Lipase and the Fat Metabolism

by Walter Last

Lipase is the fat-splitting enzyme. Lipase has vast importance for our health, not just in regard to the commonly recognized diseases of the fat metabolism such as overweight and underweight, cardiovascular disease, diabetes, strokes and degenerative muscle diseases, but also for skin problems, autoimmune diseases, cancer, degenerative diseases of the brain and nervous system, and also for rejuvenation and regeneration in general. How can lipase be important with all of these problems and diseases?

The answer lies in the overriding importance of fats and oils not only for our energy metabolism, but even more so for the structural integrity of our body. Fats, oils and related fat-soluble vitamins and other biochemicals, such as lecithin and cholesterol, are collectively called lipids. Most of our brain, nerves and cell membranes consist of lipids. Lipase is important to maintain optimal cell membrane permeability; this allows adequate nutrient supply into the cells and wastes to flow out. P.G. Seeger, the most prolific researcher into the relationship between nutrition and cancer, has clearly shown that the first biochemical step towards cancer is a deterioration of the cell membrane.

Fats are chemically called triglycerides, and consist of three fatty acid molecules combined with the alcohol glycerol. The biochemical function of lipase is to split fats into their components, specifically to remove two or all three fatty acids from their glycerol base in order to transport the individual components through the intestinal wall. There are several lipases for different functions, including phospholipases, which split phospholipids, such as lecithin. Phospholipids are important structural components of brain, nerves and cell walls. Lipase is not only needed to digest and absorb lipids from food, but also for the internal use of lipids.

Fat Absorption

Most of our digestive lipase is released by the pancreas. It is water-soluble and works at the interface between water and lipids. Therefore, lipase can only do its work properly if the lipids in our food are finely emulsified which is done by bile released from the liver and gallbladder. The sulfur-amino acid taurine is a major component of bile. A deficiency of lipase, taurine or lecithin can lead to a lack of bile and the formation of gallstones from cholesterol. This can then lead to malabsorption of lipids and liver problems.

Lipase and lecithin added to meals help to avoid deficiencies of essential lipids after gallbladder removal, and are also beneficial with liver diseases.

Another common cause of lipid and mineral malabsorption is gluten sensitivity. Gluten causes irritation and inflammation of the intestinal wall and this erases the absorption villi. Instead of long and slender they now become blunt with a greatly reduced absorption surface. Fat malabsorption is called steatorrhea. It leads to fatty, bulky and smelly stools that may be noticed to frequently stick to the side of the toilet bowel. The stickier it is the higher is the fat content. In this case the fat is split into fatty acids but instead of being absorbed, these combine with mineral ions, especially calcium, to form

insoluble soaps. This causes chronic deficiencies of minerals, essential fatty acids and fat-soluble vitamins.

As we age, also pancreatic lipase production declines. This combination of declining lipase production, reduced bile flow, reduced intestinal absorption surface, and poor food choices leads to internal lipid deficiencies, especially in regard to fat-soluble vitamins, phospholipids and essential omega-3-fatty acids. This, in turn, causes or contributes to the common symptoms of aging and the development of degenerative diseases. Widespread mineral deficiency despite an adequate diet is commonly due to a lack of gastric acid, or fat malabsorption, or usually a combination of both.

Lipid Transport

After passing the intestinal wall, the individual components are put together again to form fats and phospholipids. Now they are combined with protein carriers, called **chylomicrons**, and carried in the bloodstream to all the cell structures. Chylomicrons belong to the class of lipid carriers called lipoproteins. They are the largest and least dense lipoproteins because of their high fat content.

Another group is the VLDL or **Very Low Density Lipoproteins**. They are made in the liver to carry fats synthesized in the liver from glucose and fructose to the body cells. As they lose some of their triglycerides they collect cholesterol from other lipoproteins and are then called LDL or **Low Density Lipoproteins**. They carry cholesterol to tissue cells and fat stores. HDL or **High Density Lipoproteins** are the smallest and densest lipoprotein, they carry cholesterol and phospholipids back from the cells to the liver for recycling or disposal.

Internal Lipase

In order to split and re-assemble lipids, the liver requires its own lipase, and this is called liver lipase. Some more lipase is in the blood, and may keep blood vessels free of fatty deposits. Furthermore, before fats can enter a cell, they must be disassembled for individual components to pass the cell wall.

Therefore, there is another lipase attached to the outside of cells or on nearby capillaries. This one is called lipoprotein lipase. The amino acid carnitine carries long-chain fatty acids through the inner cell wall into the energy-producing units, while shorter fatty acids, like some of those in butter and coconut oil, do not need a carrier. Inside the cell fatty acids may be used for energy production or to form new walls in dividing cells, or replace structures in existing walls, or they may be re-assembled into triglycerides and stored in fat cells.

As all of the individual molecules in our body are constantly being replaced, there is a high turnover in structural fatty acids. If we have not eaten for a while, lipase in fat cells disassembles triglycerides and releases them into the bloodstream to be converted in the liver or used by other cells for energy production. Lipase is even an essential factor in the synthesis of insulin in the beta cells of the pancreas.

Lipase Deficiency

As you can see from this short description, there is a lot of internal lipase required to keep the body functioning and in good working order. If there is not enough liver lipase, we may develop fatty degeneration of the liver, if there is a deficiency in the blood, the blood vessels may clog up, if it is lacking in fat cells, then we may only be able to deposit fat but not mobilize it again when needed, and when lipoprotein lipase is in short supply, then chylomicrons and VLDL build up in the blood and cause a range of problems, while cells are starved of lipids for energy production or structural regeneration.

Internal lipase deficiency may develop when more lipase is needed for fat digestion and absorption than can be produced in the pancreas. Then lipase is taken from the internal lipase store to prop up the pancreas. Actually, lipase is recycled similar to bile. For the purpose of fat digestion bile and lipase are released, but unused amounts of each are reabsorbed in the lower parts of the small intestines, and re-supplied to the liver and pancreas through the blood and lymph circulation. Internal lipase deficiency arises when we habitually eat food low in lipase. Then the body has difficulties reabsorbing and generating enough lipase as we get older, and we develop age-related degenerative body changes.

Another problem is the increasing incidence of genetic, inherited or familial lipoprotein lipase deficiency, also called familial chylomicronemia. This leads to all of these problems already at a younger age. The most severe form is seen when a genetic lipoprotein lipase deficiency is inherited from both parents. Fortunately, this is rare with a frequency of only one in a million.

Much more common is a relative deficiency inherited from only one parent. In this case problems may be mild in childhood, and become more disabling as we get older.

Depending on the exact nature of the deficiency, cholesterol may accumulate and lead to cardiovascular disease, or problems may be due to excess triglycerides. This may cause enlargement of liver and spleen, inflammation of the pancreas or chronic pancreatitis; fatty deposits, fatty tumors or lipoma under the skin; deposits in the retina of the eye, white inner eyelids, yellow-brown skin patches, inflammatory skin and muscle diseases, chronic muscle pain, spasms and cramps, varicose veins and fragile arteries, and generally lack of energy. A frequent sign is the early formation of an arcus senilis a bluish-white opaque arc in the top part of the iris, which may later become a full ring around the iris.

With this I see lipase deficiency causing or contributing to a wide range of health problems and diseases such as aging skin, Alzheimers disease, arteriosclerosis and atherosclerosis, auto-immune disease, cancer, cardiovascular disease, chronic fatigue syndrome, cystic fibrosis, dementia, depression, diabetes, eye diseases, fibromyalgia, lateral sclerosis (A.L.S.), liver diseases, malabsorption, multiple sclerosis, muscular dystrophy, obesity, pancreatitis, Parkinsons disease, psoriasis, Raynauds disease, stroke, and vertigo (labyrinthis or Meniere's Disease).

The medical solution for elevated triglycerides and cholesterol levels, apart from drugs, is a low fat diet. However, this has its own problems. It leads to severe deficiencies in essential lipids, such as fat-soluble vitamins, essential fatty acids and phospholipids; while a high carbohydrate diet predisposes to the development of diabetes, and any excess carbohydrate is converted in the liver into saturated fat and cholesterol, and is a main cause of obesity. This applies to genetic as well as acquired forms of elevated lipids.

Overweight

If we have a good metabolism, then we can easily gain or lose weight. When the metabolism becomes inefficient, we have difficulty either gaining or losing weight. I see the present epidemic of overweight mainly as a symptom of lipase deficiency. This is especially a problem with high-carbohydrate diets because of their low satiety value.

The problem is this: the less fat there is in a meal, the faster it is released from the stomach into the small intestine. Unlike fats, carbohydrates are easily and rapidly absorbed. This can lead to damaging high blood sugar levels. To prevent this, the pancreas releases large amounts of insulin. This helps glucose to enter cells more quickly but if you are not doing hard work or exercise at the time, the excess glucose is either converted to lactic acid, thereby causing overacidity and mineral deficiency, or the glucose is converted to fat (mainly in the liver).

Fat is then stored in fat cells. When the blood sugar level drops, this stored fat can now be used to generate energy but only if you have sufficient internal lipase. If lipase is deficient, fat remains in the fat cells and you feel hungry again, having another carbohydrate meal with a replay of the same story. After several years of repeating this cycle with habitually elevated blood sugar levels, diabetes may be diagnosed.

There are two ways to solve this problem, and it is best to use both simultaneously. Firstly get plenty of lipase, preferably from raw fats and oils, or otherwise from lipase supplements. Secondly slow down the absorption of carbohydrates. This may be done in several ways. You may use a low carbohydrate diet, or slow down the emptying of the stomach by mixing carbohydrates with sufficient oil or fat. You may, for instance, eat fruit mixed with (coconut) cream.

Alternatively, you may eat mainly slow-digesting carbohydrates, such as legumes, especially chickpeas and sprouted mung beans and lentils, in addition to vegetable salads. Another possibility is snacking - nibble, space out the food intake. Ingest only as much carbohydrate as you need to produce energy during the next 30 to 60 minutes so that nothing is converted into fat. Then have another snack. Finally be aware that if you do have a high-calorie meal in the evening, then it just cannot help but enrich your fat cells.

However, lipase deficiency is only one factor that may prevent converting body fat into energy. Others necessary nutrients are L-carnitine, coenzyme Q10, choline or lecithin, inositol, methionine, and vitamin B3 (niacin and niacinamide). Furthermore, fat burning can be accelerated by drinking diluted lemon juice, grapefruit juice or cider vinegar before meals.

Lipase to the Rescue

The natural solution to these problems originating from lipase deficiency is to use a diet that is high in lipase. All fatty or oily foods naturally have a high content of lipase. Lipase is destroyed by heating over 40 to 45° C. Therefore, to improve genetic or age-related problems of the fat metabolism, we need to maximize our intake of raw, unheated and unrefined fats and oils.

Raw butter, for instance, has formerly been used to cure psoriasis but pasteurized butter causes or aggravates it. The healing effect of raw butter is due to its high content of lipase. The same is true for heart and liver problems, which are caused or aggravated by processed cheese and butterfat. Such health problems did not occur in the inhabitants of the Caucasus and Bulgaria with their high intake of raw milk products. Cholesterol did not harm anyone in former times when mainly unheated milk products were used; cardiovascular disease was almost unknown.

Raw milk was formerly used to cure tuberculosis but pasteurized milk is more likely to cause it. Carnivorous wild animals have diets high in fat and cholesterol but no signs of atherosclerosis and heart disease. In contrast, dogs and cats on canned food, pasteurized milk or cooked meat develop the same diseases as their masters.

Lipase in Food

All lipid-rich foods also are high in lipase. However, you need to be aware that lipase is water-soluble while at the same time being attracted to the lipid phase. Therefore, you cannot get much lipase by using only the lipid phase, such as vegetable oil. Even extra virgin olive oil does not contain lipase, except as unfiltered, milky or turbid oil, but this is not commercially available because lipase would cause it to spoil quickly. The same applies to avocado oil or coconut oil.

This is not a problem with fresh avocado, coconut flesh or raw animal lipids as they usually retain enough water and, with this, all their lipase. Cream, for instance, has still about 60% water, butter 16% and egg yolk about 50%.

Other animal sources of lipase (and protein-digesting enzymes) are minced raw meat and raw, possibly marinated fish (see The Raw Food Diet (http://www.health-science-spirit.com/HF2-3.html)).

In addition to a high intake of refined carbohydrates, I see the current epidemic of diseases, such as Alzheimers disease, cardiovascular disease, diabetes, and obesity, largely as long-term manifestations of lipase deficiency, caused by the restrictions of health departments on the sale of unpasteurized milk products. To overcome this in countries where pasteurization is mandatory, groups of people could become part owners of a cow or a small herd managed by a farmer.

Preferably do not use Friesian cows (which give the largest volume of milk) but rather Jersey cows which have the highest fat and lipase content in their milk. Friesians are linked to allergies and diabetes, but Jerseys and other types seem to be fine. However, only butter, cream, cottage cheese and other cheeses are safe for regular use, the high

lactose content of milk tends to cause mucus problem, while milk allergy occurs mainly to whey proteins.

In order to obtain a high lipase intake from vegetable sources, we need to consume the whole food. This means eating the avocado instead of using just the oil, or pressing, juicing or blending the coconut flesh to make and use coconut milk or cream. This needs then to be refrigerated or frozen because the high enzyme content causes it to deteriorate rapidly at room temperature.

We encounter another problem with nuts and oily seeds. Even if we do eat them whole, we may not get much benefit from it because of the presence of enzyme inhibitors. Eaten frequently or in high amounts these inhibitors tend to cause indigestion. The solution is to soak and possibly sprout or ferment these seeds (see Recipes (http://www.health-science-spirit.com/HF2-5.html)). In one reported experiment all enzyme inhibition had been removed after 24 hours of soaking.

Lipase Supplements

Unfortunately, the richest food sources of lipase, raw butter and cream, have been outlawed in most Western countries. Individuals with genetic or age-related lipase deficiency will find it difficult to obtain enough lipase in commercially available raw food. Fortunately, lipase powder has in recent times become more easily available.

Originally lipase could only be obtained in relatively low concentrations as an ingredient of pancreatin from animal sources. In order to protect it from de-activation in the stomach, pancreatin is commonly available as acid-resistant or enteric-coated tablets that dissolve only in the intestines. While these can be helpful with malabsorption syndromes such as cystic fibrosis, because of their late activation, they are less effective than pancreatin released from the pancreas or enzymes already present in the food.

Furthermore, in children high spot concentrations of pancreatin from dissolving tablets in the lower intestines have been reported to cause damage to the intestinal wall. Another problem of mixing high levels of protease with a low level of lipase is that lipase is a protein. Its activity can be diminished by being partly digested by close contact with proteases.

Presently pancreatin and lipase from animal sources are increasingly replaced with enzymes from plant and microbial sources. One well-known enzyme factory is papaya or pawpaw, especially the white sap in under-ripe fruit and in leaves and twigs. The highest concentration is in the green skin of unripe fruit. Besides the protease (protein-digesting enzyme) papain, it also contains appreciable amounts of lipase.

Commercially lipase is produced mainly from special strains of fungi and bacteria. It is highly purified with no contamination from fungal or bacterial protein. Its main advantage is its activity over a wide pH range. Therefore, it is not de-activated by stomach acid, and is effective when mixed with the food in powder form before ingestion. With some fatty or oily food, it can be mixed already up to one hour before

mealtime and kept in a warm place to react. However, if waiting too long an off-flavor may develop, especially in the presence of short-chain fatty acids.

The advantage of using pre-mixed enzyme powder rather than pancreatin tablets can be seen from a reported case in which enteric-coated pancreatin tablets failed to arrest the progression of cancer of the pancreas, while fungal enzyme powder pre-mixed with food helped this patient to survive.

Tests have revealed that under favorable conditions about 40% of pancreatic lipase powder added to food is being absorbed into the bloodstream. I assume that by taking lipase in juice or water before meals this percentage will be even higher.

Pre-mixing of lipase with food overcomes a common problem with microbiallipases: they tend to be degraded by the pancreas enzyme trypsin in the small intestine. Pre-mixing gives lipase time to react not only before ingestion but also for a considerable time before the meal becomes too acid in the stomach and lipase becomes dormant. Lipase activity tests measure the amount of free fatty acids liberated from olive oil per minute; however for complete hydrolysis much longer reaction time is required.

On the other hand, if we want to maximize absorption of lipase into the bloodstream, then we need to avoid the release of trypsin by taking it on an empty stomach and with a reasonably large volume of liquid. I have experimented with absorbing small amounts of high-strength lipase under the tongue, and believe that this is an effective way of getting lipase into the bloodstream, although it may be equally effective carrying it across the skin with DMSO but I have not tried it.

Cod liver oil and other fish oils are highly beneficial for most individuals who do not eat much cold-water fish. If you suspect fat malabsorption or lipase deficiency, shake a tablespoon of cod liver oil or several opened capsules of fish oil together with some lecithin and lipase in juice before ingestion, or alternatively emulsify the oil by swishing the mixture around the mouth for a while. The omega-3 fatty acids in fish oils have been shown to reduce elevated fat levels in the blood. Cells containing plenty of omega-3 fatty acids in their walls produce up to 7 times more energy than cells with other fatty acids in their walls.

As a general rule, fat or oil, or fatty food such as egg yolk, ingested without thoroughly chewing together with other food, or by emulsifying it with lecithin, are not well absorbed and may lead to indigestion and deficiencies.

If you just swallow capsules of fish oil or vitamin E, or a spoonful of cod liver oil, the oil may just remain in a puddle and not be absorbed because lipase cannot penetrate a blob of oil or fat. Therefore always try to emulsify oils and fats by shaking, swishing or, the natural way, by thoroughly chewing with other food.

Technical Details

Lipase is also used for other purposes, such as in washing powders. Therefore, when trying to source lipase, look for food-grade or supplement quality lipase. I have not been able to find single ingredient lipase supplements in the retail market. They are

always in tablet form, usually in low concentration, and mixed with other enzymes. While pancreatin tablets have their place, I believe that tablets or capsules of microbial lipase are relatively inefficient as they start working only in the small intestine where they may soon be degraded by trypsin. Alternatively you may, of course, open capsules and pre-mix their content with the meal.

For individuals with genetic or advanced age-related lipase deficiency, and no access to raw butter or cream all this is not satisfactory. Therefore, search on the Internet for enzyme manufacturers, you may be able to obtain lipase powder in kilogram quantities. Preferably store lipase powder refrigerated in a closed container. At room temperature the loss of activity is generally stated as 10% per year if kept in a tightly closed container.

The activity is commonly expressed as Lipase Units or LU, and in the US sometimes as US Pharmacopeia (USP) units. Different lipase preparations may have different activities. For fungal lipases these may range from 2,000 to 2,000,000 LU per gram. However, to make it more complicated, activity presently is also stated as FIP units /g or FCC III LU/g. One of these new Lipase Units is equivalent to ten of the old LU, or 1,000 FIP units/g = 10,000 LU/g.

Depending on the nature of your health problem you may use up to 500,000 LU daily, although no research on maximum amounts is available. Start with small amounts, such as 20,000 LU daily, and increase gradually according to your observations of any benefit or reaction. Half a level teaspoon of lipase 80,000 LU/g provides about 120,000 LU. Lipase powder easily dissolves in water.

Mix more with meals high in fats or oils, and less with food of lower fat content. With cooked food always add after cooling to below 45C. Also add some lecithin and mix and chew well.

For better absorption to clean congested blood vessels, or with lipoprotein lipase deficiency, or to lose weight, stir lipase in a glass of juice, herb tea or water and take before meals. Drink more afterwards. Alternatively try absorbing 100,000 to 200,000 LU under the tongue, possibly best at bedtime.

Two US enzyme manufacturers are Valley Enzymes at http://www.valleyenzymes.com and American Laboratories at http://www.americanlaboratories.com. You may inquire about a distributor near you. For retail supplies of fungal lipase in Australia see http://www.strideintohealth.com.

External Use of Lipase

To remove fatty lumps (lipoma), or yellow-brownish skin marks (xanthomas), or to rejuvenate aging or damaged skin, mix a suitable amount of lipase with a carrier agent, such as unheated honey, MSM in water or fresh aloe vera gel.

It may also help to add a small amount of lecithin and fish oil (possibly odorless). Apply this to the problem area and cover to leave overnight or for several days. Repeat from time to time if and as required. You may also try it on external tumors, skin cancer,

moles and boils, but in this case also add a capsule of halibut liver oil. I would use this method for skin cancer on a sensitive area such as the lips in preference to any harsher measures. Also applying the south pole of a magnet to lipomas, moles or skin cancer may help, while xanthomas may respond to rubbing on lemon juice or vitamin C.

To regenerate aging skin, you may rub on a mixture of lipase with aloe vera gel, deodorized fish oil and vitamin E oil, or add some lipase to your favorite natural skin lotion just before you rub it on. Alternatively, you may rub the skin with a lipase-rich nutrient, such as unpasteurized cream, or mix some raw egg yolk or avocado with your skin lotion. Unheated coconut milk is highly germicidal, and especially good for areas affected by Candida and other fungi.

To lose weight from specific parts of the body, such as thighs, buttocks or stomach regularly rub on lipase dissolved in an agent that easily penetrates the skin such as aloe vera gel, vanishing cream or, possibly most effective, DMSO. In addition frequently stimulate this area by rhythmic tensing and relaxing the involved muscles, by massaging the area and using alternating hot and cold showers on it.

Safety

In regard to safety, tests with rats did not show any side-effects after intakes of 2 g/kg of high-potency lipase for several months. For a human that would be equivalent to taking 100 to 150 g daily. Also there are no reported health incidents. Therefore health authorities generally do not have any concerns about lipase as nutritional supplement. A committee report of the Australian TGA states: Authors of safety studies and reviews indicated that they could find no reports of adverse reactions for oral consumption of microbial-derived enzymes in humans (CMEC47).

Caution: There is a theoretical possibility that a continued high intake of lipase supplements, especially in combination with elevated blood fat levels, may cause the blood to become high in free fatty acids. This can cause overacidity, and in addition fatty acids may enter cells too rapidly. Over time, this may cause muscle problems. Therefore, if you notice overacidity or any kind of muscle problems developing, temporarily stop lipase supplementation, and possibly re-introduce it at a later date at a lower dose. Furthermore, as enzymes are proteins, there is always the possibility of an allergy against the used lipase developing. Therefore watch out for this possibility, and possibly switch to a lipase produced by a different strain if you suspect any allergic reaction.

The information in this article has been provided in good faith according to my experience and understanding. I cannot guarantee results or accept responsibility for any side effects.

Reference website: http://www.health-science-spirit.com/lipase.html