

# ACIDITY & THE PANCREAS

## Abstract

*Three main, interrelated reasons for widespread digestive disorders in the modern world might be chronic metabolic acidosis, low exocrine pancreatic function, and intestinal dysbiosis. Chronic metabolic acidosis mainly distresses two alkaline digestive glands: the liver and pancreas, which secrete alkaline bile and pancreatic juice with a great amount of bicarbonate. The acidic shift in the bile and pancreatic juice pH can cause serious biochemical/biomechanical problems. The pancreatic digestive enzymes need an alkaline milieu to function properly; therefore, low pH disables their activity. This may be the crucial cause of indigestion. Acidification of the pancreatic juice decreases its antimicrobial activity, promoting intestinal dysbiosis. Reducing the pH of the pancreatic juice can lead to the premature activation of the proteolytic enzymes inside the pancreas, potentially leading to pancreatitis. The acidification of bile produces bile stone formation and precipitates aggressive bile acids, which irritate the entire biliary system. An aggressive combination of the acidic bile and the pancreatic juice can activate irregular spasms of the duodenum's walls and consequent bile reflux into the stomach and the esophagus. The normality of the exocrine pancreatic function is the core of proper digestion. Presently, there is no efficient and safe treatment for enhancing exocrine pancreatic function. Reinstating normal acid-base homeostasis can be a pathophysiological therapeutic approach for numerous gastrointestinal disorders. There is strong scientific research and practical evidence that restoring the  $\text{HCO}_3$  capacity in the blood can improve digestion.*

## Introduction

The interrelated combination of chronic metabolic acidosis, low exocrine pancreatic function, and intestinal dysbiosis can explain the widespread digestive disorders in the modern world. Altogether, these causes create a vicious circle. There is not enough time for genetics to be implicated in these disorders; therefore, many scientists and doctors pay attention to environmental factors, such as food, water, stress, lifestyles, toxic chemicals, alcohol consumption, and the inner ecology.

The acid-base balance, or acidity/alkalinity balance, is a critical factor in the health and functioning of the body. Optimal health depends on the body's ability to maintain a slightly alkaline state.

## Pathophysiology of Metabolic Acidosis

Normally, blood is slightly alkaline, with a pH range of 7.35 to 7.45. The consistency of the blood pH is essential to the body's ability to maintain a relatively stable internal environment. Its importance is demonstrated by the fact that a human being cannot live if the blood's pH goes below 7.0 or above 8.0. For example, blood with a pH of 6.95, which is only slightly acidic, can lead to coma and death.

Many body functions are designed to control the acid-base balance, including respiration, digestion, circulation, excretion, and cellular metabolism. The acid-alkaline regulation systems are interrelated and work together to prevent acute or chronic changes in the body's acid-base balance.

What causes the body to be too acidic? The main persistent factors are:

- The creation of too many acidic materials by human cells. For instance, the end products of cellular metabolism are amino acids, fatty acids, carbonic, and lactic acids.
- Intestinal dysbiosis (candidiasis and SIBO-small intestine bacterial overgrowth) causes an intensive, constant, fermentation process through the release of lactic acid, toxic alcohols, and other acidic compounds.
- Diet-induced chronic metabolic acidosis caused by the consumption of processed foods, red meat, sugars, white flour and rice, and others.
- Chronic toxicity caused by acid-forming compounds, such as alcohol, some medications, environmental chemicals, and others.
- Dysfunction of the lungs, kidneys, skin, liver, and gastrointestinal organs, which are responsible for releasing acidic radicals.
- Dehydration and poor microcirculation.
- Chronic deficiency of the major electrolytes such as sodium, magnesium, potassium, and calcium.
- Low capacity of blood buffer systems and, specifically, the low capacity of bicarbonate buffer.

The CO<sub>2</sub>-bicarbonate buffer system (or the "bicarbonate buffer") is the main buffer system in the blood. It works as lung CO<sub>2</sub> + H<sub>2</sub>O  $\leftrightarrow$  H<sub>2</sub>CO<sub>3</sub>  $\leftrightarrow$  H<sup>+</sup> + HCO<sub>3</sub><sup>-</sup>  $\Delta$ kidney.

The pH of blood is steady, and human beings struggle to maintain a stable state to protect the vital organs, such as the brain, lungs, and heart, which completely stop if the pH in the blood drops even slightly. During metabolic acidosis, human beings make the intelligent choice to survive by saving the life important organs, such as the heart, lungs, and brain at the expense of peripheral "less essential" organs and tissues. The alkaline digestive glands pancreas and liver are affected most by changes in the blood pH because they manufacture pancreatic juice and bile, which are generally highly alkaline solutions.

### **Negative Effect of Metabolic Acidosis on Pancreatic Juice, Bile, and the Entire Digestive System**

Under normal conditions, the pH of liver bile is 7.5 to 8.8, and the pancreatic juice has a pH of 7.1 to 8.2.2. Consequently, the liver, gallbladder, and pancreas are the inner organs, directly involved in the body's acid-base balance. On the other hand, metabolic acidosis alters the bile and pancreatic pH in an unhealthy way, leading to serious digestion problems.

## **The Importance of Bicarbonate**

To maintain the alkalinity of the pancreatic juice, the bile, the liver, and particularly the pancreas extract bicarbonates and minerals from the blood. The bicarbonate content is a key reason for the alkalinity of bile and pancreatic juice.

### **Content of Bicarbonate (mEq/Liter) in Human Plasma, Pancreatic Juice, and Bile 3**

<b><u>Body Fluid</u></b>	<b><u>Bicarbonate</u></b>
Blood (plasma)	27
Pancreatic Juice	92–145
Bile	45

As seen in bile, and particularly in pancreatic juice, there is a lot of bicarbonate. The pancreatic bicarbonate output and duodenum pH are strongly interrelated. The interaction of digestive hormones, primarily secretin and cholecystokinin, with the autonomic nervous system regulates this very complicated mechanism.<sup>4,7,8</sup>

The researchers found that the pancreas and liver extract bicarbonate ions mostly from the blood. For instance, intravenously administered bicarbonate labeled with the C radioisotope appears rapidly in the pancreatic juice.<sup>11</sup> Experiments showed that "most if not all the bicarbonate of pancreatic juice must come from plasma." <sup>4-6</sup> There is substantial evidence that in pancreatic disorders there is a decreased amount of bicarbonate in the pancreatic juice and bile.<sup>7, 9</sup>

Duodenal acidity primarily depends on a lesser amount of bicarbonate in the pancreatic juice and bile. In chronic pancreatitis patients with exocrine pancreatic insufficiency, the duodenal pH is persistently low.<sup>7,10</sup> The pancreatic enzymes work only in the alkaline milieu.

### **The Optimal pH for the Activity of Pancreatic Digestive Enzymes 36**

<b><u>Pancreatic Digestive Enzymes</u></b>	<b><u>Enzyme Optimal pH</u></b>
Lipase	8.0
Trypsin	7.8–8.7
Amylase	6.7–7.0

Therefore, the acidic milieu in the duodenum where general digestion occurs is a central factor of indigestion. There is also a direct connection between the bicarbonate concentration and pancreatic juice flow and the elimination of enzymes.<sup>11,12</sup>

McClave believed that while healthy people have a high bicarbonate concentration in the duodenum, patients with chronic pancreatitis have low bicarbonate concentrations. In this case, the acidic fluid in the duodenum inactivates enzymes. Pancreatic lipase stops working if the duodenal pH is <4.5.<sup>8</sup>

Talamini adds a new possible risk factor for pancreatic cancer after chronic pancreatitis; namely, duodenal acidity. Patients with chronic pancreatitis frequently present with pancreatic exocrine insufficiency combined with a persistently low duodenal pH in the postprandial period. Duodenal acidity may raise the risk of pancreatic cancer in patients with chronic pancreatitis.<sup>10</sup>

The relationship between the rate of low pancreatic HCO<sub>3</sub> secretion and high plasma H<sup>+</sup>-ion concentration has been investigated in numerous experiments. A proportional relationship was found between HCO<sub>3</sub> secretion and plasma pH. Different relationships were discovered between pancreatic HCO<sub>3</sub> secretion and plasma HCO<sub>3</sub> concentration during metabolic acidosis. Pancreatic HCO<sub>3</sub> secretion fell to  $41 \pm 4\%$  of that of the control during acidosis. The plasma H<sup>+</sup>-ion concentration, therefore, seems to determine the rate of pancreatic HCO<sub>3</sub> secretion.<sup>35</sup>

The importance of plasma bicarbonate is also illustrated by in vivo experiments in which pancreatic secretion was studied under conditions of metabolic acidosis. Canine pancreatic secretion was halved when the plasma bicarbonate was lowered to 16 mEq/L.<sup>13</sup>

### **Trypsinogen Activity and pH**

Acidity also promotes the premature activation of trypsinogen (inactive enzyme) to trypsin (active enzyme) in the pancreatic ducts. Trypsinogen, like all other zymogens, is packaged in zymogen granules, which further retard trypsinogen activation. The high pH (an alkaline state) in the duct inhibits activation of trypsin.<sup>14,15</sup> The more alkaline the pancreatic juice, the higher the possibility of keeping trypsin inactive within the pancreas. Even a neutral pH of 7.0 can lead to this activation pathway.<sup>16</sup>

Niederau and Grendellin suggested that the acidification of the pancreatic juice may play a role in the progression of acute pancreatitis.<sup>17</sup> Bhoomagoud et al. also suggested that metabolic acidosis may be a risk factor for developing pancreatitis. They confirmed experimentally in vivo and in vitro that decreasing pH (acidifying) increases the sensitivity of the acinar cells to zymogen activation.<sup>18</sup>

Both experimental and clinical observations suggest that acidosis may increase the risk of developing acute pancreatitis. Hegyi et al. further demonstrate that the failure of pancreatic ductal bicarbonate secretion (i.e., a decrease of the luminal pH) can increase the risk of or lead to pancreatitis.<sup>37</sup>

Magnesium is an alkalized mineral. Thus, it can attenuate the intracellular activation of proteases in the pancreas and lessen the severity of experimental pancreatitis when administered either intravenously or as a food supplement. A multicenter randomized controlled trial of magnesium sulfate in the prevention of post-ERCP pancreatitis shows the benefits of magnesium.<sup>38</sup>

## **Flushing Inactive Pancreatic Enzymes Stops Their Premature Activation**

Another protective mechanism to prevent the premature activation of trypsinogen to trypsin inside the pancreatic duct is rapidly sweeping out zymogens from the pancreas. Washing out and draining pancreatic juice that is full of inactive enzymes and zymogens (trypsinogen) to the duodenum as quickly as possible is an essential mechanism to prevent premature activation of digestive enzymes inside the pancreas. This flushing mechanism is significant in protecting the pancreas from premature activation of the proteases and self-digestion and thus from the development of recurrent acute and chronic pancreatitis.

The duct cells lining the pancreatic duct secrete ions, fluid, and bicarbonate. A high concentration of ions causes water to enter the lumen by osmosis. Afterward, water flushes the contents of the pancreatic duct lumen (including zymogens) out of the pancreas and into the intestine. On the other hand, a low bicarbonate output can reduce the amount of water within the pancreatic ducts. This in turn raises the viscosity of the pancreatic juice and slows its elimination.

Matsuno et al. mentioned that bicarbonate plays a critical role in the viscosity of pancreatic juice. In patients with pancreatitis in which bicarbonate secretion and bicarbonate output declined, the viscosity of the pancreatic juice was considerably increased. They also believed that concentrated pancreatic juice can cause the progression of chronic pancreatitis. 7

## **Acidification of Bile and Bile Refluxes**

Bile secretion has similar regulatory and closed pathways for pancreatic juice. If the bile becomes extra acidic, it turns out to be very "aggressive." Precipitated bile acids in acidic bile corrode and irritate the bile and pancreatic ducts, the gallbladder, the ampulla of Vater, the sphincter of Oddi, and the duodenum.

Irritations of the duodenum's mucosa by precipitated bile acids lead to erosion, ulcers, and spasmodic, chaotic contractions, which dislocate the aggressive bile/pancreatic juice mixture. This causes spasms, bile reflux, refractory heartburn, irritation, inflammation, ulcers, and other symptoms. In a review of the refractory gastroesophageal reflux disease literature, Fass mentioned that experimental data support a role for persistent bile acids in the reflux as a potential factor involved in refractory heartburn.<sup>40</sup>

Aggressive, acidic bile/pancreatic juice mixtures often cause bile reflux, or backflow, into the pancreatic duct. Bile from the duodenum can flow upward, into the stomach and esophagus. Bile refluxes, which involve the duodenum, stomach, and esophagus, lead to inflammation, ulcers, and cancer.<sup>19</sup> Bile reflux often occurs along with stomach acid reflux, and together they are a horrible pair, inflaming the lining of the esophagus and potentially increasing the risk of esophageal cancer.<sup>20,21</sup>

Biliary pancreatic reflux occurs when the bile returns to the pancreatic duct. It activates proteolytic enzymes within the pancreas, and initiates acute pancreatitis and/or exacerbates chronic pancreatitis.

Rege and Moore found that the acidification of bile is a major factor in the development of gallbladder stones, which have been documented to block the bile and pancreatic ducts and severely damage the liver and pancreas. 22

### **The Antimicrobial Activity of Pancreatic Juice Is pH Dependent**

When the pH of pancreatic juice falls below 7.0, the antimicrobial activity is reduced. Rubinstein et al. found that the antibacterial activity of pancreatic juice was pH dependent.<sup>23</sup> Experiments on people with pancreatic fistulas showed that, under healthy conditions, pancreatic juice is practically sterile and destroys almost the entire spectrum of microorganisms.

There are remarkably few microorganisms in the small intestine because intestinal microbial homeostasis is controlled by a variety of factors. Pancreatic juice plays an essential role in limiting the number of microbes in the small intestine. There is evidence that the antibacterial action of pancreatic juice is extremely sensitive to pH, having an optimal activity at a pH of 8.5, which is an alkaline condition, and a complete cessation of activity at a pH of 7.0, which is neutral.<sup>24</sup>

Acidification of the pancreatic juice and decreasing pancreatic secretion makes the pancreas more vulnerable to infection. For that reason, the restoration of the alkalinity in the pancreatic glands is fundamental for the treatment and prevention of pancreatitis and further pancreatic cancer.<sup>39</sup>

### **Calcification**

If chronic metabolic acidosis occurs, calcium is leached from the bones into the blood to neutralize acidity. The amount of calcium ions in the blood and body fluids increases, leading to the deposition of calcium in blood vessels and internal organs (calcinosis). This may explain the widespread simultaneous appearance of osteoporosis, arteriosclerosis, and calcification as calcium deposits in the inner organs. Calcification of the pancreatic gland is an important symptom of chronic pancreatitis.<sup>34</sup>

Precipitation of calcium salts within the pancreatic duct leads to stones, which irritate or block the pancreatic duct, causing inflammation or pancreatitis. Precipitation of calcium salts inside the gallbladder induces stone manufacturing and the obstruction of the sphincter of Oddi. This in turn can increase the pressure inside the pancreatic duct and activate proteases within the pancreas, causing self-digestion, damage, and pancreatitis.

### **Discussion: Clinical Implications**

The authors believe that chronic metabolic acidosis kills the pancreas and the entire digestion process. Questions may arise from this hypothesis. Is chronic metabolic acidosis a widespread condition in the modern human?

Does chronic metabolic acidosis have clinical significance in everyday practice?

The authors believe that subclinical, low-grade, chronic metabolic acidosis is a widespread condition that is considered a "disease of civilization." Focusing on the acid-base equilibrium may be key in prevention and treatment of either digestive or hormonal pancreatic disorders.<sup>1</sup>

Metabolic acidosis is rampant in modern society. Mostly, this is due to the standard Western diet.<sup>25,26</sup> Most of what we eat now is acidic in nature and consequently changes the acid-base balance toward metabolic acidosis.<sup>29</sup> Nutrition scientists have described the incidence of metabolic acidosis in modern humans.<sup>25,26,27</sup>

For instance, researchers from the University of California found that most health problems stem from the deficiency of bicarbonate in today's food compared with the food of our ancestors.<sup>26</sup> Other authors have proved that current eating habits have produced low-grade metabolic acidosis in otherwise healthy people.<sup>25-28</sup>

Some authors found that metabolic acidosis increases with age.<sup>30,31</sup>

Currently, overacidity is frequent and can create harmful conditions that weaken all body systems. Chronic metabolic acidosis drives humans to leach alkaline minerals, including calcium, sodium, potassium, and magnesium, from inner organs, muscles, and bones to neutralize the acidity and to remove acid radicals from the body. The human being has only one way to recover from metabolic acidosis: to obtain extra minerals and bicarbonate to neutralize overacidity. Where can the organism obtain these minerals and bicarbonate? Naturally, people can only obtain minerals and bicarbonate from food, healing mineral water, and mineral supplements, such as magnesium/potassium.

If laypeople and medical practitioners understood that our alkaline diet requires mineral supplementation, healing mineral waters would be found in the US. Let us look at the experience of European medical doctors, who have treated a variety of digestive disorders with healing mineral waters for hundreds of years. The European public often spends their "healthful vacations" in mineral spas, where medical doctors evaluate the patient and prescribe the quantity, frequency, and temperature of healing mineral waters. In some European countries, insurance covers balneotherapy/mineral water cures.

The small town of Karlovy Vary in the Czech Republic has enjoyed hundreds of years of popularity as a famous healing mineral spa thanks to its thermal springs. In 1522, the first scientific medical book was published, and a regimen of drinking water from this spring was recommended for constipation. Since then, hundreds of clinical papers have been published describing the positive effects of this water on both animals and humans. Unfortunately, most of these papers are published in Czech, German, and Russian; thus, they are unknown by the American medical establishment.<sup>32,33</sup>

The demand for this water was so high that doctors in Karlovy Vary developed a vaporizing method to obtain genuine Karlovy Vary thermal spring salt 250 years ago. Dissolving this salt in the water makes it possible to use mineral water for healing at home. The water prepared from the genuine Karlovy Vary thermal spring salt has 40 essential minerals, trace elements, and bicarbonate in a proportion similar to that of human plasma. Czech doctors determined that

the water manufactured from the genuine Karlovy Vary thermal spring salt had identical healing properties to the spring. European scientists and doctors have confirmed the positive effects of the Karlovy Vary healing mineral water on the pancreas and pancreatic digestive enzymes.<sup>1</sup>

Karlovy Vary healing mineral water is a natural alkalizing compound that helps the body to restore a normal pH by neutralizing acid radicals and removing them from the body. Before the insulin era, this water was the only healing remedy for diabetes. Karlovy Vary healing mineral water helped many Europeans with environmental and professional toxicity. Scientific research shows that this water decreases gas, bloating, stomach pain, abdominal spasms, and indigestion by increasing the production of bile and pancreatic enzymes and by opening the bile and pancreatic ducts, thereby decreasing internal toxicity.<sup>32,33</sup>

There are many complicated tests to identify overacidity in the body. More simply, one can observe positive pH changes in one's saliva and urine by using litmus paper at home. If the saliva and urine pH is less than 6.6 for one week, chronic metabolic acidosis and acidic pancreas and bile may be presumed.

### **Conclusion**

Currently, the medical standpoint on digestive disorders narrowly focuses on the "hollow" organs, such as the stomach and colon, without paying attention to the "solid" digestive glands, such as the pancreas and liver. It is known from human physiology that, without a specific quality and amount of pancreatic juice and bile, the normal digestive process in the hollow chambers could not occur. The pancreas is the main organ of the entire digestive system. Almost all of the problems of the GI tract are closely related to the proper functioning of the pancreas. Therefore, a clinical diagnosis of gastrointestinal disorders de facto presumes pancreatic disorders.

Another very important consideration is chronic pancreatitis. Descriptions of the symptoms of this disease, including pain, steatorrhea, malabsorption syndrome, and weight loss, are found in almost all medical books, textbooks, and articles. The medical literature refers to this state as pancreatic insufficiency. It is known that these symptoms occur when only 10% of the exocrine pancreatic function is left intact. Unfortunately, this is not pancreatic insufficiency; it is pancreatic failure, for which therapeutic opportunities are very limited.

The final stage of chronic pancreatitis does not develop overnight. Typically, 8 to 15 years occur between the first attack of acute pancreatitis and pancreatic failure following chronic pancreatitis. Similar to disorders of other organs and systems, the initial disease stage of the pancreas does not present any structural changes. Nevertheless, after this stage, longstanding biochemical, biomechanical, neurohumoral, and inflammation responses lead to structural damage of the pancreas (chronic pancreatitis) and a lowering of the exocrine pancreatic function while bringing many accompanying digestive diseases. However, if 90% of the pancreatic functional capacity is reduced, pancreatic failure occurs with steatorrhea and malabsorption syndrome, resulting in a total crash of the digestive system and the entire human organism.

For the purpose of focusing on the early functional stages of pancreatic disorders, the authors propose the functional clinical classification of exocrine pancreatic disorders, which subdivides digestive disorders and diseases into three groups:

1. Acidic pancreas and bile
2. pancreatic deficiency
3. pancreatic failure

On a daily basis in medical practice, crowds of people present with digestive symptoms that are consistent with those of patients in the "acidic pancreas and bile" stage of exocrine pancreatic disorders. Their tests are usually normal, and most of these patients receive palliative, symptomatic therapy. Restoration of the proper acid-base balance in digestive disorders may be one of the natural, pathophysiological approaches for functional dyspepsia, biliary dyskinesia, GERD, sphincter of Oddi dysfunction type III, IBS, and intestinal dysbiosis (candida overgrowth, SIBO), among others.

Pancreatic functional disorders are terra incognita in medicine; there is little attention on the functional stage of exocrine pancreatic deficiency regardless of the fact that the pancreas is a key organ in proper digestion. H. Worning wrote in *Digestion* that the prevalence of pancreatic diseases as the cause of dyspepsia varies in clinical practice between 0% and 25% to 30%. He believed that pancreatic function and pancreatic disease are closely related to various gastrointestinal diseases.<sup>41</sup>

The connection between functional gastrointestinal disorders such as functional dyspepsia, SIBO-small intestinal bacteria overgrowth, IBS, and impaired pancreatic function to a greater extent have attracted the attention of researchers and doctors for the last decade.<sup>42-44</sup>

Goepp et al. found low pancreatic elastase (a marker of exocrine pancreatic insufficiency) in 7.1% of the patients with irritable bowel syndrome.<sup>45</sup> Another point that low pancreatic function underlies dyspepsia and IBS is the beneficial effect of the pancreatic enzymes in these functional disorders.<sup>46,47</sup>

Smith et al. described abnormal Lundh tests in 27% of patients with functional dyspepsia. They wrote, "Pancreatic disease may explain the symptoms of some patients with non-ulcer dyspepsia."<sup>48</sup>

It is known that dyspepsia and functional dyspepsia are common conditions globally; affecting most populations, regardless of location.<sup>49</sup> Okada et al. considered that mild functional pancreatic disorders might trigger some cases with unexplainable chronic dyspepsia.<sup>50</sup>

Lindström et al. believe that, overall, 66% of the patients with abdominal pain had morphological and functional evidence of pancreatic involvement.<sup>51</sup>

Some researchers agree that differentiation between functional dyspepsia and early stage of the chronic pancreatitis is complicated.<sup>52</sup> Early-stage chronic pancreatitis and impaired exocrine pancreatic function are frequently misdiagnosed.

"Early chronic pancreatitis remains a diagnostic challenge as there is no gold standard for the diagnosis and pancreatic biopsy is risky and impractical. Reported data on the incidence and prevalence of chronic pancreatitis are unreliable and highly variable. Chronic pancreatitis is clearly under-diagnosed." <sup>53</sup>

The diagnosis of the early stage of the pancreatic diseases might be missed in clinical practice because symptoms of severe exocrine pancreatic deficiency are not specific at that time. There is no malabsorption syndrome or maldigestion, there is the absence of steatorrhea, and the pancreatic and liver enzymes levels in blood are normal. Therefore, early chronic pancreatitis is seldom suspected when pain is mild or absent, and there are unspecific symptoms of "dyspepsia."

Scientific research and clinical findings confirm that the pancreas and liver are more vulnerable to reduced functioning due to metabolic acidosis. One primary (ex juvantibus) therapy for multiple digestive and liver disorders is the mineral spa resort in Karlovy Vary and other resorts in Europe, and a great number of medical papers support the therapeutic action of the mineral/bicarbonate waters for digestive diseases. The pandemic of the digestive disorders in the modern world is associated with epidemic proportions of metabolic acidosis and dysbiosis, which form a vicious circle.

This article is an attempt to present the fresh, holistic approach that the pancreas is a vital organ for the whole body. We believe that our work may provide food for thought to many young researchers and health practitioners.

We cannot have optimal digestion if the body's system is acidic, because acidity kills the pancreas!

Notes:

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- I. Structure, Function and Disorders of the Pancreas
- II. Healing Food in the Digestive (Pancreatic) and Metabolic Disorders
- III. How to Improve the Exocrine Pancreatic Function, Postpone Pancreatic Deterioration, and Heal Digestive (Pancreatic) Disorders

In 1975, Peter Melamed established Biotherapy as a natural, holistic approach to healing. Biotherapy combines the wisdom of traditional Russian folk medicine, ancient Oriental medical therapies, and European naturopathy with cutting-edge Western technology. Biotherapy Clinic of San Francisco specializes in nondrug healing digestive (pancreatic), liver, gallbladder, and metabolic disorders.

#### **NOTES:**

I have not had experience with Karlovy Vary mineral water, but I cannot fathom that it is any better than pHenomenal Water at providing blood alkalinity and increasing blood oxygen levels, both keys to maintaining or restoring wellness. My preference is pHenomenal Water. More info available at: <https://www.longevity-formulas.com/product-list/phenomenal-water>