

Trace Metal Analysis in Meal Packets


By

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requirement for the award of the degree of Masters of Science in Food Science and
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Declaration

The work describe in this thesis was carried out by me under the supervision of a Prof.Arthur Bamunuarachchi and Mrs.Indira Wickramasinghe and a report on this thesis has not been submitted in whole or in part of any University or any other institution for another degree.

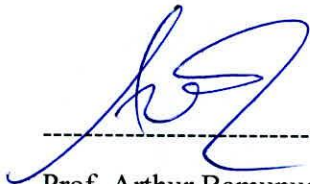


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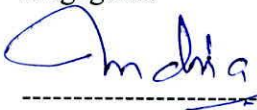
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We Prof A.Bamunuarachchi and Mrs.Indira Wickramasinghe certify that the above statement made by the candidate is true and that this thesis is suitable for submission to the university for the purpose of evaluation.



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ABSTRACT

The objective of this study was to quantify seven dietary minerals found in meals. The minerals were Ca, Fe, Mg, Ca, Cu, Zn, and K. The mineral analysis was carried out for 15 meal packets, which consisted of 5 breakfast packets, 5 lunch packets, and 5 dinner packets purchased from a food parlor where most university students buy their meals. Samples were collected within a period of one month. All the samples contained rice and a fish source. Three random samples were analyzed in each meal packet and a total subjected to analysis were 45.

Metal analysis was carried out using Atomic Absorption Spectrometer. The average Fe content obtained per day was 42.946 ± 15.092 mg while the Cu content was 3.262 ± 1.967 mg. Average amount of Zn obtained per day was 11.118 ± 6.855 mg. Similarly 2.490 ± 2.141 g of Mg was obtained per day from the meals. The value obtained for Na was 26.45 ± 8.593 g whereas K amount was 2.0 ± 0.566 g per day. Correspondingly 29.964 ± 19.417 g of Ca was obtained per day. The result compared with the RDA values (Recommended Daily Allowance) for Sri Lankans. RDA values are available only for 3 minerals for Sri Lankans. Other mineral levels compared with the World Health organization's RDA values.

Although the average values Na, Mg, Ca, Cu, and Fe were higher than the recommended daily allowance while K content was lower than the recommended value. Majority of samples contained lower Fe content than the RDA value given for Sri Lankans. In addition Zn content was within the recommended level.

CHAPTER ONE

1.1 Introduction

University of Sri Jayawardhanapura is one of the prominent Universities in the country with more than 8250 students study at a time. The Food parlor where the meal packets were collected, is situated at the front of the University and it sells more than 125 meal packets on weekdays and more than 150 meal packets in weekends specially for students as well as for the other customers. This study will give an idea whether the students can get the recommended amount of dietary minerals from this specified place.

The elements which occur most abundantly in foods are carbon, Hydrogen, oxygen and Nitrogen. Many other elements may also be present and they are referred to collectively as mineral elements. At least 25 minerals occurred in foods, sometimes in minute amounts and may find their way in to our bodies. About 16 of these are known to be essential to life and must be present in the diet.

Mineral elements are used by the body in greater variety of ways. They may form part of the rigid structure in the body or they present in the body fluids or in the cell fluids.

Minerals are remaining after ashing of plant and animal tissues. They appear in food in variety of forms. Their chemical nature may have considerable nutritional importance, since it determines whether the nutrients are made available to the body during the process of digestion and absorption. Varieties of metals are found in a range of foods in the diet, and in this context, are termed minerals, along with some non-metals, such as iodine and fluorine. The minerals are grouped in to either:

Many of these minerals have been classed as essential elements, necessary for utilization by the body to ensure good health, but the function of these minerals and their benefits to the body is still uncertain and has been widely speculated. This has given scope for arguing the justification of taking supplements.

Much research has been carried out, concerning the role of minerals in the body, but in many cases, difficulties in investigating their individual effects has been expressed because intake is often in combination with other vitamins and minerals, e.g. fruit and vegetables contain several minerals. There is, however, strong evidence that supplementation of certain minerals would benefit those suffering from deficiency disorders. It is also important to note though that intake of minerals does not necessarily correlate with absorption and a balance must be obtained.

Macro minerals are present in virtually all cells of the body, maintaining general homeostasis and required for normal functioning. Acute imbalances of these minerals can be potentially fatal, although nutrition is rarely the cause of these cases. Diet can affect levels of macronutrients in the body, but effects are generally chronic, e.g. a high intake of sodium can lead to hypertension.

Ex: - Na, K, Cl, Ca, Mg, P

Micro minerals contribute to good health if they originate from an organic source because they have essentially been processed. Plants take up minerals from the ground, digest them, making them ionic so that when consumed by humans, assimilation into the body occurs much more easily, and toxicity by accumulation does not occur. However, micro minerals from inorganic sources, such as heavy metals, can not be used by the body as they tend to build up in the tissues

Ex:- Fe,Cu,Zn,Mn,I,Mo etc.

Objectives:-

1. To find out the mineral content in meal packets.
2. To find out whether the University students are receiving the recommended mineral amount per day.

CHAPTER TWO

LITERATURE REVIEW

Minerals are the constituents that remain as the ash after the incineration of plant and animal tissues. They appear in foods in variety of forms. Their chemical nature may have considerable nutritional importance, since it determines whether the nutrient is made available to the body during the process of digestion and absorption. The importance of minerals as food ingredients depends not only on their nutritional and physiological roles they also contribute to food flavor, activate or inhibit enzyme catalyzed and other reactions and affect the texture of food (Deshpande S.S, 2002 Hand book of Food Toxicology).

2.1 IRON

Iron is one of the most investigated and best understood of nutrients. Iron is essentially required as a component of the oxygen-carrying proteins myoglobin, in muscle, and haemoglobin, in red blood cells, which transport oxygen from the lungs to various tissues around the body. Fe is also a component of several enzymes involved in chemical reactions all over the body, including those involved in cell division and growth.

It is stored in the body in the form of ferritin and hemosiderin in bone marrow, liver and the spleen, and transported from these sites to cells by transferrin in the blood. Fe is present in a variety of different foods but only a small percentage of the intake is actually absorbed. Heme iron (mostly in animal products) is more readily absorbed from the diet compared to non-heme iron, but absorption also depends on the level of Fe stores in the body, as well as absorption enhancers (e.g. vitamin C, copper, cobalt, manganese), and absorption inhibitors (e.g. phytic acid in whole grains and legumes, polyphenols in tea or red wine, calcium).

Other functions:

- Found in every cell in the body: necessary for all bodily functions
- Prevents fatigue: involved in energy production
- Assists in the production of thyroid hormones and connective tissue
- Helps in stress and disease resistance
- Promotes healthy skin tone

Suggested therapeutic uses for Fe supplementation

- Alcoholism
- Anaemia
- Colitis
- Menstrual problems

Deficiencies

Fe deficiency results in anaemia, i.e. small, pale red blood cells with a low haemoglobin concentration. The condition is most common amongst women, especially when menstruating or pregnant, and symptoms include listlessness, fatigue, paleness, irritability and difficulty in swallowing. These symptoms also present in cases of haemorrhage. If severely deficient in Fe, the physical capacity to work may be reduced, and an increase susceptibility to infection can result due to a decrease in white blood cells, which reduces the ability to produce antibodies as well. Anaemia in pregnancy can increase the risk of premature and low birth weight babies, and in young children, a lack of Fe may be responsible for behavioural abnormalities and reduced cognitive performance, which may not be reversible with Fe supplementation. Other symptoms include:

- Breathing difficulties
- Brittle nails and koilonychia
- Constipation

However, excessive intake can sometimes be more of a problem.

Excessive intake

Over supplementation can cause adverse effects. Athletes who take Fe supplements to enhance their training performance may be more prone to recurrent illnesses and infections because bacteria have been known to thrive in Fe-rich environments. Babies who are fed Fe-fortified infant formulas may also suffer from symptoms of excess Fe, causing the proliferation of foreign bacteria in the gut and producing discomfort from gas and bloating. (Babies are born with naturally high levels of tissue Fe, enough for a year of normal growth, and therefore do not require Fe supplements.) Fe poisoning can occur if children accidentally consume adult doses of Fe supplements, and toxicity can also occur from cooking in cast Fe pans. There is also a condition called haemochromatosis, which results in the individual suffering from excessive Fe stores. Other possible causes of excess Fe identified include repeated blood transfusions and chronic alcoholism. Symptoms of toxicity are vomiting, diarrhoea and intestinal damage (Deshpande S.S, 2002 Hand book of Food Toxicology).

Food sources:

- Red meat, poultry and fish
- Liver, kidney, heart
- Dried fruit, e.g. raisins, prunes
- Vegetables Clams, oysters
- Wholegrain cereals ,nuts,beans,bananas

(<http://www.portfolio.mvm.ed.ac.uk/studentswebs/session2/group29/index.htm>)

2.2 POTASIUM

Potassium is present in high concentrations in the body as an intracellular cation in all cells. It interacts with sodium (which is extracellular), via a sodium-potassium pump on all cell membranes, maintaining a membrane potential, and therefore conducting nerve impulses and also fluid balance.

Most of the total body K is found in muscle tissue where it plays a major role in muscle contractions, e.g. regulating the rhythm of the heart in heart muscle. Because of its high concentrations in muscle cells, a measure of total body K can be used as a measure of lean body mass or cell mass, so that a decrease in total body K can indicate a loss of muscle mass. K exists in nature as three isotopes and it is the radioactive form, ^{40}K , which is responsible for the body's internal radioactivity and allows the total body K to be monitored. The values obtained can then be used as an indication of age (body K decreases with age), and disease.

K is also present in blood serum, which is sensitive to dietary intake but not indicative of total body K. This small percentage of K present extracellularly is required for propagating electrical potentials between neurones, skeletal muscle function, and blood pressure homeostasis.

Other functions of K include:

- - Needed for enzyme-induced chemical reactions in cells
- - Helps maintain normal plasma levels
- - Reduces blood pressure
- - Converts glucose to glycogen for storage
- - Involved with hormone secretion
- - Helps in excretion of body wastes
- - Used to treat allergies
- - Promotes clear-thinking by helping to provide oxygen to the

brain

Therapeutic uses

Suggested therapeutic uses for K supplementation

- - Acne
- - Alcoholism
- - Allergies
- - Heart attack and heart disease prevention
- - Hypertension
- - Diabetes

N.B. Supplements taken on an empty stomach may cause nausea, and those with kidney disease or complications should not take K supplements.

Deficiencies

Low levels of total body K is not usually due to a lack of K intake from the diet, except in the case of starvation. However, K deficiency can result from a protein wasting condition in which the total cell mass of the body is decreased. Alternatively, hypokalaemia (low serum K), in which excessive K is lost from the body via urine, could occur as a result of using diuretics in hypertension treatment. In extreme cases, heart failure could be precipitated.

Other symptoms of K deficiency Nausea and vomiting

- Listlessness, anxiety and nervousness
- Muscle spasms, weakness and cramps
- Rapid heart beat and hypertension
- Oedema
- Hypoglycaemia
- Constipation
- Acne and dry skin