbalance in regard to zinc and copper metabolism (5,6,7). The ratio of zinc to copper of human milk is approximately 6:1, in contrast to that of cow's milk which is about 38:1. Considering the protective effect of nursing on coronary heart disease, a ratio of 6:1 must be considered desirable for infants and a ratio of 38:1 must be considered too high. Whether the ratio of 6:1 will prove desirable for adults is unknown at the present time. As already mentioned, Recommended Dietary Allowance for zinc is 15 mg and no recommendation for copper is made. If a recommended allowance for copper should exceed 2 mg the ratio of zinc to copper for the adults would be less that 7.5:1 (5). As nutritional requirements vary among species, so may also optimal ratios vary among species. From the present study, the ratio of zinc to copper in rice is approximately 11:1 which is apparently too high, in comparison to the ratio of zinc to copper in human milk. Glutinous rice, millet and corn represent the ratios of approximately 16:1, 7:1 and 14:1, respectively. The ratio of 7:1 in millet under present investigation, should be considered desirable. However, the ratios of approximately 16:1 and 14:1 in glutinous rice and corn may not be able, at the present time, to consider whether they are too high or not suitable for human consumption. As already discussed, hypercholesterolemia produced in rats by the ratios of zinc to copper of 14:1 to 20:1 compared to the ratio of less than 4:1 in

control group. A ratio of 14:1, which must be considered high for a rat, is not necessarily high for human. Optimal ratio for human is, therefore, waiting for further research. However, Klevay has reported the ratios of Zn to Cu of the diets in the United States range from 3:1 to greater than 38:1 (5). The ratios obtained from the present study range from 4:1-37:1 correspond to the range of Zn and Cu obtained from the diets described by Klevay. It is likely that the relatively high ratio of Zn to Cu could possibly be a vehicle of marginal intoxication in population group subsisting primarily on these foodstuffs. Fortunately, the fiber and phytate contents in cereals interfere the absorption of these elements, lower the ratios and thereby prevent toxicity that might exist. Also, as already discussed in previous chapter, toxicity of Zn and Cu on normal consumption is very rare.

Whether the ratio of zinc to copper, or copper deficiency alone is of primary importance in induction of hypercholesterolemia remains to be determined by further study. But, the necessity of cereals as sources of energy and trace elements is always important especially for people in the developing countries who consume cereals as almost the sole sources for both energy and protein.