PC Liposomal Encapsulation Technology

Proven Nano-Chemistry that can Make Health and Longevity Supplements Many Times More Efficient and Effective.

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Life's Fountain Books

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DISCLAIMER

The information herein is intended to help you make informed decisions about your diet and health, not to substitute for any treatment that may have been prescribed by your physician.

Unless otherwise noted, the views presented in this book are those of the author which are based on sound research and reports.

If you suspect that you have a medical problem, we urge you to seek competent medical help. Keep in mind that nutritional needs vary from person to person, depending on age, sex, health status and total diet. Because there may be some individual risks involved, the author, publisher and researchers are not responsible for

any adverse effects or consequences resulting from the use or misuse of any of the suggestions, preparations or procedures in this report.

CONTENTS

CHAPTER 1

Liposomal Encapsulation Technology (LET) — The Future is Now!

The medical research world is abuzz with excitement about a host of bio-technologies that promise to improve health and extend life. Although the expected fruits from these new endeavors are very promising, decades may pass before they will be harvested.

Although Liposomal Encapsulation Technologies (LET) have not yet received much attention in the mass media — unlike gene therapies, and stem cell research — it offers tremendous potential to help

mankind right now. It is tried, proven and there are products which are currently available to the medical practitioner as well as the ordinary consumer.

Even as you read this page, new products are being formulated that promise to improve health and increase longevity.

A Little LET History

LET has been in the developmental stages since the 1970s. For the first 25 years or so, it was employed almost exclusively by medical researchers who needed to deliver particular drugs, dyes, or other therapeutic agents to specific tissues. From that time until the writing of this book, a handful of companies have used LET in non-medical applications.

Because of its superior transdermal transport qualities, a tiny

number of companies use LET in some of their topical moisturizers, cell therapy and cosmetic products.

An even smaller number of companies are now using LET for the oral delivery of dietary supplements. Given the impressive benefits of LET, we anticipate a massive boom in the number of supplement companies and supplement products employing Liposomal Encapsulation Technology very soon.

Why LET is so Powerful

The basic reason that LET is so powerful is that it enables the delivery of more pure, nondegraded, substances to the specially targeted tissues and organs than any other method. In most cases, LET is so efficient that dose levels can be 10 to 15 times smaller. Dose re-

ductions of this magnitude have tremendous therapeutic and economic implications whether the substance to be delivered is a drug or a dietary supplement.

In addition, the essential phospholipids used to make the liposomes which encapsulate the nutritive substance have vast health benefits in and of themselves.

How LET Can Increase Bio-Availability by Several Times

There are many factors that can substantially lower the bioavailability of a food, food supplement or drug.

As you will learn shortly, LET can greatly mitigate, and in some cases, totally eliminate the factors that reduce bio-availability, absorption, and proper distribution of the substances it encapsulates.

The bio-availability of tablets and capsules can be drastically reduced before they are ever placed in the mouth. Exposure to mois-

Table 1: Factors that can adversely effect bio-availability

- Moisture, oxygen, and other factors in the environment
- Enzymes and digestive juices in the mouth and stomach
- Bile salts in the intestines
- Friendly and unfriendly organisms in the intestines
- Food and drug interactions in the digestive system
- Additives such as capsule gelatins, coatings, binders, fillers, sugars, colors and flavors to facilitate packaging or swallowing
- Incomplete assimilation due to partial or non-breakdown of tablet or capsule into small enough particles for uptake in the intestines

ture, oxygen, and other substances and conditions in the normal environment will degrade most supplements and drugs over time.

Another factor is the human digestive system itself. Enzymes in the mouth and stomach, digestive juices, bile salts (to neutralize the digestive acids), and various flora in the intestines can further degrade the supplement or drug. These endogenous substances and organisms can also hinder uptake of food, food supplements and drugs in the intestinal tract.

Since the digestive system is seldom empty, interactions between foods, other supplements or drugs can also reduce, degrade or alter the desired outcome.

The use of binders (for tablets), fillers (for tablets, and capsules), coatings, artificial colors, artificial

flavors, sugar and other additives can also diminish the digestibility and uptake of nutrients and therapeutic substances.

Liposomal encapsulation protects substances from most of the degrading and inhibitory factors mentioned above by providing unparalleled payload protection.

LET utilizes phospholipid liposomes to form a barrier around their contents that is resistant to digestive juices, alkaline solutions and salts found in the human body as well as free radicals. Because of this, they do a superior job in protecting the contents from oxidation and degradation from external substances and conditions.

Most importantly, this protective barrier stays intact until the contents have been delivered to the

gland, organ or system where the contents will be used.

A myriad of liposomal carriers have been developed. Some release their contents at a certain temperature, others at a specific pH, while others in the presence of certain substances. In other words, they function like microscopic smart bombs that can travel through the body and deploy their payload in the desired location.

Another quality of liposomal encapsulation that makes it so effective is found in the very make up of the encapsulating liposomes.

Most LET liposomes are made with essential phospholipids. The body needs phospholipids in order to grow and function. In fact, every cell in your body has a protective membrane which is made from phospholipids.

Table 2: Factors that make Liposomal Encapsulated substances more bio-available.

- Liposomal encapsulation protects substances from:
  - moisture, oxygen, and other factors in the environment
  - enzymes and digestive juices in the mouth and stomach
  - bile salts in the intestines
  - friendly and unfriendly organisms in the intestines
  - food and drug interactions in the digestive system
- Liposomal encapsulation does not use additives such as capsule gelatins, coatings, binders, fillers, sugars, colors, and flavors to facilitate packaging or swallowing
- LET liposomes can hold their contents until they reach the specifically targeted tissues, organs, glands or other bodily structures
- LET liposomes have essential health qualities in and of themselves
- LET liposomes are submicroscopic allowing them to better reach their target.

As new, high quality phospholipids are consumed, they replace damaged or inferior ones, making cell membranes throughout the body healthier and more able to protect and nourish the cells they encase.

The importance of phospholipids is so great that, in some cases, the encapsulating liposomes in liposomal products may actually provide more health benefits than the substances they carry.

Since liposomes form an air tight protective sphere around their contents and are easily ingested by themselves or in a beverage, there is no need for binders, fillers, artificial flavorings, artificial colors, buffering agents or any other substances.

Finally, because of their submicroscopic size and a chemical

structure that is recognizable as a friendly substance to the body, they can navigate through the digestive, lymphatic, and circulatory systems with ease. This is in contrast to some supplement tablets, pills and capsules that can be eliminated in the stool partially digested or totally intact.

Coming Applications of LET

We are certain to see more LET utilization in the future as health care specialists need to treat certain body structures with powerful drugs that provide needed treatment to targeted areas, but are highly toxic to the body as a whole.

Although the medical and pharmaceutical uses of LET are very important and promising, it is beyond the scope of this work. This book will focus on the extensive, nutritive and non-medical ap-

plications of LET which are just as powerful and potentially more beneficial for all of mankind.

LET can benefit virtually every man, woman, and child on this planet. It is our hope and purpose that this incredible bio-technology will be exploited to its full potential so that all may enjoy the unequaled health and longevity afforded by it.

CHAPTER 2

The Phospholipid Miracle that Makes LET Possible

Liposomal Encapsulation Technology (LET) is a unique method of making sub-microscopic bubbles — called liposomes — which are used to encapsulate various substances. The liposomes used in LET are made from phospholipids.

To appreciate LET fully, the next two chapters will delve into some biochemistry and will get a little technical. Please bear with it — the rest of the book gets much easier to read and understand.

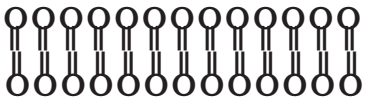
Phospholipids are the basic building block of every cell membrane in the human body. How they work and form membranes is elegant and miraculous.

Each phospholipid molecule has three major parts, one head and two tails. The head is made from three molecular components: choline, phosphate, and glycerol. The important thing to remember here is that the head is hydrophilic — in other words, it is attracted to water. Each tail is a long, essential fatty acid chain. These fatty acids are hydrophobic — that is, they are repelled by water.

When phospholipids are put in an aqueous (water-based) solution, the hydrophilic heads of the phospholipids form a line side by side with their tails behind — much like swimmers at a starting

Figure 1: Phospholipids in Typical Mono-Layer Alignment

Figure 2: Phospholipids in Typical, Tail-to-Tail, Bilayer Alignment



gate (see Figure 1). Then because the tails are hydrophobic, another phospholipid layer will line itself up tail-to-tail in response to the same aqueous environment (see Figure 2). This natural alignment creates two-rows of tightly fitted phospholipid molecules, called a phospholipid bilayer. It is these phospholipid bilayers that form the membranes around and within

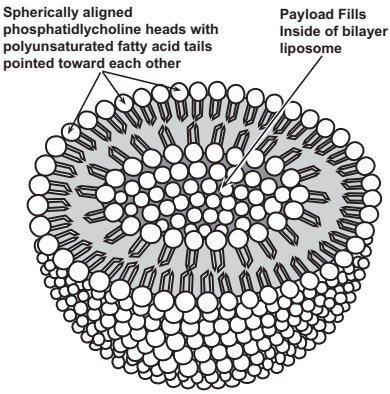
every cell in our bodies. One bilayer is about one 1,000th the thickness of this page.

In the human body, phospholipid bilayers form the outer wall for each cell by arranging themselves in a spherical shape with the heads of the phospholipids making up the external and internal surfaces of the cell. This submicroscopic membrane holds the contents of the cell in and protects the cell from harmful substances on the outside (see Figure 3).

A combination of different proteins interspersed within the phospholipid bilayers in every cell provides channels for allowing nutrients in and allowing cellular waste products out.

Considering the trillions of cells in the human body and the thou-

Figure 3: Cross-Section of Bilayer Liposome.



Phospholipids form all cellular membranes in the body. In LET they form protective liposomal capsules around the substance to be encapsulated.

sands of phospholipid molecules required by each cell, the number of these molecules is almost incomprehensible.

Without phospholipids, your body would be nothing more than a puddle of mineral water and organic solutions.

As you will learn in the next chapter, there are different kinds of phospholipids. Some phospholipid compounds are synthesized in the liver. Other phospholipids, such as phosphatidylcholine, are essential for life and health yet cannot be made by the human body. Called essential phospholipids, phosphatidylcholines must be ingested. The difference in form and function between the different phospholipids is determined by the composition of the two fatty acid tails attached to the choline-phosphate heads.

Phosphatidylcholines — essential phospholipids — are made from essential, polyunsaturated, fatty acids. In most LET food supplement applications, it is these essential, polyunsaturated, fatty acid phospholipids which are used to create the liposomal capsules.

CHAPTER 3

Polyunsaturated Phosphatidylcholine: The Most Powerful Phospholipids

Although the name phosphatidylcholine (pronounced FOSS fah tie dal KO lean) can be very intimidating the first few times that you see it, its inclusion in our discussion of liposomal encapsulation is essential if we are to fully appreciate the significance of LET. To make reading easier, this text will often abbreviate phosphatidylcholine as PC.

What is PC

As mentioned above, PC (phosphatidylcholine) is a special class

of essential phospholipids. As discussed in Chapter 2, phospholipids are comprised of a hydrophilic, phosphated choline head and two hydrophobic fatty acid tails.

Fatty acids are organic acids made from chains of carbon and hydrogen atoms that form the building blocks for lipids, oils, and waxes.

Essential fatty acids are required for cell membrane synthesis and fat metabolism.

There are a host of fatty acids in our foods and in the human body. Linoleic acid and gamma-linolenic acids, however, are the only essential fatty acids. These acids are absolutely required for growth and health but can not be synthesized in the human body — they must be supplied by the food we eat.

Essential phospholipids are phospholipids which have essential fatty acid tails.

PCs are a smaller subset of essential phospholipids.

Not All PC is Created Equal

As discussed above, phosphatidylcholine is a type of phospholipid which has two essential fatty acid tails. Fatty acids can be saturated or unsaturated.

Therefore, there can be a substantial difference in some important qualities of different PCs based upon the saturation level of the two fatty acid tails.

The Value of Unsaturated versus Saturated Fatty Acids in PC

Saturated fatty acids are chains of carbon atoms joined by single bonds which allows each carbon atom to bind to a maximum (satu-

rated) number of hydrogen atoms. In an unsaturated fatty acid some of the carbon atoms are attached to one another with double or triple bonds.

Each double bond eliminates one hydrogen atom and each triple bond eliminates two hydrogen atoms from the chain.

In addition, each double or triple bond creates a bend or "kink" in the fatty acid chain. The physical properties of fats, oils, and fatty acids can change substantially as the chains become more unsaturated.

The difference between saturated and unsaturated fats is so dramatic that it can be seen with the naked eye.

Lard, butter, and bacon are examples of saturated fats. Because of their straight carbon chains, the

chains lay very closely to one another. They easily solidify at room temperature and are more viscous (sticky, thick, slow to flow).

Because of the bends in the carbon chains of unsaturated fats — like vegetable oils — these fats are usually liquid at room temperature and non-viscous (slippery, thin, easy flowing). Fats and fatty acids that have a high number of double and triple bonded carbons are called polyunsaturated.

Just as the physical and chemical properties of saturated, unsaturated and polyunsaturated fats, oils, and fatty acids are varied and profound, so the difference in PC with polyunsaturated fatty acid tails are quite significant.

The significance of PC with polyunsaturated fatty acids has so many positive health implications

that much of the remaining material in this book is devoted to that topic.

Please understand that the benefits of LET enumerated in this book assume the use of polyunsaturated phosphatidylcholine in the preparation of liposomal encapsulation products.

All the studies and research regarding the use of essential phospholipids and phosphatidylcholine cited in this book were accomplished using polyunsaturated PC.

Integration of Polyunsaturated PC into the Body

Although there is much yet to be learned about the specific mechanisms of PC integration and metabolism in the body, there is much we do know.

Table 3: Observed health and anti-aging benefits of polyunsaturated PC (essential phospholipids).

- Reduction in total serum lipids (fat in the blood)
- Reduction in LDL (bad) cholesterol
- Increase in HDL (good) cholesterol
- Reduction in total cholesterol
- Reduction in triglycerides
- Reduction in cholesterol deposits in vascular walls
- Reduction in blood platelet aggregation (detrimental tendency of blood cells to stick together)
- Effective anti-oxidant in lipids
- Increase in red blood cell fluidity
- Improved coronary circulation
- Increased exercise tolerance
- Improved peripheral circulation (hand and feet)
- Liver protection and rejuvenation
- Improved immunity
- Improved memory
- Prevention of excess collagen formation and cross-linking (wrinkles and scarring)

As the liposomal process is examined, the importance of size and polyunsaturation of PC liposomes in LET become very apparent.

Observations using radioactively tagged fatty acids in PC demonstrate that the polyunsaturated PC quickly replaces the more saturated and/or damaged phospholipids in plasma membranes. This exchange accomplishes many important tasks.

The polyunsaturated fatty acids quickly begin to facilitate the metabolism of low-density lipids and cholesterol. This gentle "degreasing" scrub is manifested throughout the body.

Soon, life-giving blood moves through the circulatory system more quickly and easily, especially in the tiny capillaries, as the blood becomes less viscous (thick

and sticky) and deformable (able to change shape).

Plasma membranes return to a more efficient, more fluid state and hardened saturated fats and cholesterol that have become lodged there are removed and metabolized.

Cells throughout the body become more able to resist the damaging effects of free-radical attack.

The heart, pancreas and liver become energized as their work becomes much easier.

Choline levels increase in the brain which has many positive implications for proper mental function and help maintain and improve memory.

Many astounding health and anti-aging benefits have been documented from the oral and intra-

venous use of polyunsaturated PC — sometimes called "essential phospholipids."

Several specific findings and studies will be cited in subsequent chapters. For a general list of these health and anti-aging benefits, see Table 3 on page 33.

CHAPTER 4

Scientific Studies Showing PC's Health Promoting Power

For several decades, phosphatidylcholine (PC) has been used and studied in the laboratory and in clinical settings. As of this writing, there have been no less than 35,000 studies with PC, well over 500 have been human trials.

PC researchers widely accept and have lauded its numerous health benefits — none have reported any adverse side effects related to the oral use of PC.

One would expect PC to be completely non-toxic, since it is

the major building block for all the cellular structures in the body.

In addition, since plasma membranes are the first line of defense for every cell against toxic substances, free-radicals, carcinogens and the like, and because they are essential for the integrity of every cell, it is logical to deduce that a constant supply of high quality PC would have some dramatic implications for the good health and longevity of the body as a whole.

Experience over the years has borne out the truth of this simple deduction. The next four chapters are devoted to sharing the findings of a few of the many scientific articles regarding the positive health effects of PC (essential phospholipids).

CHAPTER 5

PC Protects and Promotes Liver Health

Introduction

No organ in the body performs as many vital functions as the liver. A healthy liver is essential to vibrant health and longevity. Yet, at a time when so many are seeking better health and longevity, the very organ that can provide much of what they seek is under unprecedented attack.

Prior to the industrial revolution, the human liver was subjected to many challenges, but our modern way of life has dra-

matically increased the liver's workload with a never-ending, all out siege.

Today, we are exposed to an increasingly higher level of toxic substances like gasoline, exhaust, paint fumes, herbicides, pesticides, food additives, contaminated water, and common prescription and over-the-counter drugs.

As a result, millions of Americans are living with some degree of impaired liver function.

The liver is the largest organ of the body and is the body's major line of defense against ingested toxins and performs over 500 vital functions.

The liver processes carbohydrates into energy, regulates protein metabolism into useful building elements for recon-

structing tissues, and stores many vital nutrients. Ingested food undergoes interchange, synthesis, oxidation, and storage in the liver.

While the liver's primary function is detoxification, it also stores and distributes nourishment for the entire body. Besides storing Vitamins A, E, and D, and glycogen, the liver also manufactures enzymes, cholesterol, amino acids, and proteins.

More than 1,000 different enzymes necessary for digestion and nutrient assimilation are synthesized in the liver. It also creates and regulates some of the body's hormones.

A healthy adult liver produces nearly one quart of bile every day which travels through the gall

bladder and into the small intestine for emulsification of fats.

Every 60 seconds approximately one-half gallon of blood is filtered by the liver. Every day, over 10,000 chemical compounds toxins, poisons, hormones, and enzymes, are broken down and detoxified in the liver.

Normally, the liver removes toxic chemicals from the blood, and stores them in its own cells until it is able to dump the toxins into the lymph system, or into the bile for removal from the body.

If chemical exposure is too great or the toxins from the diet or environment exceed blood cleansing limits, the poisons accumulate within the liver, creating a toxic internal environment

that will further impair liver health and function.

Impaired liver function has been linked to accelerated aging, low libido (sex drive), excessive fatigue, weight problems, impaired immunity and many serious diseases including cancer, coronary heart disease, hepatitis, and kidney disease. A sick liver can also be responsible for conditions such as asthma, migraine headaches, allergies, varicose veins, and hemorrhoids.

Dozens of studies have shown that PC provides unequaled protection and support for the liver.

PC Protects the Liver from Toxins, Drugs, and Free Radical Assault

Since the liver receives the brunt of the stress caused by trans fats, alcohol, drugs, and environmental toxins, this finding

demonstrates a protective quality of PC that is much needed.

Several studies have shown that 1,000 to 2,000 mg of PC daily protects the liver from the oxidative damage caused by alcohol.[1]

A couple of studies with rats fed PC prior to exposure to gamma radiation demonstrate its powerful liver — and spleen — protection abilities. The researcher reported that the ingestion of PC 24 hours prior to the radiation exposure prevented all expected changes in histones, RNA and DNA.[2]

PC Reverses Fatty Liver

Another damaging consequence of a continual attack of toxic substances is the accumulation of lipids (fats) in the liver cells called "fatty liver."

A significant animal study found that a single dose of PC was able to reverse the unwanted accumulation of lipid particles in liver cells.[3]

Human trials, using daily PC doses between 1-3 grams, with subjects diagnosed with fatty liver have concluded that PC was effective in the treatment of this condition. One of these studies demonstrates that PC is effective in restoring the integrity of hepatic cells.[4]

Another human study giving 300 mg PC daily to 30 fatty liver patients over a 6 month period found that 29 —96.6% — displayed at least a partial improvement. Over half — 16 patients — had a major improvement in a number of subjective and objective measurements.[5]

A similar clinical trial with 29 patients reported similar findings.[6]

PC Helps General Liver Problems

For many years, PC has been used as part of a treatment protocol for patients with various forms of liver dysfunction.

PC was reported to hasten recovery in patients suffering with viral hepatitis in a 1989 clinical trial.[7]

In 1992 a double-blind, placebo-controlled study showed "clear improvement in the clinical and histological picture" using PC.[8]

Thirty-six patients with pronounced circulatory insufficiency and hepatic dysfunction were treated with PC during a 4 to 6 week period in 1997. Six weeks after the treatment ended, follow up tests revealed good liver function and lipid metabolism.[9]

CHAPTER 6

PC Improves Blood, Heart and Vascular Health

Introduction

Perhaps no other nutritional supplement provides such rapid and profound positive impact on cardiovascular health as PC. Many studies have been performed over the years.

PC Lowers LDL Cholesterol

Low density lipoprotein (LDL) cholesterol has been implicated in the formation of arterial plaques. Often called "bad" cholesterol, high blood levels of LDL cholesterol are

associated with a high health risk for coronary heart disease, strokes, and other circulatory problems.

Since the late 1970s, several human clinical studies demonstrate that the oral administration of PC can significantly reduce LDL cholesterol levels in the blood.

In one study, LDL cholesterol was lowered by over 31% within six weeks.[1]

A double-blind, placebo-controlled study using 2,700 mgs of PC per day produced reductions of LDL cholesterol over 20 percent within six weeks.[2]

Average reductions in LDL cholesterol of over 25% were reported in another cross-over PC study within a 2 month period.[3]

Several other studies have produced similar and even more im-

pressive results.[4] It should be noted, however, that there have been some studies which have failed to show a significant reduction in LDL in conjunction with PC usage.[5]

PC Raises HDL Cholesterol

Often dubbed "the good cholesterol," high density lipoprotein (HDL) cholesterol has been shown to suppress the arterial damage caused by heightened levels of LDL cholesterol. Research suggests that PC actually converts LDL into HDL.

Several studies with oral PC have shown average increases of HDL cholesterol levels of 150% to 200% within as little as 30 days and no more than 90 days.[6]

Another study reports an increase of HDL to LDL ratio from a dangerous 12-14% range to the

normal range of 18-22% using a daily dose of 1,500 mg of PC with diabetic patients over a 12 month period.[7]

Several other studies show a similar increase in serum levels of HDL with improvements ranging from 10% to 45% with the greatest improvements associated with the lowest beginning values.[8]

An increase in HDL and decrease in LDL was associated with a simultaneous improvement in vascular elasticity during one study involving PC. The researcher concluded that this observation demonstrates a movement of LDL cholesterol out of arterial walls.[9]

PC Lowers Serum Triglycerides and Overall Cholesterol

A significant decrease in triglyceride levels was reported in seven independent placebo-con-

trolled studies. All subjects had initial triglyceride levels over 200 mg/dl (above normal range). The smallest triglyceride decrease reported was 4.9%[10] and the greatest was 44%.[11]

The most favorable trial (44% reduction in triglycerides) also showed a corresponding 15.2% decrease in overall serum cholesterol during a two month trial.[11]

Data from many other studies strongly suggests that the results are very much dose and duration dependent. The study showing the smallest decrease (4.9%) had the smallest dosage (1,500 mg/day) over a four week period. The clinical showing the largest decrease (44%) used 3,000 mg/day over an 8 week period.[12] Results, dosages, and trial durations from the other studies fall predictably in between.[12]

Other studies with subjects who had average triglyceride values under 200 mg/dl showed little or no change.[13]

In summary, most of the trials that have been published indicate that PC produces a significant reduction of serum triglycerides. These reductions are further influenced by the initial triglyceride levels, the dosage, duration of treatment, and the subject's diet.

PC Improves Blood Circulation by Promoting Healthy Blood Cells

Two major characteristics of red blood cells can dramatically affect blood circulation. The first is the fluidity of plasma membranes, and the second is plasma viscosity.

To varying degrees, all cells in the body require membranes (cell walls) with some degree of ri-

gidity. Rigid molecules of cholesterol are interspersed within the phospholipid bilayer that makes up the cell membrane. The more cholesterol that is present, the more rigid the cell.

As the phospholipid to cholesterol ratio exceeds a certain point in red blood cells, they lose their ability to reshape themselves. This decreases their ability to pass through tiny capillaries. This ability to reshape is called deformability.

When blood cell membranes become more sticky and less fluid, the ability of the cells to circulate is also diminished. The tendency to stick together is called platelet aggregation.

Anything that limits blood circulation can have a profound and harmful affect on the entire body.

Clinical tests have shown that PC can significantly increase blood plasma fluidity, increase cell deformability, lower blood viscosity, and diminish platelet aggregation.[14]

One study involved the injection of PC into healthy volunteers. After 15 minutes and 45 minutes, blood was drawn and sent through an eight micron capillary filter. The number of red blood cell passing through the filter was counted and compared with pre-injection results. Researchers reported a significant increase in the number of cells that were able to move through the filter.[15]

A similar study with heart patients began with a 500 mg injection of PC and 1,800 mg oral PC per day for 3 months. At the end of the study, the cholesterol/phospholipid ratio of platelet

membranes had dropped 28% to normal values. The authors also reported normalized blood viscosity and a statistically significant improvement in capillary flow.[16]

Subsequent trials with patients with subnormal blood parameters and impaired circulation using oral PC have substantiated improvements in deformability and viscosity of blood cells.[17]

In another 30 day study using 1,800 mg of oral PC per day, substantial improvements in blood flow to muscles in the legs as well as increased blood flow velocity were reported.[18]

PC Raises Exercise Tolerance

Any substance that can improve blood viscosity, deformability, and circulation factors

should also improve ones exercise endurance and stamina.

In a trial group of heart patients using oral PC, subjects were able to walk nearly 100 times farther, without using nitroglycerin and without pain.[19]

Another PC study with heart patients, conducted over a two month period, states that 88 out of 94 subjects claimed improvement in energy, more comfortable and restorative sleep, less pain, more stamina and more endurance.[20]

CHAPTER 7

PC Rejuvenates, Protects Cells

Introduction

Much has been written during the last 20 years about free radicals and their detrimental effects upon the human organism. These rogue agents are unstable, incomplete molecules that roam through the body looking for atoms that will make them stable and complete. Most often free radicals steal the atoms they require from healthy tissue. The damage caused by this theft opens cells up to further attack from patho-

gens, parasites, and other free radicals.

The first line of defense for any cell in the body is the cell membrane. As discussed in previous chapters, this membrane is made up of phospholipids. Once the cell wall has been compromised, the mitochondria (the cell's power plant), RNA, and DNA inside the cell are open to attack.

Studies show two major functions of PC in regard to individual cells — cell protection and cell repair. A constant supply of PC allows cells to replace damaged phospholipids within cell walls and also demonstrates an antioxidant ability.

PC Provides Cellular Protection

PC provides protection to cells in three distinct ways:

1. **PC reduces lipid peroxidation.** Peroxidation is the degrading process that occurs as a result of free-radical attack. When iron is peroxidized, the result is rust.

   Although the mechanism for PC's ability to reduce lipid peroxidation has not been fully established, several indicators of this valuable PC function have been observed.

   A group of angina patients was given 1,800 mg of PC orally for a three-week period. At the end of the study, a significant rise in HDL cholesterol and reduction of serum lipids was considered to indicate an inhibition and a reversal of lipid peroxidation.[1]

   In other studies, improved resistance in red blood cell

membranes and reduction in metabolites associated with lipid peroxidation were reduced significantly.[2]

2. **PC replaces easily oxidized, low-density lipids in cell membranes.** The studies that demonstrate this function of PC have only been performed in animals because of the need to use radioactively labeled PC.

   Although this mechanism of PC has not been observed in human studies, the reductions in LDL and the increases in HDL have been observed. See Chapter 6 for discussion and citations of these studies.

3. **PC aids in the removal of free cholesterol.** An enzyme synthesized in the liver — lecithin:cholesterol-acyl-transfer-

ase (LCAT) — circulates in the blood plasma and aids in the uptake of free cholesterol that has attached itself to blood cell walls, lipoproteins, or other cells in the body. Once gathered by HDL, this cholesterol can be eliminated from the body.

PC has been shown to substantially increase LCAT activity in several different studies.[3]

PC Promotes Cell Repair

As cells become damaged from lipid peroxidation, the natural cellular response is to "plug the hole" with cholesterol and/or collagen. PC's ability to limit, prevent, and in some cases reverse this process has been demonstrated in many surgical settings.

Several researchers have used PC to prevent or limit scarring from burns and from surgery.[4]

Using radioactive labeling techniques, scientists have also shown that ingested poly-unsaturated PC molecules quickly replace more highly saturated phospholipid molecules in cell membranes. This particular research demonstrates that cell membranes, rather than being static structures, are quite fluid.

A steady supply of fresh PC helps to maintain this important replacement function.

CHAPTER 8

PC Boosts Immunity and Aids Memory

Introduction

PC's contribution to improved liver function (see Chapter 5) and an increase in blood health (see Chapter 6) could easily account for observed improvements in immunity and memory. Beyond that, however, various investigations with PC suggest that there are additional mechanisms which contribute to a boost in the body's natural immune functions and memory improvement.

This chapter will investigate some of these mechanisms.

Immunity and PC

Newborn babies can often be victims of bacterial infection (septicemia). In a study with newborn rats, PC demonstrated an immunomodulating of the acute response to gram-negative bacterial infection. The test animals were given a prophylactic dose of PC just prior to exposure to various bacteria.

The treated animals showed several indications of improved immune response as measured by white blood count and other immune factors in the blood. In addition, the survival rate in the treated newborns was significantly higher.[1]

A human immunity study was completed with 56 patients with

chronic kidney infections. Thirty-one of the subjects were treated with PC while 25 were not. The subjects who were given the PC had shorter duration of fever, less active inflammation, lower urine excretion of oxalates and normal lipid composition of biological membranes than the untreated patients.[2]

In an in vitro (test tube) study with cultured T-lymphoma cells permanently infected with human immuno-deficiency virus (HIV 1), PC inhibited the growth of the HIV exposed cells.[3]

In yet another study of the surgical outcomes of 117 patients with complicated liver echinococciasis (an infestation of tapeworm larvae) a combined use of PC and T-activin were studied. The authors conclude that the use of these two substances in tandem cut the inci-

dence of post-operative complications in half and helped to restore normal liver function and immune response.[4]

Memory and PC

Aside from anecdotal reports, clinical studies showing the effect of PC on memory are very limited. At this writing, several animal studies but only one human study was found in peer-reviewed medical journals. All the studies show great promise which is why some of these studies will be discussed here.

Many researchers have associated diminished choline concentrations in the brain with dementia.

In one study with laboratory mice, two groups were tested with PC. One group had normal choline concentrations in the brain

and the other group, in which all the mice were showing signs of dementia, had low concentrations. Although the normal animals showed no memory improvement, mentally impaired animals showed dramatic improvement in conjunction with higher levels of choline in three different parts of the brain.[5]

Mice fed a high saturated fat, high glycemic diet were investigated in another study. The diet decreased their exploratory behavior and the presence of choline in the brain. When treated with PC, the animal's exploratory behavior returned to normal levels. These PC treated animals also showed a significant increase of choline in the brain.[6]

In a study with healthy college students, a test group was given a single, oral PC dose of

25 grams. The control group was given a placebo. The students were then tested with a serial learning task at 60 minutes and 90 minutes after ingestion. A slight improvement was observed after 60 minutes and a significant improvement was observed at 90 minutes.[7]

It is hoped that further studies will be conducted in the future.

CHAPTER 9

Optimizing the Power of PC Liposomal Encapsulation Technology (LET)

The Structure of Liposomes

PC liposomes are an integral part of LET. They are the spheres or vesicles which encapsulate the supplement (payload) to be delivered.

Liposomes come in many sizes and structures. The size of a liposome is determined to great extent by the process used to make them. Diameters can range from hundreds of micrometers (one millionth of a meter) to under a

hundred nanometers (one billionth of a meter) or smaller.

The liposomal structures are also largely dependent upon the method of preparation. They can be unilamellar (single layer) bilamellar (double layer) or multilamellar (multi-layer).

Nature teaches that bilayer liposomes provide the best combination of protection and efficiency. Liposomal efficiency (a ratio of payload mass to liposome mass) increases with the size of the liposome which may be a consideration is some LET applications.

In general, however, smaller liposomes are much more able to protect the payload and navigate within the human body than larger ones. In addition, the smaller the liposome, the longer

the shelf life and the greater the stability of the liposomal structure.

Biochemical Makeup of Liposomes

Glycerophospholipids are used to make liposomes. Most LET used for food supplements employs a particular type of glycerophospholipid called phosphatidylcholine which can be extracted from certain animal proteins, egg yoke, soy lecithin or synthesized in a laboratory. For food supplements, the phosphatidylcholine from lecithin seems to be the best.

Liposomal Preparation Processes

There are at least five preparation method types used to prepare liposomes. The only method type of importance here is the

mechanical type. Mechanical methods employ machines or devices to cause the formation of liposomes as opposed to the use of chemical or environmental agents.

Most mechanical preparation processes can be classified into one of three categories: extrusion, sonification and microfluidization. Extrusion forces the liposomal material through a grate (usually a polycarbonate membrane).

Sonification uses sound waves to agitate the liposomal material into a spherical shape.

Microfluidization uses a device called a microfluidizer which forces the material against a forming plate at an extremely high pressure. The impact causes the formation of extremely tiny

vesicles — the smallest liposomes of any other method.

Liposomal Packaging

As with all chemical compounds, liposomes will eventually decompose. Over time, liposomes are subject to oxidation, hydrolysis, and aggregation. To a degree, having a liposomal size under 200 nanometers will provide increased stability and protection.

Table 4: Optimal Conditions for LET

- Size: under 200 nanometers
- Structure: bilayer
- Composition: Phosphatidylcholine
- Source: Egg or soy lecithin
- Storage Temperature: Room temperature or below, above freezing.
- Ingestion: 10 to 15 minutes prior to a meal.

Liposomes should be protected from extremes of temperature. Cool temperatures above freezing are preferred.

In addition, the product should have limited exposure to the atmosphere — meaning hours or days rather than weeks or months.

Optimally, the product should be kept at room temperature or below. At the time of use, it is best consumed 10 to 15 minutes prior to a meal.

CHAPTER 10

Liposomal Vitamin C: A Real Life LET Application

As discussed in Chapters 4-8, there have been numerous studies showing the immense health and longevity benefits of PC — phosphatidylcholine, aka essential phospholipids — as a food supplement all by itself.

The goal of this work, however, is to show the value of PC liposomes as an encapsulation and oral delivery system for other food supplements.

What happens when a food supplement is encapsulated by

PC liposomes? What are the synergistic effects? What are the benefits? To answer these questions it will be extremely useful to look at Vitamin C as an existing LET example.

Vitamin C is the ideal candidate for discussions regarding delivery via LET. It is universally known, its value to human health has been well documented in over 100,000 studies, and its physical qualities, as well as its health implications, make it well suited for liposomal encapsulation and delivery.

What Most People Don't Know About Vitamin C

Although humans and some animals are unable to synthesize Vitamin C — a great number of animals do make this valuable

substance in the liver or the kidneys.

Most mammals with the exception of humans, primates, and guinea pigs synthesize Vitamin C in the liver.

In fact, one of the reasons that guinea pigs and primates have been used in much medical research over the years is due, in part, to their inability to synthesize C. Since Vitamin C is such a powerful agent in neutralizing toxins and killing pathogenic microbes, and since humans do not produce the substance on their own, toxicological and pathological research using animals which do produce C is often rendered invalid.

Goats — well known for their indiscriminate eating habits — normally produce 13,000 mgs of

Vitamin C per day. When exposed to high concentrations of toxic substances and/or pathogens, they have been known to manufacture up to 100,000 milligrams of Vitamin C per day.

Other animals have been observed to dramatically increase their output of Vitamin C to combat similar stresses.

Most Vitamin C researchers believe that at some time in the past, humans were able to synthesize this vital nutrient in the liver. Consider the following two facts:

1. All the enzymes necessary to convert glucose (blood sugar) into Vitamin C are already present in the healthy human liver with the exception of one — gulonolactone oxidase (GLO).

2. The human genome contains the gene that can create GLO.

For some unknown reason, the GLO recipe encoded in the gene never finds expression in the human body. It is generally accepted that most, if not all, humans suffer from this genetic defect.

Some have theorized that if humans could still manufacture Vitamin C, life spans would increase dramatically.

Others have suggested that the genetic defect that prevents the body from producing GLO and therefore Vitamin C occurred at the time of the Biblical flood and explains why life spans decreased so rapidly after the flood.

Still others have suggested that some isolated, long-living

populations of humans do produce GLO and therefore synthesize Vitamin C on their own. The fact that some early mariners were able to avoid the development of scurvy — caused by a lack of Vitamin C — even though they had no dietary source for the Vitamin has been suggested as a possible proof of this theory.

In any event, most Vitamin C researchers would agree that the ability to synthesize this substance in the liver would have profound benefits for health and longevity.

Traditional Forms of Oral Vitamin C Show Low Assimilation Rates

It can be deduced from the scientific data that much of the Vitamin C that people take orally never gets assimilated by their bodies. Here are the facts:

1. No significant difference in blood or tissue concentrations have been observed in people who take 100 mg of oral Vitamin C per day from those who use 2000 mg per day.

2. Vitamin C is a super anti-oxidant. As it neutralizes free-radical oxygen, it becomes oxidized and is thereby neutralized itself. This can take place in the bottle, in the mouth, in the stomach, and in the intestines before it ever gets assimilated.

3. Frequently, those people who supplement with Vitamin C doses above 2,000 mg report gastric distress such as gas, cramps, and diarrhea. This suggests a natural intolerance and reduced uptake of

free floating ascorbic acid in the lower intestines.

4. Doses of Vitamin C injected intravenously produce more blood and tissue saturation than equivalent doses taken orally. This method of Vitamin C supplementation prevents degradation of the nutrient by the ambient environment or the human digestive tract.

This data suggests that only 1/10th to 1/20th of the oral Vitamin C we ingest is actually bio-available due to the perilous mechanisms for its assimilation. It is easy to see that a delivery system that is able to bypass the environmental and biological hindrances to its usability and uptake will dramatically improve its bio-availability and consequently,

health and longevity. LET provides that ability.

LET Vitamin C Increases Usability and Bio-Availability by Several Times

It has been theorized by producers of LET Vitamin C that the optimum delivery system of Vitamin C would be to have non-oxidized Vitamin C disbursed from the liver — where it would have been produced in the first place were humans still producing GLO.

Liposomal Encapsulation Technology provides a perfect way for Vitamin C to get to the liver in an unadulterated state.

PC liposomes protect the Vitamin C from interaction with oral enzymes, digestive juices, bile salts, and other contaminates usually found in the envi-

ronment and in the human digestive system.

Sub-microscopic, PC liposomes easily pass through the small intestine and are transported by the lymphatic system directly to the liver — completely intact and ready to release their untainted contents.

Once in the liver, the PC liposomes are disassembled. As cells in the liver grab the much desired, polyunsaturated phosphatidylcholine, the encapsulated Vitamin C is released.

Preliminary data show that much more Vitamin C gets where it's supposed to go — between 10 to 20 times more. Plus, there have been no reports of diarrhea or gastric distress from anyone. Even those who have taken up to 10,000 mgs of liposomal en-

capsulated Vitamin C at one time have not reported any digestive upset or the increased urination

Table 5: Benefits of Oral LET Vitamin C

- 10 to 20 times more bio-available
- Protection from Vitamin C degrading agents in environment
- Protection from Vitamin C degrading agents in the digestive system
- Targeted delivery to the liver (the most likely source of Vitamin C when humans were able to synthesize it)
- No gastric distress — even from large doses
- No increase in urine output
- No extra load on kidneys because no increase in urine output
- Maximum health and longevity benefits from Vitamin C available from any oral source
- Plus, all the benefits of the phosphatidylcholine used in the liposomes that carry and protect the Vitamin C (see Table 3 on page 33 of this book)

often associated with high intake of oral Vitamin C.

Conclusion

We live in a great historical time. Liposomal Encapsulation Technology is tested, powerful and available today. Those concerned about good health and longevity should seriously consider employing LET supplements in their health regimen.

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