

Hydrophilic Colloidal Diet*

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HYDROPHILIC COLLOIDAL DIET

HYDROPHILIC colloids form the substratum of all living protoplasm. They possess the property of readily taking up and giving off the substances essential to cell life. Precipitation of the hydrophilic colloids of protoplasm causes cell death.

PHYSIOCHEMICAL CONSIDERATIONS

Man's food in the raw state consists largely of hydrophilic colloids. The heat of cooking on the other hand—to mention only the physiochemical change—precipitates the colloids of our diet. This change in colloidal state alters the hydration capacity of our foods so as to interfere with their ability to absorb digestive juices. The amount of interference depends upon both the degree of thermo-concentration and the specific character of the colloidal medium itself. Certain colloids will withstand more heat than others; for instance, cellulose of vegetable origin and certain pectins will stand a greater temperature without being precipitated than the proteins of animal origin.

Any hydrophilic colloid, be it living protoplasm or a mineral jelly, has a certain hydration capacity under given conditions. By varying the physiochemical conditions surrounding such a colloid, it may be made to expand or contract. In the laboratory the expansion and contraction of colloids can be controlled within set limits at will.

Familiar laboratory experiments dealing with the absorption of chemicals and fluid by hydrophilic colloids are the experiments described by M. H. Fischer

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(1). If two gelatin squares of similar weight are immersed in finger bowls, one containing distilled water, the other a solution of hydrochloric acid of 1/100 normal concentration, we find two interesting phenomena. First, the gelatin square in the acid expands at a much greater rate than the square in the water. Second, the solution about the square in the acid medium becomes almost of the same hydrogen ion concentration as distilled water. Now, if the acid solution is made stronger, the gelatin is digested, making a colloidal suspension, and unless too great a concentration of acid is present the acidity of the solution approaches neutrality. On the other hand, gelatin precipitated by heat fails to take up water or acid.

PHYSIOLOGIC APPLICATION

If man did not cook his food, there would be no need for the addition of any hydrophilic colloid to his dietary. Uncooked foods contain sufficient hydrophilic colloid to keep his gastric mucosa in excellent condition. On the other hand, man living largely on cooked foods presents a different problem. Recall the description of the stomach contents so vividly described in medical school days, as consisting of several layers, each layer assuming its position by virtue of its specific gravity; meat first, then vegetables and fruits followed and interspersed by the mashed potatoes, and last the water layer with its scum of fat; and how this was churned around and had poured into it sufficient gastric juices to digest the meal in one and one-half to four hours if all was well. If such gastric contents are removed and examined, the aqueous layer is found to be strongly acid, the degree

differing with the individual. The digestive action takes place between the food particles and the gastric mucosa, which to be sure does not digest itself.

If we give a similar meal to another man, adding to it a hydrophilic colloid of excellent hydration capacity, let us say $\frac{1}{2}$ to 1 ounce of gelatin, a definite change takes place in the contents, and if they are withdrawn for analysis, a gluey mass is recovered. It is not sour as would have been the contents of the stomach which did not contain gelatin; and on the contrary it does not show any acidity till the colloid is broken down. Under these conditions, digestion is quite generally distributed throughout the mass.

The gelatinous mass that results from the ingestion of a prepared hydrophilic colloid such as gelatin is formed more quickly than is the case when such raw foods as fruits and vegetables are used, which must first take up the digestive juices and then be partially digested before the mass develops. Raw meats apparently become gelatinous in less time than vegetables. But, as digestion proceeds, all raw foods become more or less gelatinous before liquification takes place. In case of cooked foods, gastric digestion is also directed toward the liquification of the stomach contents, but it is interfered with by the fact that the heat of cooking has precipitated the colloids.

CHOICE OF HYDROPHILIC COLLOID

The choice of hydrophilic colloids for this purpose is legion. Cactus juice and beet juice are both useful. They are considered excellent feed water compounds by engineers because they keep minerals in solution and prevent scale from forming in steam boilers. They are cheap but not refined. Mucin (2), colloidal aluminum hydroxide (3), agar, the edible sea weeds, and many proprietary preparations, which include certain of the silica jells, mucilaginous substances of vegetable origin, etc., are among colloids that may be used.

Each one of the above mentioned substances has one or more drawbacks. It is either too expensive, it produces toxic effects, it is not readily available, it is bad tasting, has insufficient hydration capacity, or it is indigestible. In my work I have chosen to use gelatin because it possesses none of the above disadvantages. It is non-toxic and has a good hydration capacity. It can be purchased at a reasonable price at any grocery or drug store. It is readily available. It can be served in many tasty ways. One can get it at any hotel or restaurant. It is completely digested. Should a hydrophilic colloid with bulk be needed, an indigestible colloid such as agar may be added.

SELECTION AND PREPARATION OF GELATIN

Just as there are grades of gasoline and flour, so are there grades of gelatin. Roughly in the competitive market the grade and price correspond. Gelatin may be made either by an acid or an alkaline process, and any of the poorer grades of commercial gelatins are either alkaline or acid to taste. The best gelatins are neutral. Gelatin may be bought in sheets, or in granulated form. The latter is more readily soluble. In this discussion it is the plain, unflavored and unsweetened gelatins to which we refer.

When one is to choose between two neutral gelatins of different grades, their adhesive properties serve as the best guide. To test this stickiness, take weighed

samples and place them in different containers of the same shape and size. Add to each weighed sample of gelatin an equal amount of cold water, and allow it to expand for five minutes. The containers with the samples of gelatin to be compared, are immersed to the same depth in boiling water and allowed to remain there until all the gelatin is dissolved. Then remove from the water and allow the mass to stand five minutes to cool. Take in turn a definite amount of each sample between the thumb and forefinger, and compare their stickiness. Wash and dry the hands carefully after testing one sample before testing the next. Though this method is rough, it is accurate enough and one will be surprised to find the difference shown by different samples of gelatin.

PREPARATION OF GELATIN

Gelatin may be served to the patient in many ways. It may be beaten up with an ice-cream-malted milk. Prepared in this way it is somewhat granular. It may be taken from a spoon, dry, and washed down with a liquid, although this is usually a very sticky procedure. It may be mixed with dry or cooked cereals, with vegetables, or many other foods. In my experience, the most satisfactory way to use it is to first dissolve it, by mixing it with cold water allowing it to stand in hot water until dissolved and then adding water and flavoring to make it the proper consistency and to improve its taste. It should be stirred while heating to mix it thoroughly. It may be made in concentrated form and added to soup or bouillon or made into a drink flavored to suit. Often a satisfactory method is to add stock solution made from the unflavored preparation to a little fruit flavored gelatin already sweetened. Cold dishes using the amount of gelatin recommended are too tough to eat. It must be remembered that if it is allowed to dry and adhere to cups and glasses it may break them by the contraction.

AMOUNT OF GELATIN

The amount of gelatin to be prescribed varies with the type of diet used and the purpose for which it is intended. If used in connection with a modified Sippy milk and cream diet using hourly feedings, from 7 a. m. to 7 p. m., gelatin, a dram to the feeding, may be added to the milk to take the place of the alkaline powders. For use with regular meals, $\frac{1}{2}$ to 1 ounce usually suffices for the adult. This is enough to make from two to four pints of dessert.

CLINICAL APPLICATION

The use of a hydrophilic colloid in the dietetic treatment of gastric complaints is frequently sufficient in itself to rectify what are apparently serious conditions. Gelatin may be used in conjunction with almost any diet that the clinician feels is indicated. Its colloidal properties aid the digestion of many foods which cause the patient to suffer from "sour stomach." Even foods to which individuals may be definitely sensitive as proven by the leucopenic index, and elimination diets, frequently may be tolerated with slight discomfort or none at all if gelatin is made a part of the diet. The favorable effect on digestion in the upper portion of the gastro-intestinal tract frequently leads to improvement in patients suffering from spastic colitis. The necessity for pureeing foods may not be found if hydrophilic colloids are added. Even

raw vegetables, green salads and fruits which are usually taboo may often be given to these patients with impunity after a short time.

A hydrophilic colloid diet will often give marked relief in the syndrome of slow digestion, gas formation, relaxed cardia and heartburn in which the burning is due to organic acids instead of an excess of the normal hydrochloric acid which frequently accompanies chronic inflammatory diseases affecting such organs as the heart, lungs, gall bladder and appendix. Here again the colloid may be used either in connection with the patient's regular food or with whatever diet the physician feels is best fitted for the patient.

In children who present problems of growth and development and those who show symptoms of allergy in the bowel, the hydrophilic colloid proves to be of great value. One usually prefers to use it in conjunction with a diet designed for the child's general up-building, although the addition of the colloid to the usual diet may be all that is necessary.

The patient with gastric atony or nervous indigestion who complains of heartburn and vomiting four or five hours after eating is often helped. There is apparently a lessening of the emptying time of the stomach and an improvement in gastric tone. A strict dietary regimen is not as necessary when the colloid is used.

Alcoholic gastritis presents a problem which the stewards of country clubs usually solve with their cannibal sandwiches of raw beef on rye bread. The effect is produced by the hydrophilic colloid of the beef. Gastric lavage, some pill or hot soda water have usually sufficed for the physician. The steward who uses the raw meat sandwich probably never heard of hydrophilic colloids yet he and his kind have handed on from father to son the knowledge that raw beef will meet the condition better than any other remedy. A tasty gelatin drink gives relief and allows the patient to avoid the raw meat which is usually distasteful to his squeamish sensibilities.

Gastritis in other forms can be relieved by the use of milk added to a suitable amount of hot gelatin concentrate, beaten thoroughly and taken before coagulation or setting.

While gastric hemorrhage requires special dietary supervision, that particular type with low acid and no demonstrable ulcer may be treated by substituting gelatin for the alkaline powders of the Sippy diet. The gelatin is given with the milk, and not between feedings. The milk, in order to have the greatest potency of vital elements, should be a green pasture raw milk. As was formerly pointed out by me (4) Pasteurization destroys some of the vital elements of milk. It also materially alters its colloids.

The true gastric or duodenal ulcer patient is of a different type and while some patients, as just mentioned, are frequently included under the general heading of gastric ulcer, they have no ulcer. When gastric ulcer with erosion demonstrable by X-ray is present, an increased gastric acidity is usually present. Formerly, attempts were made to reduce the hyperacidity chemically by the alkaline powders. Of late years, colloids too numerous to mention, such as

mucin, colloidal aluminum hydroxide and powdered okra, having different degrees of hydration capacity, have come into use. Absorption of gastric content by the colloidal mass rather than neutralization is the fundamental aim underlying these treatments. Absorption by the colloids of milk and cream, too, plays a large part in the Sippy diet. Therefore, in substituting gelatin for any of these excellent colloids, such as mucin, one is merely changing the nature of the colloid by replacing an indigestible colloid by a digestible one and also inserting an item of common household usage for an expensive preparation.

The dietary regimen to be followed with these patients depends largely upon the convictions of the practitioner. It usually has been my practice to follow a modified Sippy regimen, eliminating the alkalinizing agents and using gelatin instead.

DISCUSSION

Hydrophilic colloids have a very wide application in the field of dietetics provided a sufficient amount of an article of the proper quality is used. In reference to gelatin, which is discussed in this paper as being one of the most available products, we recognize that we are also dealing with a preparation which is a source of glycine, which, as shown by Brand, et al (5), is a muscle and tissue builder and an energizer of first importance; and that because of these properties it may play a very important role in certain of the chronic illnesses; nevertheless, its physiochemical properties seem to be the factors of most importance in the immediate problems of digestion. Gelatin is largely digested before it leaves the stomach, yet it has a profound effect on the entire gastro-intestinal tract. Exactly why this should be true is somewhat puzzling at first. However, if we consider the effect of unusual irritation upon the nerves of the gastro-intestinal canal, it is rational to think that a less violent and more nearly "normal" digestion above might quiet the activity of the otherwise hyperactive gut. Inasmuch as the same foods which formerly produced irritation may frequently be continued without harm when gelatin is used, the relief to nerve irritation seems to offer a logical explanation. Whether the change, in the lower gastro-intestinal tract, is due to the effect of the gelatin itself, or to a more complete digestion taking place along the entire tract due to physiochemical alteration is not clear.

Both factors are probably important. There is undoubtedly a better assimilation of food as is indicated by the general improvement which takes place in underdeveloped children without following so closely the carefully planned maintenance diets which are so often prescribed. Undernourished adults also respond with increased weight and strength without adding to the total calories of their diet.

SUMMARY

1. Hydrophilic colloids bring about conditions in the stomach during digestion which approach those resulting from the consumption of foods in their natural state.
2. Hydrophilic colloids lessen gastric irritation by

absorbing the digestive secretions of the stomach so that digestion takes place within a mass of food.

3. Gelatin, because of its availability, relatively low cost, non-toxicity, adaptability as an item of dietary and its thorough digestibility becomes an admirable hydrophilic colloid for dietary usage.

4. The amount of gelatin to be used in a given case depends on the patient's needs, but it must be of good quality and sufficient in amount.

5. It has a wide range of usefulness in gastro-

intestinal ailments ranging from the atonic conditions met in the chronic invalid to the irritating conditions presented in gastric ulcer.

REFERENCES

1. Fischer, Martin H.: "Oedema and Nephritis." John Wiley & Sons, 1914.
2. Fogelson, S. J.: *Jour. Am. Gastro-enterological Assoc.*, p. 157, 1932.
3. Crohn, B. B.: *Jour. Lab. and Clin. Med.*, 14:610, April, 1929.
4. Pottenger, F. M., Jr.: *Certified Milk*, Vol. 12, 129, Jan., 1937.
5. Brand, E. Harris, Sandberg, M. M. and Ringen, A. L.: *Amer. Jour. Physiol.*, 90:269, Oct., 1929.

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