

Superiority of Wheat Enrichment in the Farm to Flour Fortification in the Factory in Promoting the Society's Health Status

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INTRODUCTION

Enrichment of agricultural products with micronutrients could be realized through numerous ways such as agronomic methods (Cakmak, 2008) on the farm using balanced fertilization approach (Malakouti *et al.*, 2008); supplementing essential minerals in the food processing (Malakouti *et al.*, 2006); developing efficient genotypes by plant breeding or even by genetic engineering (Welch, 2002). A rapid approach to improve zinc (Zn) concentration in food crops is needed, because breeding approach is a long-term process. Recent studies indicate that application of Zn-containing fertilizers represents an alternative and economical approach to breeding, food fortification and mineral supplementations (Cakmak, 2008). This study has been conducted to demonstrate the effectiveness of Zn fertilization approach in improving grain Zn and its contribution to human nutrition.

METHODS

Three experiments were carried out in six different provinces, i.e. East and West Azerbaijan, Kerman, Sistan and Baluchestan and Southern Khorasan. The first and second experiments (2001-02 and 2003-04) were designed based on t-distribution and included two treatments: The control plots were given nutrients based on Farmer's conventional fertilization practice (NP) and the treated plots received nutrients based on soil tests (balanced fertilization) in Meyaneh (three-wheat farms) and Naghadeh (one-wheat farm) in East and West Azerbaijan provinces. In the wheat fields, 0.5% micronutrient-fertilizer solution was sprayed at three growth stages (stem elongation, heading, and a week after flowering). After harvesting, the grain yield and grain, phytic acid, Zn and PA/Zn molar ratio were measured. Then, whole-wheat bread and regular bread prepared from these farms were fed for 4 and 6-month periods to different inhabitants living in Tajark, Khanghah and Kahriz villages in East and West Azerbaijan, respectively. Before and after feeding trials on village inhabitants, Zn concentration was measured in blood serum collected from the inhabitants. In the third experiment conducted in the summer of 2003, a further feeding trial has been conducted to study the effect of fortification and improvement of the quality of bread on the health of consumer subjects in Moghadam Mersad Military Station. During a 4-month test period, bread consumed at the Station and the associated units was fortified as mentioned below. Zinc concentration in the blood serum of the military personnel was determined by using an atomic absorption spectrometer. Fortification of the wheat flour was carried out by adding, 80 mg Zn; 50 mg Fe; 10 mg vitamin B1; 2.5 mg Vitamin B2; and 5 mg vitamin B6 per kg of flour.

RESULTS AND DISCUSSION

In the first and second experiments, the results demonstrated that consumption of whole wheat bread in comparison with white bread for four and six-month periods noticeably increased Zn and Fe concentrations in blood serum, especially for the six-month period. While the average Zn concentration of the blood serum in case of the control was 80, they increased to 110 µg/dl after the intervention in Kahriz village. In the third experiment, in places where bread was not fortified, the average level of Zn in the blood serum of individuals was measured to be 72 µg/dl; whereas, the serum Zn of the test subjects consuming fortified bread for a three-month period averaged 89 µg/dl (Table 1). For persons who were fed on unfortified bread, 47%

* Dedicated to my son the late Amin Malakouti (MD) who passed away on February 06, 2010 in Seattle, WA.

suffered from Zn deficiency but those who used the superior quality, fortified bread, only 10% suffered from this deficiency (Table 1). While the number of people using stomach-problem-related-medicines at the Beghin Martyrs Station during a 4-month period before the experiment was figured to be 1615 cases, it was reduced to 1375 cases after the conducting the tests (or decreased by 15% during a 4-month period).

Table 1. Changes in serum Zn concentrations of those people who consumed wheat flour enriched by fertilization or fortification (Malakouti et al., 2007)

| Treatments | Zn in serum (Before intervention) (µg/deciliters) | Zn in serum (After intervention) (µg/deciliters) | Increment (%) |
|------------------------|---|--|------------------|
| Wheat grain enrichment | 80 | 110 | 38 |
| Flour fortification | 72 | 89 | 24 |

CONCLUSIONS

The results obtained show that enrichment of wheat in field with Zn resulted represents a superior approach over the flour fortification regarding better Zn nutrition of human populations. Zinc fertilization also improved grain yield. There is a close link between unhealthy people and unhealthy soils as discussed before by Sanchez and Swaminathan (2005). The statement "health comes from the farm, not the pharmacy" made before in agreement with the results of this study (Malakouti, 2011). So, by practicing optimal management in fertilizer use, the enrichment of agricultural products in farms, and using healthy agricultural products, the Iranian society's health can be significantly improved (Malakouti *et al.*, 2008).

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