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Abstract: The article presents information on the function of the digestive system in the human body. It reflects on how pH affects some important physiological processes. The article observes that the beginning of the digestive system is the mouth, which is a good place for first pH reading due to the presence of saliva. The saliva is supposed to have a pH value between pH 6.50 and 7.50. It contains an enzyme called ptyalin. Its job is to break down large starch molecules into smaller units. With the help of peristaltic waves the food parts slide down the esophagus to the stomach. Acid content is in the stomach with a pH value of 2.00. Gastric juices, including hydrochloric acid, are produced in the stomach. Hydrochloric acid is a strong acid secreted by cells of the wall of the stomach. The enzyme pepsin is being made from pepsinogen. Pepsin begins protein digestion in the stomach. Pepsin works best at a pH of 2.00 to 3.00. It also informs that the external secretions in the digestive system are pancreatic juices, which include protease, lipase and carbohydrase. (Copyright applies to all Abstracts)

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Chapter 8: A Cruise Down The Alimentary Canal

Join me on a journey. We'll use high-tech, state-of-the-art imagination to travel the route taken by our daily bread and other goodies. We are going to have an on-site look at how pH affects some very important physiological processes. To help us in our investigation, we'll take along a pH meter and a couple of reference books as travel guides.

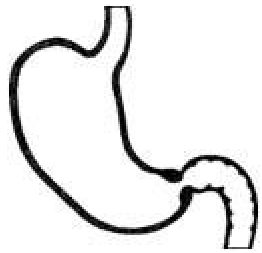
We'll begin at the beginning of the digestive system — the mouth. This is a good place for our first pH reading; there is a lot of saliva in here. Our tour guide reference book says saliva is supposed to be between pH 6.50 and 7.50. But the pH meter is registering only 5.8. That's strange.

Saliva contains an enzyme called ptyalin. Its job is to break down large starch molecules into smaller units so they can be used farther down the road. Ptyalin works best around pH 6.5 or above. It isn't logical that the body would put an enzyme designed to function in an alkaline environment in an acidic environment of pH 5.8 and expect it to work. The body wouldn't create a substance and put it in an environment that hinders its functioning unless it had to.

If the environment had been designed to be acid, the enzymes would be the sort that would work best in an acid climate. Nature makes enzymes that work in more acid conditions. The saliva of dogs, for instance, ranges from pH 3.0 to 5.0. But dogs aren't basically starch-eaters; they are meat-eaters. Their saliva serves the same pre-digestion function as man's but is designed to work on tougher substances. Man's saliva was fashioned to prepare plant life for processing.

We haven't even progressed beyond the mouth and already a mystery has cropped up. We'll move on, and perhaps we'll find a solution.

With the help of peristaltic waves, we'll slide down the esophagus to the stomach. We'll have to wriggle through the stricture between the esophagus and stomach.



Peristaltic waves, we'll slide down the esophagus to the stomach.

In the stomach we find an entirely different situation from that in the mouth. It's nasty! Our pH meter shows an extremely acid 2.00.

Gastric juices, including hydrochloric acid, are produced here. Hydrochloric acid is a strong acid secreted by cells of the wall of the stomach. We also find that the enzyme pepsin is being made from pepsinogen. Pepsin begins protein digestion in the stomach. The atmosphere here is good for pepsin to do its job. Pepsin works best at a pH of 2.00 to 3.00.[1]

It's interesting to note that the food here in the stomach is stored and processed in layers; it's not all jumbled up and churning around, even though sometimes we feel as if it were. The food that arrived first is nearest the wall and is worked on first. Gastric glands in the wall of the stomach secrete the digestive juices to process the food.

There's not much more to see here and it's pretty unpleasant in this highly acid atmosphere. Let's continue.

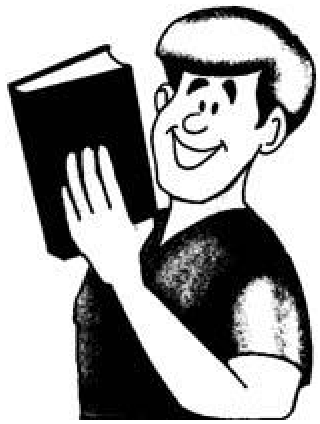
We exit the stomach through the pylorus (sometimes called the pyloric valve) and emerge in the duodenum to encounter another dramatic change in climate. There is mucus everywhere! Lots of little cells of Brunner's glands all around the walls are spitting out mucus. There are a few enzymes here also, but mostly mucus. It appears that the pH climate of the duodenum depends on whether or not partially digested food called chime (pronounced chime) is being pumped in from the stomach. When chime is coming in, the environment is very acid; when there's no chyme, it's slightly alkaline.

As we move along the upper course of the small intestine, we see an opening in the duodenal wall. After we pass the opening, the walls are different and there isn't as much mucus. We'd better stop and figure out why there's such a big change in the landscape.

The first clue is that the pH meter has been getting quite a workout on this trip. Coming down through the stomach it registered a highly acid pH 2.0 and 2.5; we moved into the duodenum and it registered less acid at about 4.2; then we went by that hole in the duodenal wall and the needle bounced up to the alkaline 7 and 8 pH range. Whatever is coming out of that hole certainly has changed the pH readings.

We know that it's very acid in the stomach and that the chyme moves from the stomach into the duodenum. There are a lot of mucus-producing Brunner's glands in the duodenum to protect it from the acid. Yet as soon as we passed that opening, we noticed that there are fewer mucous glands. We must assume that additional protection isn't needed any more. It follows logically that the contents of this part of the small intestine should be less acid since the tissue of the walls isn't as well protected.

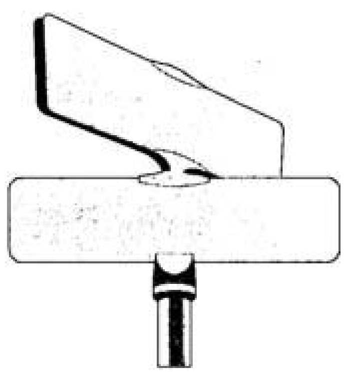
A quick check of our reference book tells us that the opening we passed is called the ampulla of Vater, or the papilla of Vater. This is where the common bile duct from the liver, gallbladder and pancreas empties into the duodenum. We had better see what's going on in there to cause the big change out here.



A quick check of our reference book tells us that the opening

Slithering through the sphincter of Oddi that guards the opening at the ampulla of Vater puts us into the common bile duct. In here, as liquid cascades toward the opening, we get a deep appreciation of the plight of salmon swimming upstream. The amount of liquid coming down this duct totals approximately two quarts a day. A closer look tells us that it is pancreatic fluid and bile.

As we move along the common passageway, we come to a junction. The signpost tells us the right fork leads to the pancreas and the left to the gallbladder and liver. Since we're closer to the pancreas, we'll see what's going on in there first.



Common passageway

As we pass the fork in the duct and move into the pancreas, a quick check of the pH meter shows 8.0. A lot of clear fluid resembling saliva is coming out of the pancreas — enough to add up to nearly a quart a day.

When we reach the pancreas, we find it has two distinct but equally important functions. It produces both internal and external secretions. Although we can't see what's going on internally, hormones, including insulin, are being produced and delivered directly to the blood.

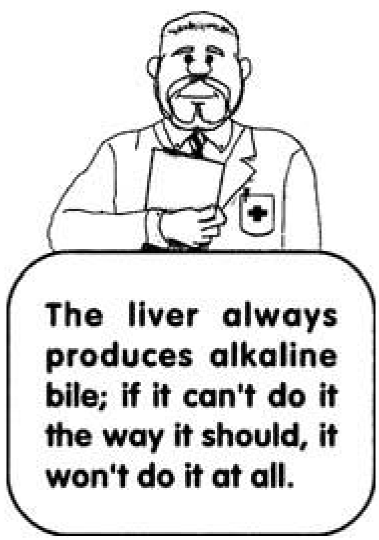
The external secretions are pancreatic juices; we can see these. There are three major enzymes in this juice, each with a specific role to help in the digestion process: protease for protein; lipase for digest fats; and carbohydrase for carbohydrates. Our reference books tell us that all of these enzymes work best in an alkaline environment — 7.5 to 8.2 pH.[2] They also tell us that there is a lot of sodium bi- carbonate secreted and that the pH of this sodium bicarbonate solution averages 8.0.[3]

Now we can see why there was such a big change back there in the walls of the duodenum after we passed the ampulla of Vater. All of this alkaline pancreatic juice flows into the duodenum and neutralizes the chyme that comes from the stomach. You don't need Brunner's glands to produce tissue-protecting mucus when the contents of the intestine are alkaline.

We've solved the riddle of the changing landscape in the duodenum. As long as we're in the neighborhood, let's go up the other spur of the common bile duct. Moving along the north fork headed toward the liver, we notice it isn't quite as pleasant here as it was in the pancreas. It is definitely more acid.

We come to an opening in this wall and, as soon as we pass it, the needle on the pH meter springs right back up to an alkaline reading. It appears we are now measuring the pH of bile as it comes directly from the liver.

Bile contains no enzymes, only substances that emulsify fats. Bile doesn't "digest" fats. It breaks them down so that they can be absorbed by the intestine and dealt with by other systems.



The liver always produces alkaline bile; if it can't do it the way it should, it won't do it at all.

Everything coming out of the liver has a pH of 7.1 or above. It can be as high as 8.6. This is an exciting discovery, because it substantiates the claim that the body really knows what it is doing. Remember those pancreatic enzymes that work best in pH 7.5 to 8.2? This liver bile is going to be mixed with them in the common bile duct. Liver bile of 7.1 to 8.5 pH is going to be dumped in with 7.5 to 8.2 pH pancreatic juice that contains enzymes, and the liver bile pH won't interfere with enzymatic function at all.

Now that we've figured that out, we'll head back. But once again, as we come abreast of the opening labeled "gallbladder," our pH meter blips to a more acid reading. We' d better go in and take a look.

With meter in hand, we step inside the gallbladder. The meter needle plummets from pH 8.5 to 5.5. It looks as though we've stumbled onto another acid-producing organ. Yet our search of the reference books gives no hint that the gallbladder produces acid. They do tell us, however, that water and electrolytes (substances such as sodium, potassium, and chloride salts that conduct electric current)[4] are reabsorbed from the gallbladder. When these properties are taken out, the bile is concentrated and becomes thicker.

The gallbladder is the storage area for bile from the liver. Remember that the liver produces 7.1 to 8.5 pH bile. Yet this same bile, after it has been concentrated in the gallbladder, registers as low as pH 5.5. That's amazing! We must have missed something. There is no way to turn an alkaline substance into acid by concentrating it. If anything, taking only neutral substances away would make it an even more powerful alkali.

Let's look at what it takes to change an alkaline solution to an acid solution. You can either add acid to it, or take the alkalizing substances from it.

We'd better sit down and think about this. We know that the body doesn't make mistakes. It certainly wouldn't have a 5.5 pH substance here in the gallbladder unless it is absolutely necessary. Everything else in this neighborhood is alkaline. Why would gallbladder bile be acid when (1) it is going to mix with alkaline pancreatic juice containing enzymes that need an alkaline environment, and (2) it is going to flow into the duodenum where acid stomach chyme needs to be neutralized?

It would appear that although acid gallbladder bile may be Normal, it certainly isn't Natural; so it must be Necessary.

Let's see what our reference books say about the physiological capabilities of the gallbladder. They tell us that the gallbladder can concentrate bile by removing sodium, bicarbonate, and chloride. These properties can be reabsorbed from the bile and put back into the bloodstream. Sodium can be removed from the gallbladder! That's interesting. I think we have found something very important. Gallbladder bile becomes acid when the alkaline properties are reabsorbed.

Perhaps the body isn't "making" acid gallbladder bile after all. Instead, the bile is "becoming" acid as a result of the body being forced to "rob Peter to pay Paul." Neutralizing elements are being "taken" from the gallbladder because they are urgently needed someplace else to take care of an even more crucial job. The gallbladder doesn't produce acid bile because it needs it as an end product; acid bile is a consequence of the body solving another problem someplace else. Looking at it this way, acid gallbladder bile is an effect, not a cause. Since the body never does anything without good reason, the alkaline properties taken from the gallbladder must be needed desperately for another function.

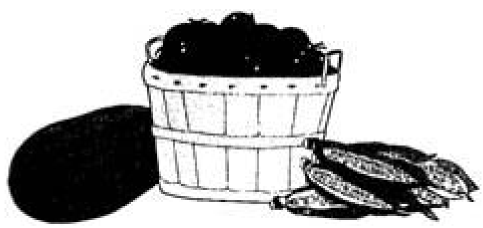
We had better take a closer look here inside the gallbladder to see what's going on. For one thing, there is a lot of thick sludge, rocks and boulders. Look at what we have been sitting on while reading our reference books and analyzing the situation — a gallstone! According to the books, gallstones in man are almost always made up of cholesterol and pigment,[5] or a mixture of cholesterol, bilirubin, and proteins.[6]

Some of the conditions that bring about gallstones, our authorities tell us, are "too much" water, bile salts and lecithin being absorbed from the bile, and "too much" cholesterol being secreted into the bile. But this doesn't square with our perspective that the body doesn't do "too much" or "too little" of anything — everything the body does is correct. Nevertheless, stones aren't a part of the natural design, so there must be a good reason why they form.

Cholesterol constitutes the greatest portion of gallstones. Cholesterol is supposed to be in liquid form. It stays that way by its relationship to bile salts. However, in a gallbladder where stones form, the ratio of the cholesterol to bile salts has been upset. When the gallbladder takes sodium out of the bile, cholesterol is left to fend for itself. The cholesterol isn't a liquid any longer. It solidifies; and while we've been in here, we've been using it for a bench!

However, since we have said that the body never makes a mistake, why would it take sodium from the bile and leave solidifying cholesterol behind to cause all kinds of problems? There must be a very good reason.

Sodium is a primary contributor to the bicarbonate buffer system which is one of the systems that keeps the body from becoming too acid. If the person doesn't eat enough fruits and vegetables to provide organic sodium to work with the bicarbonate buffer system, the body will take the sodium from gallbladder bile. With the sodium gone, cholesterol is left high and dry to turn into stones. It is far more important for the body to be able to remain slightly alkaline than it is for it to prevent cholesterol from solidifying in the gallbladder. What difference does it make if stones are forming in the gallbladder if the alternative is for the body to become so acid that it can't function.



Sodium is a primary contributor to the bicarbonate buffer system

Your body will do everything it can to keep you alive — not necessarily to keep you comfortable and happy — just alive! It will attend to the most important things first in order to keep your cells functioning, and in this case it needs the sodium from the gallbladder to neutralize excess acid that is affecting your cells. We'll learn more about where the excess acid comes from after we complete our journey.

If sodium is taken from the gallbladder where it is serving an important, if not vital, function, we can assume that sodium is in short supply throughout the body. That explains why the saliva at the beginning of our journey was only 5.8 pH. There wasn't enough sodium in the body to keep the saliva alkaline. There is such a shortage of sodium that even when it is conscripted from the gallbladder, there's not enough to keep the saliva at its proper pH. Whatever process the sodium is being used for is much more crucial for sustaining life than are alkaline saliva and liquid gallbladder bile. If we had understood how this worked when we first entered the mouth, we would have realized that the 5.8 pH saliva reading was an indication that this body is in trouble.

This whole situation beautifully illustrates that everything that goes on in your body is in response to at least one stimulus and results in at least one effect.

Solving the low-saliva pH and gallstone riddles also sheds light on why ulcers generally occur in the duodenum rather than in the stomach. Three-fourths of ulcers are duodenal ulcers. We can see from our vantage point inside the gallbladder that the alkaline bile originating in the liver becomes acid in the gallbladder before it gets to the common bile duct. The bile leaving the common bile duct should be alkaline so it can neutralize the acid chyme coming from the stomach. But if the alkaline liver bile and pancreatic juice have been contaminated with acid bile from the gallbladder, it can't neutralize acid chyme. Acid is being added to acid, and we know that strong acids can burn unprotected tissue. The walls of the duodenum are unprotected after the ampulla of Vater, so it becomes apparent that what we term a duodenal "ulcer" is really an acid bile burn!

Our observations of what is going on in the gallbladder are really exciting. We've seen things that reinforce our contention that the body never makes a mistake, and we've come to understand how some of the digestive problems that plague thousands of people are in reality the results of the body working intelligently to preserve itself.

We have so much food for thought, we had better abort our journey now and contemplate our observations.

We now know that gallbladder bile becomes acid only when sodium and other alkalizing elements are taken from it. We understand why bile leaving the common bile duct can be acid although it is supposed to be a neutralizing alkaline.

How can the problem of acid bile be resolved? There are two ways to return the alkalinity level of bile to normal. The best way is to change your diet so that there is plenty of organic sodium available throughout your body to meet the needs of the entire body. The other, far less desirable way is to remove the gallbladder so it can't pump acid bile into the system. This is about as effective as cutting off a foot to cure gout. The painful toe may be gone, but the condition that caused the symptoms runs rampant.

When we realize that everything the body does is to protect and/ or sustain itself, we can see that removing a gallbladder to relieve pain is not going to solve the problem. The person will feel better, but only the symptoms have been relieved.

Friends or relatives who have had their gallbladders removed may bask in the comfort of their new gallbladder-free lives. They say they can eat anything they want without the pain they had before surgery. You can understand now why they feel better. You can also understand that they haven't really solved the underlying problem.

In reality, the problem has been compounded. The problem is that there isn't enough sodium to satisfy the body's requirements. When the gallbladder was intact, at least sodium was being reclaimed from liver bile. With the gallbladder gone, the sodium that would have been recycled is lost, thereby reducing the total sodium supply even more.

After the gallbladder is removed, the person may feel better, but his level of health has taken a serious turn for the worse.

Unless those who have had their gallbladder removed add enough alkalizing foods in the form of vegetables and fruits to their diets, their bodies are still in danger of becoming intolerably acidic. The problem hasn't gone away. The body still needs neutralizing minerals. Unless these minerals are supplied regularly by the diet, the body will find another source to carry on the function of the sodium that had previously been supplied by the gallbladder. Calcium is the most readily available substitute for sodium. The best source of calcium is the bones, and you know what happens when the bones lose more and more calcium — osteoporosis.

It would be interesting to see the results of a study of the incidence of osteoporosis in those who have had their gallbladders removed as compared with those who haven't.

A few pages back, you may have begun to feel smug about your own sodium level if you eat the standard fare served in most homes and restaurants around the country. In our society, we put salt on everything from breakfast eggs to margaritas. It seems almost impossible not to have enough sodium to handle the body's requirements. Unfortunately, table salt is different from the organically bonded sodium in fruits and vegetables. Our bodies don't use table salt. How do we know this? As we will see in Chapter 16, studies have shown that we eliminate as much sodium chloride each day as we take in. I am firmly convinced that ultimately investigations will confirm that inorganic table salt can't be easily broken apart by the body. Remember: inorganic = tightly held together; organic = easily broken apart. In a later chapter, I'll go into why the type of chemical bonds of minerals in our food is so important. For now, keep in mind that we can't beef up our sodium supply with salt on our steak.

The lessons we have learned on our excursion down the alimentary canal are crucial. They are paramount to understanding how the wrong types of food can cause major problems in unexpected areas. Let's recap.

1. Saliva should provide an environment where the enzyme ptyalin can work most effectively. The body doesn't put a substance in surroundings that inhibit its function unless it must in order to survive.
2. The stomach is the only place that needs acid solutions to function properly. It normally produces all of the acid necessary to prepare food for digestion.
3. Liquified food and digestive juices are emptied from the stomach into the duodenum. The resulting mixture, known as chyme, is acid.
4. The upper part of the duodenum can accept acidic substances from the stomach without being damaged, because Brunnens glands produce great quantities of protective mucus.
5. Mucus protection is not present in the duodenum after the opening to the common bile duct. Alkaline liver bile and pancreatic juices coming from the common bile duct neutralize the contents of the duodenum.
6. The liver produces about 1.75 pints of bile a day. About 95% is water. Bile includes cholesterol, bile pigments, bile salts, and mineral salts. Production of liver bile is continuous. When bile is produced but not needed immediately, it is stored in the gallbladder.
7. The gallbladder can reclaim sodium, water and other elements from bile salts for use elsewhere in the body.
8. Bile becomes concentrated when water and bile salts are taken out.
9. Cholesterol loses its fluid nature when sodium is separated from the bile salts and is removed, along with other liquifying elements, from the bile.
10. Continuous concentration of gallbladder bile provides an opportunity for cholesterol to solidify. Cholesterol is the principal ingredient of most gallstones. Gallstones cause pain and can obstruct the opening of the gallbladder.
11. Gallbladder bile becomes more acid when alkaline properties are removed. Bile that should be alkaline becomes acid.
12. Acid gallbladder bile dumped into the common bile duct mixes with alkaline liver bile and pancreatic juice.
13. When gallbladder bile is acid, fluids from the common bile duct enter the duodenum in an acidic state rather than alkaline state. They add to the acid level of liquified food from the stomach instead of neutralizing it. The unprotected duodenum can then be burned by the acid chyme.
14. Acid bile bum in the duodenum masquerades as an "ulcer" and adds to the discomfort of indigestion and "heartburn."
15. The body must adapt its natural functions to handle large quantities of acid farther along the system.
16. Additional acid puts greater demands on the bicarbonate buffer system, calls for more sodium to be reclaimed by the gallbladder, and the cycle is perpetuated.

We'll go into more detail in the following chapters about other effects a shortage of organic sodium has on your body and what causes the shortage in the first place. This trip, however, illustrates the intertwining nature of all of the systems of your body. The key to providing enough of the proper minerals to keep your body from having to take essential elements from one job to do another is to eat the correct types of foods in correct proportions.

Adding generous quantities of vegetables to your diet every day and fruits as often as possible will give you the sodium you need for natural physiological function.

The only sure-fire source of appropriate sodium to replenish the alkaline reserve is fruits and vegetables. In time, you can build up your alkaline reserve and your body can function more easily and efficiently. However, table salt just won't do the trick.

Your body must respond to everything you put in your mouth. Different kinds of foods cause different responses. Some leave an acid ash after they are digested; others leave an alkaline ash. The kind of ash that is left often has little to do with how acid the food itself is when you eat it. Oranges and lemons, for instance, are acid fruits, but they leave an alkaline ash. The secret to being healthy is to know which foods do what, and to keep a balance of the two kinds so that your body can function at its best.

By modifying your diet to provide more natural neutralizing minerals, all sorts of "symptoms" will disappear and you will be on your way to being genuinely healthy. The next chapter will explain how the ash residue of food dictates that your body adapt to necessary methods of physiological functioning.

WELLNESS PRINCIPLE

If at all possible, the body always puts any substance it produces in a desirable environment.

WELLNESS PRINCIPLE

Sometimes it's easy to mistake the symptom for the problem.

WELLNESS PRINCIPLE

No process of the body takes place in isolation.

WELLNESS PRINCIPLE

Unprotected sensitive tissue that is designed to carry alkaline materials is defenseless against acid substances.

WELLNESS PRINCIPLE

With or without a gallbladder, everyone needs to eat fruits and vegetables to keep his supply of neutralizing minerals replenished.

WELLNESS PRINCIPLE

You DO NOT need to be a vegetarian to be healthy! And by the same token, being a vegetarian does not INSURE health. Ratios are the key factor. When you eat MORE vegetables and fruit than acid ash-producing foods, your body can maintain the necessary reserve of usable sodium. With adequate reserves, acid ash can be processed easily, other minerals are allowed to perform their functions, and good health follows.

Source: Fell's Official Know-It-All Guide: Health & Wellness