Nutrition

By

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Minerals

The human body contains a large number of minerals in varying quantities. Some are in large amounts, while others in minute amounts are spoken of as "trace elements". Though the trace minerals are in very small quantities their role in nutrition is great and they are vital to good health. The figures below give the quantities of each present in an average adult healthy human body.

Minerals	*Quantity*	
Calcium	1400-2000 gm. or 2% of body weight.	
Phosphorus	450-700 gm.	
Sodium	335 mgm/100 cc serum 43 mgm/100 cc corpuscles	or 105 gms. in blood.
Potassium	18-20 mgm/100 cc serum 425 mgm/100 cc corpuscles	or 245 gms. in blood.
Chlorine	362-376 mgm/100 cc serum	or 105 gms. in blood.
Sulphur	175 gm.	
Magnesium	35 gm.	
Iron	2·8 gm.	
Manganese	0·21 gm.	
Iodine	0·028 gm.	
Cobalt	a trace.	
Silicon	a trace.	

Aluminium, Arsenic, Boron, Copper, Flourine, Nickel and Zinc—mere traces.

From the above it will be apparent that at least 19 elements enter into the composition of body though in varying amounts. The order of magnitude does not necessarily indicate the importance of the elements. For instance, there is much more potassium in the body but in daily dietary we need more sodium; there is a small amount of iodine, a trace of cobalt, copper and zinc but life would be impossible without iodine and proper haemopoesis would be retarded in the absence of copper and cobalt; zinc is essential for the manufacture of insulin; flourine, though in minute amounts, is essential for the hardening of the enamel of teeth.

These elements enter into the body structure and aid in catalysing the reactions. Ionised calcium salts are essential for maintaining the activity of skeletal, cardiac and unstriped muscles of the body. Iron is an integral part of haemoglobin; phosphorus enters into the structure of the cell nuclei and the myelin sheaths of nerves; sulphur is present in every protein of the body and more particularly in skin; potassium is essential for cellular elements of the body, and shortage of magnesium leads to defective bones and teeth. Zinc is also an essential constituent of an enzyme, essential for respiration found in red cells. Phosphorus in combination with vitamin B_1 and nicotinic acid acts as a catalyst in the carbohydrate metabolism, while iodine is essential for the formation of thyroxin, the secretion of the thyroid gland.

The above facts show the enormous importance of the minerals in our body and the necessity of obtaining these in our daily diet.

Each of the important elements need a little more consideration while those of therapeutic interest will be discussed later in "Diet in disease".

Calcium.—It enters into the formation of bones and teeth. It is absorbed in the small intestine, the quantity absorbed being related to the amount of vitamin D and phosphorus

present in the dietary. Calcium circulates in the blood, of which 10 mgm/100 c.c. is present in the plasma. The non-absorbed calcium is excreted through faeces, and anything that hurries the food along the intestine *e.g.*, diarrhoea, or purgatives, hinders its absorption. To be absorbed, calcium should preferably be in an inorganic form; calcium oxalate is not absorbed, hence foods containing oxalic acid keep its calcium content from being utilised by the human system. While 90 to 100 per cent of calcium in milk and 80 to 100 per cent of that in cabbage and other green leafy vegetables is absorbed, but the calcium present in spinach is available only to the extent of 15-20 per cent because of its high oxalic acid content.

Lack of calcium in diet leads to osteoporosis of the bones and lack of vitamin D to rickets and osteomalacia. A proper intake of vitamin D is essential for proper utilisation of calcium. During the last three months of pregnancy, the need of the foetus for calcium is highest and it has been observed that the skeletal growth of the baby depends on the amount of calcium in the mother's diet.

The daily average requirements of calcium has been variously estimated and the figures for the average Indian has already been given in the earlier of this series. It may be of interest to note that one pint of milk contains 680 mgm of calcium (1 gm=100 mgm.)

Meat contains negligible amount of calcium, as do large fish, but small fish eaten whole with bones frequently give large amounts of calcium. Milk is richest and next come the leafy vegetables. Spinach contains 595 mgm/100 gm and rhubarb 103 but the calcium in these is unavailable to the system because of the oxalates present in them.

Phoshorus.—Milk, milk products, eggs, meat, fish and cereals are rich in phosphorus and no special attention is paid by dietetitians on this score. The absorption of calcium depends on the quantity of phosphorus in foods and the optimal ratio is possibly 1:1.5. Sherman suggests a ratio of 1:1.94. Human diets investigated reach a figure higher than those and it is almost certainly true that if the calcium in the diet is adequate, the phosphorus will also be adequate. In practical dietetics all that one has to care for, is the adequacy of calcium in the dietary keeping in view the conditions of stress and strain.

Iron.—Iron is essential for the proper formation of haemoglobin and deficiency of it does lead to macrocytic anaemia. The quantity of iron present in any food as estimated by chemical methods is not a guide to its utility for the human system, since a food may be rich in iron but some of it may be poorly utilised; for example, spinach which has 4 mgm of iron per 100 grams is no better than tomatoes which have only 0·43 mgm. It is questionable to dogmatise the richness of a food in iron, unless the proportion of it that would be available to the system is proved by biological experiments.

The assertion that excess of iron is excreted in the faeces is questionable. Excess of it may not be utilised but the body retains it tenaciously and the retention may be twice as great as the quantity already present in the blood stream. The excess is presumbly retained in the reticuloendothelial system — liver and spleen.

We are born with 266—937 mgm of iron, average 400 mgm. This is all present as haemoglobin. The newborn baby has 42·1 mgm of iron per 100 c.c. of blood, any excess of it is quickly disintegrated and the haemoglobin level falls, but the disintegrated iron is retained and used little by little to form more haemoglobin as we grow. Mother's milk contains very little iron and the fall in the baby's haemoglobin may be as much as 43% in breast-fed and 70% in artificially-fed babies, hence the need to supplement iron to

artificially-fed babies. If the mother during pregnancy is suffering from anaemia of pregnancy, the iron store of the baby would be low and the fall during its first few months of life would be much more than the normal. In girls at puberty and during the menstrual periods there is a fall in the haemoglobin level and this may be as much as 40 mgm per period. Pregnancy causes a drain on the iron content of the mother's system for she has to pass on to the foetus about 400 mgm and another 100 mgm to the placenta, and again there may be considerable loss during child birth.

Normal daily requirements of an average Indian has been estimated as 20-30 mgm a day. The following shows the iron content of some of the important foods — mgm per 100 gm of food :—

Apricots	...	4·09
Currants	...	1·82
Dates	...	10·6
Figs	...	4·17
Raisins	...	1·55
Rice flakes	...	8·0
Rice puffed	...	6·2
Bengal gram	...	9·8
Black gram	...	9·8
Green gram	...	8·4
Red gram	...	8·8
Soya bean	...	11·5
Amaranth tender	...	21·4
Bengal gram leaves	...	23·8
Bitter gourd	...	9·4
Cluster leaves	...	5·8
Drum stick	...	5·3
Crale	...	21·2
Duck's egg	...	3·0
Small fish	...	2·3
Liver—sheep	...	6·3
Mutton	...	2·3
Sardines	...	2·5
Whole milk *khoa*	...	5·8
Jaggery	...	11·4

In order that the iron of the food may be absorbed, it must be present in a soluble form and there should not be such substances as would form an insoluble salt of the iron. For example, the iron present in wheat combines with the phytates which also are present in wheat and an insoluble salt iron phytate is formed. Such a reaction cannot happen only if the enzyme phytase is present in the gut, but human gut does not contain any phytase. It has been shown by McCance that the use of wholemeal bread depresses the amount of iron absorbed from the food, probably due to the presence of phytates. It has been further observed that cutting, chopping, and cooking the vegetables with an iron (not stainless) knife and cooking in an iron pan increases the iron content of cooked food.

When profound iron deficiency has been produced, iron should be given in medicinal form as diet therapy by itself is not expected to give any quick relief.

Iodine.—It is essential for the formation of thyroxine, the secretion of the thyroid gland. Very small amounts of it are necessary : 70—140 Y per day per adult. (Y=one thousandth of a mgm.) Though its daily requirements are so small, in many parts of the world deficiency of this is observed in the form of the disease called goitre—enlargement of the thyroid gland. The areas bordering the tarai of the Himalayas are endemic areas of goitre. The water supply and the soil of the area are deficient in iodine and the population do not get the adequate daily requirements through food and water. The condition can be improved by the administration of common salt to which has been added potassium iodide in the proportion of 1 part of iodine in 200,000 parts of salt.

Sea fish and sea weeds are rich in iodine ; onions if grown on a soil containing iodine also contains sufficient amounts of it.

Sodium.—It is consumed by man in the form of common salt ; sodium chloride. The cortex of suprarenal gland governs the excretion of sodium in body. In Addison's disease, the blood sodium content is reduced by as much as 28 per cent.

In intense sweating, loss of sodium occurs and due to this there may be

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