THE BIOAVAILABILITY OF TRACE ELEMENTS IN FOODS OF SRI LANKA

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Trace elements such as iron, copper and zinc are micro nutrients which play an important role in the oxidative pathways involved in energy metabolism. Deficiency of these elements in humans could drastically reduce the physiological, immunological and reproductive performance. There is some information available on trace elements of local foods. But these refer to the content and not to their bioavailability. It has been reported that the organic compound like phytate, tannin and elements like calcium could interfere with absorption of these elements and reduce their bioavailability. As such, there is a need for research to study the bioavailability and total content of these elements in local food articles and interfering substances such as phytate, tannin and calcium.

Therefore, we have initiated a research project at the Division of Oral Biochemistry, Department of Biochemistry, University of Peradeniya to investigate the local foods for their bioavailability of trace elements. The determination of the bioavailability of trace elements of local foods could provide the nutritional informations necessary to overcome trace mineral deficiencies in Sri Lankan population.

To study the bioavailability of trace elements, we have used a novel method and it tries to replace the conventional animal model experiments, which are laborious, time consuming and expensive.

The method involved for the bioavailability is an *in vitro* two stage enzymatic digestion which occurs in the same order as in the events occurring in the stomach and duodenum. The food material was first subjected to digestion with pepsin at pH 2.0 and then by pancreatin at pH 7.5 A segment of dialysis tubing which is compatible with intestinal mucosa was used and the digested material was allowed to diffuse into dialysis tube. The trace element contents of dialysate were measured using atomic absorption spectrometry.

The total trace element contents were estimated by wet digestion using conc. HNO_3, perchloric and conc. H_2SO_4 acid followed by atomic absorption spectrometry. The phytate and tannin contents were estimated by preparing the coloured complexes of those followed by colorimetry. The concentrations of these substances were calculated in mg/100 g of edible portion of foods and ± SEM was calculated.

In this project we have investigated 30 food articles including cereals and pulses; rice *[Oryza sativa]* (samba, parboiled, raw- white and raw-brown), horse gram *[Cicer arietinum]* and soya bean *[Glycine max]* and vegetables; brinjal *[Solanum melongena]*, okara *[Hibiscus esculentus]*, beet *[Beta vulgaris]*, carrot *[Daucus carota]*, agathi *[Sesbania grandiflora]*, amaranthus *[Amaranthus gengeticus]*, beet leaves *[Beta vulgaris]*, black nightshade *[Solanum nigrum]*, brussels sprouts

[Brassica oleracea], cabbage *[Brassica oleracea]*, cabbage *[Brassica gemmifera]* (two species), drumstick leaves *[Moringa olerfera]*, gotukola *[Centella asicatica]* (big var.), kankun [Ipomea aquatica], leeks [Allium ambelloparasum], manioc leaves *[Manihot esculenta]*, mukunuwenna *[Alternanthera sessilis]*, onion leaves *[Allium cepa]*, passion fruit *[Passiflora edulis]*, plantain flower *[Musa sapientum]*, sarana *[Trianthema deceandra]*, spinach *[Basella alba]* (bush and creeper), valkohila *[Syngonium podothyllum]* and yellow pumpkin *[Cucurbita maxima]*.

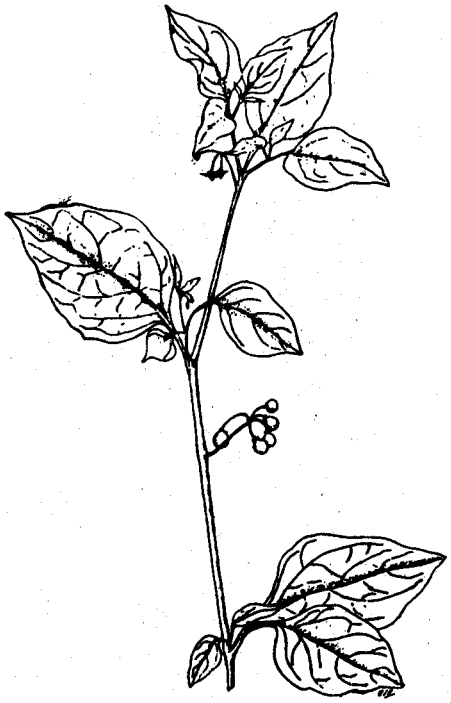
Okara *(Hibiscus esculentus)*

Of the food articles analyzed beet leaves (43.14 ± 2.76), onion leaves (39.53 ± 5.28), spinach bush (87.27 ± 0.38) and creeper (81.39 ± 1.06) and yellow pumpkin leaves (78.21 ± 1.28) had high content of iron while agathi, amaranthus, gotukola, kankun, mukunuwenna, sarana and valkohila had moderate values ranging from 20-40 mg. Other food articles had less than 20 mg.

Kankun (1.27 ± 0.06) and yellow pumpkin (1.12 ± 0.09) had high content of copper and brinjal, beet leaves, gotukola and valkohila had moderate values (0.7 - 1.0 mg) and other food articles had less than 0.7 mg of copper.

The food articles rich in zinc are amaranthus (4.36 ± 0.01), beet leaves (2.91 ± 0.18), gotukola (big var.) (3.52 ± 0.34), manioc leaves (2.93 ± 0.03), mukunuwenna (5.41 ± 0.63), spinach (bush) (2.23 ± 0.04), val-kohila (2.67 ± 0.02) and yellow pumpkin leaves (2.14 ± 0.14) leaves. However, the bioavailability of zinc in these vegetables is less than 20% except for gotukola which had 72% bioavailability of zinc. Soya bean, okara, beet, beet leaves, agathi, cabbage, kankun, leeks, passion fruit, plantain flower and sarana had moderate values ranging from 1.0 to 2.0 mg. Others had less than 1.0 mg.

The food articles high in bioavailable zinc are agathi (49%), carrot (45%), drumstick leaves (65%), gotukola (72%) and leeks (42%), however they have moderate values of total zinc except for gotukola. The bioavailability of zinc high vegetables had low (less than 30 mg) and/or moderate (30-45 mg) phytate content, low (less than 100 mg) and/or moderate (100 - 125 mg) calcium and less (less than 200 mg) and/or moderate (200-400 mg) of tannin. The bioavailability of zinc low vegetables always had high concentrations of phytate, calcium and tannin.



Black nightshade *(Solanum nigrum)*

This project is an ongoing project and it involved estimation of bioavailability of iron, copper and zinc in 9 cereals, 8 pulses, 49 vegetables, 12 spices and condiments and 5 souring agents a total of 83 samples. This project is funded by Natural Resources, Energy & Science Authority of Sri Lanka.