

Improving Zinc Bioavailability in Value Added Traditional Foods

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INTRODUCTION

Zinc (Zn) deficiency is a public health problem in many developing countries with devastating effects on the nutritional and health status of populations in underprivileged settings. The majority of the Indian population who consume diets based on cereals and legumes are not able to get enough of the micronutrient from the diets due to the presence of phytates and other antinutritional factors.

The use of indigenous food processing method like grain germination prior to milling and the inclusion of such foods in the diets that can lower the phytate content can considerably improve Zn absorption and bioavailability and can thus reduce the burden of Zn deficiency among the population.

METHODS

Commonly consumed Bengal gram (*Cicer arietinum*) and whole wheat (*Triticum aestivum*) were germinated in incubator at 25°C for 36 hours, dried in the hot air oven at 60±2°C for 7-8 hours and then milled into flour. Bengal gram leaves and amla (*Emblica officinalis*) after blanching, were also dried and ground to fine powder.

Various value added traditional products namely: *Parantha*, *Matri*, *Seviyan*, *Ladoo* and *Biscuits* were developed using four different germinated wheat treatments. The treatments were: Germinated wheat (GW) alone in S1 (control); GW and Germinated bengal gram (GB) in the ratio 8:1 in S2; S2 + 4 per cent Bengal gram leaves powder (BLP) in S3; and S3 + 5 per cent Amla powder (AP) in S4.

Products were scored thrice for appearance, color, texture, taste and flavour and overall acceptability by an expert panel of 12 judges using 9 point hedonic rating scale (Rangana 1986). The products were analysed for phytate (Haug and Lantzsch 1983) and Zn concentrations by atomic absorption spectrophotometry.

RESULTS AND DISCUSSION

Products obtained mean overall acceptability scores in the range of 6.7 to 8.8. The process of germination significantly decreased the phytate in wheat and Bengal gram by 18 and 34 per cent respectively. AP did not contain any phytates whereas 1.09 mg g⁻¹ of phytate was found to be present in BLP.

Table 1. Total and Soluble Zn concentrations of raw ingredients and developed products (µg g⁻¹, DM basis).

Raw ingredients			Developed products (p<0.05)											
			Parantha		Matri		Seviyan		Ladoo		Biscuits			
T	S		T	S	T	S	T	S	T	S	T	S		
GW	36.9	12.9	S1	34.2	7.6	33.3	7.7	34	6.8	34.1	6.1	36.2	7.5	
GB	58.1	16.2	S2	46	10.7	45.2	11.9	47.2	10.5	45.3	11.1	49.2	12.6	
BLP	43.5	13.8	S3	45.3	10.8	45	12.3	47	12.3	44.2	12.4	48.8	13.3	
AP	9.1	2.9	S4	45	11.3	45.1	12.8	46.9	13.2	44	13	48.3	14.1	

T – Total, S - Soluble (indicating available Zn out of the total)

The inclusion of GB and BLP with high Zn concentration in the recipes significantly ($p < 0.05$) increased the total and soluble Zn concentration of the products (Table 1). During the germination process, the phytase enzymes are either synthesised or activated which degrade phytic acid. Ascorbic acid in the AP caused lowering of pH that increased the activity of the phytase enzyme thereby facilitating the further degradation of the phytic acid in the S4 products. A reduction in phytate content in the range of 4.7 to 8.5 per cent was observed in S4 products as compared to control (Fig. 1). The quantities of Zn and phytate in the diet are the primary factors determining Zn absorption (Miller *et al.*, 2007). In the present study, the increase in Zn solubility may be attributed to incorporation of GB and BLP as well as a reduction in phytic acid by germination and ascorbic acid of AP, which enhances the availability of divalent ions (Fig. 2). Increased dietary Zn intake with the decreased molar ratio of phytate : Zn has been reported in another study in South Korea (Do *et al.*, 2007).

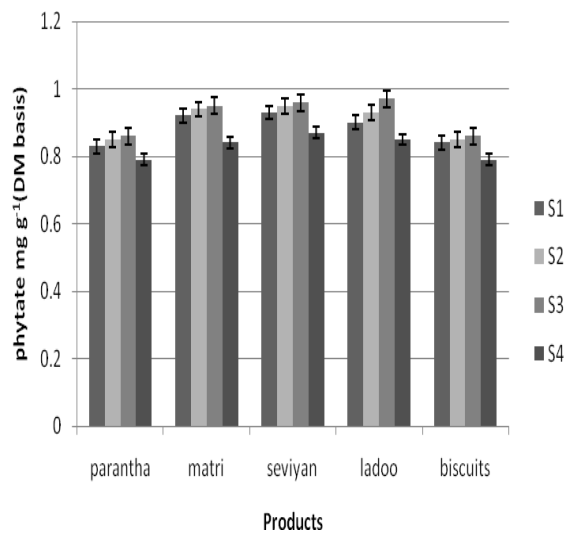


Fig. 1. Changes in phytate content of value added products with various treatments.

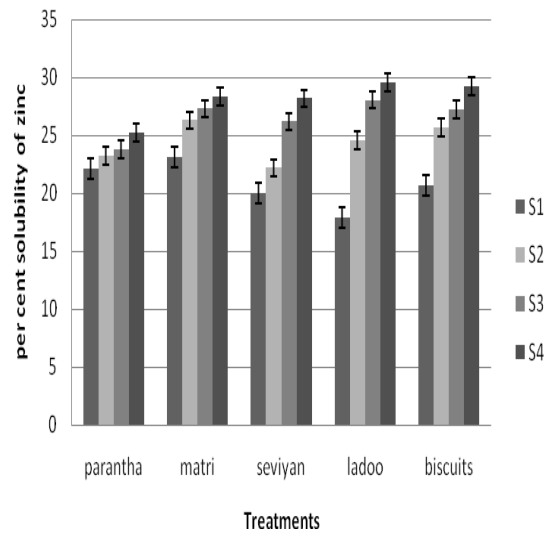


Fig. 2. Per cent solubility of Zn of value added products with various treatments.

CONCLUSIONS

Incorporation of underutilized Bengal gram leaves in the traditional recipes based on cereals and legumes increases the total and soluble Zn content of the diet. Furthermore, the process of germination and inclusion of ascorbic acid in the form of amla powder significantly improved the Zn availability from the diets high in phytate content.

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