

## **Acid-Base Balance of Diets Which Produce Immunity to Dental Caries Among the South Sea Islanders and Other Primitive Races**

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Among the many theories regarding the controlling factors for immunity to dental caries, "potential alkalinity" has been stressed by many as playing the controlling role. This has been strongly emphasized in the paper by Dr. Martha Jones entitled "Our Changing Concept of an Adequate Diet in Relation to Dental Disease." She and her associates have emphasized this factor in several previous communications. I do not find in her reports, however, the type of quantitative data which seem to be needed for evaluating this problem. The fact that a given potentially basic diet has been found associated with immunity may have little significance regarding the role of acid-base balance in establishing immunity.

It is very clear that a satisfactory approach to this problem will require the consideration of many diets which have been competent to establish and maintain a very high immunity. No modern civilization provides such a control group, since dental caries is active and in certain groups rampant among the individuals of all of our modernized peoples. It is for this reason I have been making expeditions during several years to reach the remnants of primitive racial stocks who, like their ancestors, are characterized by a very high immunity to dental caries and who by their isolation make possible a critical study of the variables at the point of contact with modern civilization where the high immunity changes to a high susceptibility to tooth decay.

I have previously reported on my studies among the Swiss in the high Alps (1) in isolated valleys. The people of the Outer Hebrides (2), the Eskimos of Alaska (3) and the Indians of northern and central Canada (4) have also been reported. In addition to these we now have very extended data obtained during the past summer from studies among the Melanesians and Polynesians on eight archipelagos of the Pacific.

In this report we shall include a consideration of the acid-base balance of the foods for both these racial stocks and for groups with high immunity to dental caries and for those who have lost that high immunity.

In order to make these data more readily understood when a comparison is made of the potential acidity of the various diets that have been found capable of producing and maintaining high immunity, it is important that we visualize, first, the levels of incidence of tooth decay in these groups while they are isolated and also the levels of those of the same racial stocks who had lost their immunity at the point of contact with civilization. These are shown for the different groups in Figure 1.

Figure 1: Dental Caries on Primitive and Modern Food (caries in teeth per 1000 teeth examined)

Peoples	Primitive	Modern
Alps	46	298
Hebrides	11	300
Eskimos	0.9	130
Indians	1.6	215
South Sea Islanders	3.4	308

There are five groups. We are using all of the people of the South Sea Islands in one group for convenience in this study. It will be noted that the isolated Swiss of the high Alpine valleys had forty-six teeth attacked by tooth decay out of each 1,000 teeth examined. The modernized Swiss who were eating our modern foods had 298 teeth involved with caries for each 1,000 teeth examined. For the primitive Gallics in the Outer Hebrides these figures were eleven teeth of each 1,000 teeth examined which had been attacked by dental caries and for the modernized groups 300 teeth. For the isolated Eskimos less than one tooth, 0.9, was attacked by caries in each 1,000 teeth examined and for those at the point of contact with our modern foods 130 teeth were involved. For the Indians of the far north and interior of Canada living on their primitive native foods 1.6 teeth were attacked with dental caries, while for the modernized Indians 215 teeth. For all of the groups in the South Sea Islands living on their primitive native foods 3.4 teeth per 1,000 teeth examined had been attacked by dental caries, whereas among those eating foods of modern civilization this was increased to 308 teeth.

It is important that we keep these figures in mind as we observe the total acidity and total base provided in the average daily diets of these various groups.

Figure 2: Acid Base Content of Primitive and Modern Diets

Peoples	Acid		Base	
	Prim	Modern	Prim	Modern
Alps	359	165	355	171

The figures for acidity and base content are shown in Figure 2. We have in this chart the same groups in the same relationship as in Figure 1. The method of determining the acid and base content of a given food involved determining the quantity of each of the basic elements --

Hebrides	248	171	152	152
Eskimos	707	234	382	227
Indians	892	234	628	227
South Sea Islanders	322	203	399	244

calcium, magnesium, sodium and potassium -- and the acid elements -- phosphorus, chlorine and sulphur. These determinations have been made by using Sherman's tables with special determinations of special foods. These are expressed in terms of cc. of normal acid and normal base, using the method suggested by Salter, Fulton and Angier in the Journal of Nutrition for May 1931. The excess of acid over base or base over acid is expressed as potential acidity or potential alkalinity. It is important to note that in four of these five groups of primitive racial stocks, living on entirely different native foods and in widely divergent climates and entirely different living habits, **the immunity-producing diets were found to be higher in acid factors than in base factors.** In some the divergence is quite small and in others, quite large. It is also important that, in changing, from high immunity to high susceptibility diets there was no increase in potential acidity with increased susceptibility to tooth decay. This graph shows the quantity of acid and base in each of the diets associated with immunity and also with susceptibility to tooth decay, and it is of interest to note the very great difference in total acid and total base contained in the nutritions of the various groups.

The clinical work that has been done by Dr. Jones and her associates in the Hawaiian Islands has been on a diet that is potentially alkaline, consisting, as we have learned from her, of poi and milk. The poi is made from powdered cooked taro to which water has been added and fermentation allowed to take place for a definite period. We are primarily concerned with the inorganic acids in evaluating the role of potential acidity, since the organic acids are largely, if not completely, oxidized in the body. Fermenting the poi does not therefore materially change the acid-base balance. The following are the figures for both acid and base factors for each of the primitive and modernized diets for the five groups: for the primitive peoples in the Alps we have as cc.N. acid 359 and base 355; for the modernized groups we have acid 165 and base 171. For the Gallics of the Outer Hebrides in the primitive groups we have acid 248 and base 152, for the modernized groups, acid 171 and base 152. In the primitive Eskimos diet the acid is 707 cc.N. and the base 382; for the modernized Eskimos the acid is 234 cc.N. and the base 227. In the primitive groups of Indians the acid content is 892 cc.N. and the base 628; for the modernized groups the acid is 234 cc.N. and the base is 227. For the primitive South Sea Islanders' diet the acid is 322 and the base 399, and for the modernized groups the acid content is 203 and the base 244.

**My data, accordingly, do not support the theory advocated by Dr. Jones.**

It is of particular interest that in my studies of the South Sea Island groups taro was found to be one of the most universally and extensively used articles of food. When used with adequate primitive diets of all the Island groups studied, except the Hawaiian Islands, which would include the Marquesas, Society, Cook, Tonga, New Caledonia, Fiji and Samoan Islands, the taro, which was cooked by baking in ovens consisting of heated stones covered with leaves and dirt, produced a very high level of immunity to dental caries in every instance where the groups were isolated from contact with foods of modern civilization and where they were using only their native vegetables and fruits and animal life of the sea. The nutrition of these people will be discussed from a chemical and activator basis in another communication, since space does not permit including it here.

It is very important that dependable data be accumulated as rapidly as possible which bear upon this problem of acid-base balance of foods, since many enthusiasts are advocating strongly the elimination or reduction of potentially acid foods such as cereals, meats and fish. Indeed, a great deal of propaganda is reaching the profession and laity which places great stress upon the importance of keeping the diet potentially alkaline.

It is my personal belief, based on the extensive data that I am accumulating, from a study of these various primitive groups and their breakdown at the point of contact with civilization and its foods, that several constitutional factors may be involved besides tooth decay, and which are very important. My investigations are showing that primitive groups have practically complete freedom from deformity of the dental arches and irregularities of the teeth in the arches and that various phases of these disturbances develop at the point of contact with foods of modern civilization.

It is not my belief that this is related to potential acidity or potential alkalinity of the food but to the mineral and activator content of the nutrition during the developmental periods, namely, prenatal, postnatal and childhood growth. It is important that the very foods that are potentially acid have as an important part of the source of that acidity the phosphoric acid content, and an effort to eliminate acidity often means seriously reducing the available phosphorus, an indispensable soft and hard tissue component.

It is my belief that much harm has been done through the misconception that acidity and alkalinity were something apart from minerals and other elements. Many food faddists have undertaken to list foods on the basis of their acidity and alkalinity without the apparent understanding of the disturbances that are produced by, for example, condemning a food because it contains phosphoric acid, not appreciating that phosphorus can only be acid until it is neutralized by combining with a base.

An illustration of this is the following case: A girl was brought for assistance and study who still had her childhood face at sixteen years of age. There had been marked delay in physical development and function other than this growth factor. I was advised that the nutrition of this child had been very largely guided by the literature of the Defensive Diet League which, as one of its principal premises, has urged the keeping down of the acid-producing foods. This girl was so conscious of her underdevelopment that she disliked to go to social events with those of her age. When brought to me for assistance and correction of her facial deformity I did not deem it wise or feasible to undertake to change the position of the facial bones by use of orthodontic appliances. I depended entirely on a reinforced nutrition. We supplied mineral and activator carrying foods, with the hope that the growth factors might be in part latent and still be capable of stimulation. There was a very marked improvement in the facial development. In one year she largely developed her adult face. She is very conscious of this improvement and, instead of being reticent and reserved, she has become the leader in her group.

It is very unfortunate that medical and dental science has not looked to the primitive people earlier for standards of not only physical perfection but also of nutrition.

Indeed, while I am dictating this text I have been interrupted by a nurse who has come to inquire whether the teachings so strongly heralded by certain groups should be followed, namely, that proteins and carbohydrates should never be eaten together.

I have seldom found anywhere in the world such a high percentage of physical excellence with high immunity to our modern degenerative diseases as among these people of the South Sea Islands. Their diet practically every day consisted of eating the proteins from the animal life of the sea with the carbohydrates of their land vegetables, many of which were very rich in starch. This was equally true of the Gallics in the Outer Hebrides, living almost entirely on oats and sea foods.

By studying primitive people who have exceedingly high immunity to dental caries and those people at the point where they lost that high immunity, we were able to reduce the total number of variables to a minimum. It was then possible to study critically those factors of the nutrition which are found to be changed and the varying amounts which can be directly related to the changed incidence of dental caries. This provides still another approach to the problem since, by adding those factors to a deficient diet which are found to constitute the difference between that diet and one that has been demonstrated by those primitive peoples to be efficient, we have a means for checking and determining whether these factors when added will change susceptibility to immunity. It is by this procedure that we can now control dental caries when active, or completely prevent it from developing.

It is of particular significance that when all of the foods of these various primitive groups are reduced to their chemical and activator content they are found to be relatively equivalent. This strongly indicates the direction in which the dental profession can profitably move in this matter of the prevention of tooth decay. Since many other degenerative processes are found to develop simultaneously, or nearly so, with the loss of immunity to dental caries, we have strong evidence that these physical afflictions are, like dental caries, symptoms rather than unit diseases. This clearly is the direction that modern preventive medicine will take in order to establish high immunity to the degenerative diseases.

In every instance in my studies of these primitive racial stocks where I found that they had made contact with our modern civilization, with the result that they had lost their immunity to dental caries, that contact included displacing part of their native diet with imported white flour and sugar and sweetened goods. These foods are exceedingly low in Nature's building material for growth and repair. Refined sugar has practically no minerals or activators, and white flour has had removed about four fifths of the minerals and nearly all of the germ with its contained activators. Molasses, or sorghum, carries very little phosphorus, though it does carry calcium, which is usually provided easily in safer foods like milk and vegetables. It also carries potassium liberally.

Concentrated sweets of all kinds are too high in caloric value to be safe in liberal quantity. Our daily limit of two or three thousand calories, together with our requirement of about two grams of phosphorus in the foods (in order to obtain two-thirds of that amount for body building), means that to obtain this amount we would have to eat enough molasses to supply about 13,300 calories, or about ten pounds. This, if possible, would probably do much harm. To get sufficient phosphorus from white flour products usually requires eating about four and one-half pounds of white bread daily, which would provide about 10,000 calories.

In my clinical practice, in which I am endeavoring to put into practice the lessons I am learning from the primitive people, I do not require that the foods of the primitive races be adopted but that our modern foods be reinforced in body building materials to make them equivalent in mineral and activator content to the efficient foods of the primitive people. This usually is accomplished by displacing white-flour products with whole-wheat products, together with eliminating or reducing the high caloric foods such as sugars and other sweets, and adding foods that are good providers of the fat-soluble activators, such as the butter of milk as produced by cows that are eating liberally of fresh or cured rapidly growing green wheat or rye, together with the organs of animals and the use of sea foods such as these primitive people have used so successfully in providing not only high immunity to dental caries but excellent bodies, with high defense for the degenerative diseases.

We are learning Nature's methods and undertaking to utilize them. The chemical content of all of these primitive foods is comparably high in minerals and activators, especially the fat-soluble activators, while being relatively low in calories. In no instance have I found the change from a high immunity to dental caries to a high susceptibility among these primitive racial stocks to be associated with a change from a diet with a high potential alkalinity to a high potential acidity, as would seem to have been the case had the high alkalinity balance theory been the correct explanation. If the requisite is so simple as a potential alkalinity, why has not the addition of sodium bicarbonate to a deficient diet controlled dental caries?

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