In vitro Studies on Bioavailability of Iron by Changing Techniques in Home Cooked Foods

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Summary: Measurement of 1,10 phenanthroline colour complexes with free (Fe^{++}) iron released after "in vitro digestion" of the food stuff was carried out. Intensity of colour produced was directly proportional to the amount of iron released from food which was measured spectrophotometrically. Results have shown a diverse amount of free iron in different foods. In general, it was observed that food processed by simple method and without spices contain comparatively high contents of iron.

Introduction

Nutrient losses occurring during food preparation and processing have always been a metter of concern. They are the result of various operations like washing, peeling, boiling, milling and drying, some occurring in the household preparation as well as in industrial production sensitive components of foods like proteins, vitamins and trace elements are prone to many possible interactions, either in the food itself or in our body. Such interactions have major influence on the final bioavailability, absorption and utilization of nutrients, some being beneficial while others harmful [1]. The great number of intersections between macro- and micronutrients and naturally occurring antinutrients such as enzyme inhibitors, vitamin antagonists, goitrogens, saponins, polyphenolics, oxalates etc. have offered good opportunities for interesting research so that today we are able to identify many of the favourable and unfavourable food combinations. The standard example of such as interaction is that of iron where concomitantly absorbed dietary components as well as physiological conditions can enhance or inhibit its absorption [2]. Bio available iron is considered

as a portion from total iron which is metabolized in the body. An overall distribution of iron in the body is about 1.5-3 g in form of hemoglobin, 0.6-1 g in form of stored iron, 0.3 g in form of myoglobin, and enzyme iron, and 3-4 g in form of plasma iron, total value of iron is between 3-5 g in a normal person [3]. One of the unique features of iron among all other mineral elements is that body could recycle it in such a way that there is hardly may loss (about 0.7-1 mg per day) [4]. Fibre-containing foods and various types of fibers can have inhibitory effects on the absorption and retention of minerals. It has also been demonstrated that phytates inhibit the absorption of non heme iron [5]. The dietary use of brans rich in phytate could have a detrimental effect on the iron-status of people at risk e.g. pregnant woman and elderly people [6]. Major objective of this work was to study the effect of cooking techniques which are involved during processing of food such as pressure cooker, deep frying with yogart, simple boiling, making curry and oven cooking on bioavailability of iron.

Results and Discussion

The growing importance of processed foods in our diet calls for efforts to minimize nutrient losses through processing. Results of our determination of percent bioavailable iron in cooked samples processed by different techniques are shown in Table-1. The trend in beef, mutton and chicken is that the boiled sample contain more percent bioavailable iron then curry, which in turn has higher concentration of percent bioavailable iron than simple roasted with yogurt. The reason for higher concentration in boiling may be that, we do not use any spices which could form complex with iron [9]. Curry contained slightly lower concentration of percent available iron because we use spcies, onion, tomato and garlic. In these ingredients onions and tomatoes are rich in ascorbate, a factor known to enhance iron absorption [10,11]. We noticed that curry when cooked in tomatoes gives lower value of percent bioavailable iron. It may be that pigments or cholators bind Fe to lower the percent bioavailability of iron [7].

In same way, when sample was deep fried with yogurt, the concentration of iron was decreased because yogurt may retain some factors in milk which complex with iron and reduce its bioavailablity. Yogurt as compared to milk diet decreases iron absorption slightly (4-9%). The process of making yogurt involves growth of bacteria, the presence of which releases powerful iron chelators, the presence of which reduce the percent bioavailability of iron [6].

Table-1: The effect of various cooking techniques on availability of iron in different home-cooked food sample

Sample	Cooking method	Ingredient in 100g meat	Bio-availability of iron mg/100g Mean ± S.D.
Beef boiled	Pressure Cooker	Salt + Chilli	4.7 ± 0.1
Beef curry	Flame Cooking	Onion + Tomato	4.6 ± 0.8
Beef roast	Deep Frying	Yogurt	4.1 ± 0.6
Beef roast	Oven Cooking	Yogurt	2.8 ± 0.5
Mutton boiled	Pressure Cooker	Salt + Chilli	4.5 ± 0.9
Mutton curry	Flame Cooking	Onion+Tomato	4.2 ± 0,7
Mutton roast	Deep Frying	Yogurt	3.5 ± 0.24
Mutton roast	Oven Cooking	Yogurt	2.25 ± 0.13
Chicken boiled	Pressure Cooker	Salt + Chilli	1.7 ± 0.16
Chicken curry	Flame Cooking	Onion + Tamato	1.5 ± 0.2
Chicken roast	Deep Frying	Yogurt	1.02 ± 0.3
Chicken roast	Oven Cooking	Yogurt	0.89 ± 0.1

Moreover bioavailability of iron is much reduced in oven cooking because oven has high temperature of 250°C than ordinary flame cooking (100°C) and air oxidation also take place so the quantity of total iron although remain same but more iron is oxidized to Fe(III) and remain undigested and hence the quantity of bioavailable iron is reduced [2].

It is suggested that over cooking has some effect on percent bioavailability of iron due to the decomposition of Vit.C [6]. We got maximum values by using pressure cooker because it requires much less time (15 min) than other techniques.

Experimental

The samples were chopped and sufficient water (250 ml/100 g of sample) was added and homogenized. From this a 50 g of the aliquot was adjusted to pH 2.0 with 1N HCl and was incubated with 10 mg pepsin/g protein at 37°C for 2 hr. After incubation, 20 ml aliquot of this first digestion was titrated against standard KOH in order to

determine the titratable acidity. Afterward, an equal amount of $NaHCO_3$ was taken 25 ml of water in a dialysis bag (width 76 mm, diameter 49 mm, capacity 640 ml/ft) which in turn was placed in a second 20 ml aliquot of the pepsin digest and were placed as well as a third 20 ml aliquot on a water bath maintained at 37°C. A 10 ml of pancreatic and bile salt mixture was added after 30 minutes and incubation continued for another 2 hr. After the completion of the incubation, the dialysis bag was removed, rinsed and proteins were removed by the addition of TCA. The contents were analyzed for iron in a medium of acetate buffer at pH 4.5 using O-phenanthroline, the resulting coloured complex, tris (1,10-phenanthroline) iron(II) was measured at 510 nm. Hydroxylamine-HCl was used as reducing agent to make it confirm that all iron is present in form of Fe(II). The % bio-available iron is the ratio of the dialyzable iron to total iron times 100 [7,8].

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