

## **THE MINERAL ELEMENTS OF THE AVOCADO**

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The analyses that have been heretofore published of the avocado have not given any insight into the nature of the mineral matter of this fruit, merely indicating the total amount. A few years ago when a dietary or even the nutritive value of a food was discussed, it was deemed only necessary to consider the content of protein, fat and carbohydrate, and the caloric value, no special attention being paid to the mineral matter or to the value of the individual proteins and fats. This is emphasized by reference to the literature bearing on dietary studies and digestion experiments. As has been previously stated, the general subject of the mineral matter has only recently been accorded the prominence which it demands, as evidenced by the fact that the first complete and comprehensive bulletin by the Agricultural Experiment Stations of the United States on the importance of the mineral elements in nutrition, was issued by Dr. Forbes of the Ohio Station about seven years ago.

It was formerly considered that the amount of mineral matter in any diet or ration, particularly for the adult animal, was ample and that no further attention need be paid to this matter, owing to which, as above mentioned, in the compounding of rations and diets only the organic nutriment were considered. The older views have been gradually changed to meet the results of late nutrition investigations, particularly with reference to not only the amount but the nature of the minerals ingested by animals, and this is particularly true in connection with human dietaries.

The mere statement that a combination of foods contains so many grams of mineral matter or such and such a percentage of mineral matter is almost meaningless as far as its physiological value is concerned. Not only must there be an adequate supply of mineral matter but there must be an adequate supply of each of the chemical elements necessary and furthermore these must bear some quantitative relation to each other, otherwise the diet is unbalanced in this respect.

The most important elements which we have to consider are iron, calcium, magnesium, potassium, sodium, chlorine, sulphur, and phosphorus, and it may be said that these elements, which are most important as far as animal nutrition is concerned, are equally important to the soil as plant food.

The question may well be asked if these mineral elements are so important, why were not earlier investigations conducted with reference to them. As Dr. Forbes writes:

"There are a number of reasons why our knowledge of the functions of the mineral elements in nutrition has not kept pace with our advancing knowledge along other lines. First, animals need comparatively little of the mineral nutrients in their food; second, animals' bodies contain considerable reserve supplies of the mineral

nutrients which can be drawn upon in case of need, so that a deficiency of the food in certain mineral nutrients is not at once made apparent by the behaviour of the animal; third, the excretion into the intestine of waste products containing mineral elements, and their consequent appearance in the feces along with undigested mineral nutrients prevents an accurate judgment as to the digestibility of the same; fourth, the redigestion and reassimilation of mineral matter from certain waste products which have been excreted into the intestine, thus resulting in a repeated utilization of the same nutrient substance, tends to obscure the facts regarding the nutrient in question; and fifth, most foods, though by no means all, even of our commonest ones, furnish as much of the mineral nutrients as animals need."

"Can it be that such an important matter as the provision of the body with mineral nutrients has not been adequately provided for by natural selective processes? Have not animals' food-habits and digestive processes been adapted to the provision of the body with all those nutrients which it needs?"

In a general way we may answer these questions in the affirmative, but when we consider them with care we see many exceptions and qualifications becoming necessary.

"It is doubtless true that in his aboriginal state man's food habits provided his body with all those nutrients which his simple life required, but civilization has set up new standards, unnatural ones in the sense that natural selection has not been able to accomplish new adaptations as fast as they were required by changed habits and so we find ourselves living somewhat out of harmony with our physiological processes.

"Civilization requires specialized efficiency, and so the organism is put upon a strain by the severity of the tax upon some functions; certain it is that the twentieth-century American has need for more food of a sort capable of developing his nervous system than had aboriginal man. Indiscriminate eating may sustain life at low-pressure, but keen competition and highly specialized activity call for definite adaptation of the food, both as to kind and quality, to the necessities for nutriment."

Time will not permit entering into detail regarding the use made by the body of each of the different minerals above mentioned. The sulphur, however, that is found in the protein in foods is mainly metabolized into sulphuric acid, the phosphorus into phosphoric acid, etc. It is very necessary that there be some base to take up or unite with these acids in order to preserve the neutrality or faint alkalescence of the blood and tissues. Many illustrations could be cited indicating that the continued use of a so-called mineral-free diet will product acidosis resulting from the lack of the base-forming elements in the food. A mineral-free diet is one that consists of proteins, fats, and carbohydrates, but that has been freed from mineral matter and leaves no appreciable residue on burning in the air. Such a combination of foods is termed an acid-forming diet because in the body there will be furnished from the metabolism of proteins sulphuric and phosphoric acids. As stated by Sherman:

"A diet in which the acid-forming elements greatly predominate must result in a withdrawal of fixed alkalies from the blood and tissues or an increased circulation

of ammonia salts in the body, neither of which can be regarded as advantageous. While such a diet is more or less habitual with carnivora and may not be dangerous to man, it must put upon the body accustomed to a mixed diet a tax, which, however, small, might better be avoided, especially as we have no reason to anticipate any disadvantage from a predominance of base-forming elements, which if not used to neutralize stronger acids, would take the form of bicarbonates and thus aid in the maintenance of the normal and necessary neutrality or faint alkalescence of the blood and tissues. It therefore seems desirable that in constructing a dietary the foods in which the acid-forming elements predominate should be so balanced by foods having a predominance of bases that the diet as a whole may yield sufficient fixed bases to neutralize the mineral acids produced in its metabolism."

The foregoing thus indicates the value of the generous use of fruits and vegetables in the diet. Previous to the investigation of the importance of the mineral matter, the value of fruits and vegetables was considered more of a hygienic nature and the fruits themselves more as luxuries. Nuts belong- to the foods which furnish the acid-forming elements in excess and therefore the wisdom of the combination of fruit and nuts.

An investigation just completed in the Nutrition Laboratory at the University of California, shows that the avocado belongs to that class of foods which yield an excess of the base-forming elements. This was perhaps to have been inferred, but until the investigation was completed, no definite conclusions could be drawn. Four different analyses were made; the varieties examined being the Taft and Sharpless furnished by C. P. Taft and B. H. Sharpless, respectively, and seedlings from Messrs. C. P. Taft and W. A. Spinks. There is evidenced a close agreement between the results of the specimens tested.

More than one-half of the ash of the avocado consists of soda, potash, magnesium and lime, the latter occurring, however, in comparatively speaking small amounts, the phosphoric acid averaging about 17.5 per cent, with 1.5 per cent of iron.

In the ash of the cereals, nuts, meats, eggs, etc., the phosphoric acid greatly predominates. This element is found -in the avocado, on the other hand, as in other fruits, only in relatively small amounts. In view of the low content of lime, therefore, it could not be said that the avocado should be recommended as furnishing any notable supply of bone material. This, however, is not the function of the avocado. Its great value, as far as mineral matter is concerned, lies in the fact that the ash contains a predominance of bases such as sodium, potassium, magnesium, and calcium.

Another advantage which may be cited in favor of the avocado is that its content of ash is far higher than that noted for any other fruit. The pure ash of the edible portion of the avocado shows an average content of 1.05 per cent, while those of the other fruits are as follows:

Grapes	500
Prunes	565
Plums	524
Apricots	484
Nectarines	490
Figs	440 - 897 (av. 600)

Lemon	535
Orange	500

The olive is not included in this list for the reason that the ash of the olive is high but due mainly to the salt with which it is pickled. In other words, the olive is a processed fruit which cannot be eaten in the fresh state and therefore one might say does not belong to the same class as the avocado.

It is true that if we were to compare the fruits above listed and the avocado on the same water basis, or upon a water-free basis, the figures would not be so favorable to the avocado, in that the avocado contains less water on the average than do most of the fresh fruits. The above statements, however, are made on the fruit as consumed and therefore it can be said that per unit weight of fresh fruit eaten, more mineral matter is ingested with the avocado than with any of the other fruits mentioned.

Current investigations carried on by such men as McCollum, Osborne, Mendel, etc., have now fully established the fact that animals cannot grow when limited to rations of carefully purified proteins, carbohydrates, fats, and salts. McCollum and Davis have shown that certain fats, as butter fat, egg yolk fat, kidney fat, and some others, contain something which greatly stimulates growth when added to a diet of casein, dextrin, lactose, and a salt mixture of appropriate composition. This substance is present in certain products of plant origin as well. Later they discovered that if the lactose was replaced by dextrin in this ration the addition of butter fat did not induce growth. When this diet, containing butter fat, was supplemented with small additions of the water extract of boiled egg yolk, or water or alcoholic extracts of wheat germ, growth proceeded at the normal rate. They formulated the working hypothesis that in addition to the recognized essential constituents of a successful diet, viz., protein, carbohydrate, fats, and inorganic salts, the growing animal requires two ' substances, or groups of substances; one, which is soluble in fats, is contained in fats from certain sources; the other, which is soluble in water and alcohol, is found widely distributed both in the animal and the vegetable worlds.

This Laboratory intends, during the summer, to conduct investigations en growing animals with avocado oil to ascertain whether it will rank in the positive or negative group as regards its content of this unknown element necessary for growth.

It has been shown, as above, that in addition to this fat-soluble material, there is another water-soluble material that must be associated with the fat-soluble material in order to bring about the best conditions for growth. It has been suggested by McCollum that this unknown element soluble in fat be called fat-soluble A, while the other unknown substance soluble in water which is contained in different plant foods, be termed water-soluble B. If it could be proved that both the fat-soluble A and the water-soluble B were present in the avocado, as they are in the wheat embryo, it would be the highest recommendation for the avocado as a food for the very young.