LECITHIN AND PLANT STEROLS
A unique naturopathic combination to holistically support liver and cell health

Lecithin contains a very special mix of phospholipids, including phosphatidyl choline. Phospholipids play an integral role in many areas of health. The principal benefits arising from phosphatidyl choline relate to its unique structure that is essential for supporting membrane integrity of every cell in the body. Phosphatidyl choline is also crucial for regulating and stimulating liver activity as well as balancing fat transport around the body and reducing pathological fatty deposition, especially in the cardiovascular system. Plant sterols also help to naturally balance fat levels, namely cholesterol, within the body.

The structure of our cell membranes is crucial for optimal cell function. This is true for cells throughout the body including in the liver, which is the major hub for many essential biochemical and physiological pathways that play a crucial role in our health. Excess cholesterol is often (incorrectly) blamed for causing heart disease. However the problem really arises when there is excess cholesterol in the cell membranes and deficiency in phospholipids such as phosphatidyl choline, arising through dietary deficiency and poor liver synthesis of these crucial fats. These imbalances in fats in the cell membrane can alter the delicate structure of the lipid bilayer and disrupt cell function. This affects cell function throughout the body including the liver, immune system and brain resulting in many disease processes such as gallstones, fatty liver syndrome, cardiovascular disease, dementia and even cancer.

Naturopathic nutrition programmes support the fat handling processes of the liver and cell membrane structure through careful use of essential phospholipids like phosphatidyl choline found in enriched lecithin powders. The synergistic use of harmonious levels of plant sterols serves to enhance the action of lecithin due to the role these phytonutrients play in naturally blocking the reabsorption of excess waste cholesterol in the digestive tract.

WHAT IS LECITHIN?

Lecithin is a generic term for a group of fatty substances that naturally occur in animal and plant tissue. Lecithin is composed of a mix of phosphoric acid, choline, fatty acids, glycerol, glycolipids, triglycerides and phospholipids such as phosphatidyl choline, phosphatidyl ethanolamine and phosphatidyl inositol. The phospholipids in lecithin, in particular phosphatidyl choline, are of great importance to human health, including supporting fat digestion and absorption in the intestines, fat handling in the body, liver health and cell membrane structure.

In animals, lecithin can be found in blood, bile and brain tissue. Lecithin can also be extracted from sources such as soya beans, egg yolks, milk and sunflower seeds for use as an emulsifier in the food industry and in food supplements. The origin and quality of lecithin used in food supplements is of paramount importance, in particular selecting a non-Genetically Modified (GM) lecithin when derived from a soya bean source.

WHAT IS PHOSPHATIDYL CHOLINE?

Phosphatidyl choline (also known as lecithin – see definitions p2) falls into a class of fatty substances called phospholipids. These can all be viewed as derivatives of triglyceride fats (figure 1). The molecules of fats are made up of one unit of glycerol combined with three units of fatty acids, hence the name triglyceride. In the phospholipids, one of these fatty acid units is replaced by a phosphate group with a nitrogen base attached to it. The effect is to give the substance a dual character. The phosphate-nitrogen base component is readily attracted to water and is referred to as “hydrophilic” or “polar” whilst the fatty acid part tends to be repelled from a watery environment and is referred to as “hydrophobic” or “non-polar”. This structure also gives the molecule a mixed acidic and basic (or alkaline) property. Molecules of this type have interesting and quite far-reaching biological functions and properties such as playing a key role in membrane lipid bilayer structure.

Phospholipids in which the nitrogen base is choline are called phosphatidyl choline or lecithins. These are generally considered to be the most important phospholipids because of the wide reaching effects they have to health, which we will explore in detail in this newsletter. Phospholipids containing ethanolamine (phosphatidyl ethanolamine) or the amino acid serine (phosphatidyl serine) as the nitrogen base are classed as cephalins. Inositides are where the phospholipid contains an inositol moiety. The different phospholipid structures are illustrated and compared to that of the entirely non-polar fats (triglyceride) in Figure 1 (See page 2).
THE STRUCTURES OF PHOSPHATIDYL CHOLINE AND TRIGLYCERIDE

DEFINITIONS

At this stage of the newsletter, it is important for everyone to understand clearly the sometimes confusing modes of use of the terms “phosphatidyl choline” and “lecithin”. To any scientist they mean exactly the same thing. Lecithin is a “trivial” or common name, whereas “phosphatidyl choline” is a technical term, which specifies and describes the chemical structure of the compound (Fig. 1).

However, a completely different mode of use of these terms has arisen amongst the names used by suppliers who sell these nutrient substances. For sales and marketing purposes “lecithin” has come to mean a fairly crude preparation of different phospholipids from the source material, such as the soya bean. Such a crude preparation contains much less true phosphatidyl choline than more concentrated materials, and usually contains more of other kinds of phospholipids and more non-phospholipid substances. Other terms include “cephalin” and “inositides” to describe these substances. These other terms are not considered important in the field of biochemistry, but are used by some as synonyms of phosphatidyl choline.

PHOSPHATIDYL CHOLINE IN THE DIET

Choline is not by strict definition a vitamin but is an essential nutrient to our health. Humans cannot synthesise small amounts of phosphatidyl choline from phosphatidyl ethanolamine. However, research suggests we cannot synthesise enough choline to meet our daily metabolic needs. There are also certain genetic polymorphisms involved in choline metabolism that can increase susceptibility to choline deficiency. This means dietary sources of phosphatidyl choline are essential.

Phosphatidyl choline is found in foods such as milk, egg yolks, liver and peanuts. These fats are not eaten regularly, which may be the case for many who either choose not to consume any animal-derived products as well as for those who choose a diet low in dairy. Stability of oil during processing always remains an issue, with rancidity of an oil product a potential issue. This makes phosphatidyl choline enriched powders an attractive form of lecithin supplement.

Many commercial lecithin products are comprised solely of lecithin in either oil or powder form with widely varying levels of phosphatidyl choline. The most valid and useful comparisons are those between (a) lecithin fluid in soft gelatin capsules (b) regular lecithin powder and (c) phosphatidyl choline enriched lecithin powder. The lecithin found in soft gelatin capsules and regular lecithin powders often comprise around 20%. However some powdered products can contain as little as 1% phosphatidyl choline! The phosphatidyl choline enriched powders increase that content to around 30%. Since it is without question the phosphatidyl choline itself that is the key component of these products, it follows that the relative merits of different lecithin nutritional supplement are in accord with these percentages. One also has to remember that lecithin oil is often encapsulated in bovine gelatin. Stability of oil during processing always remains an issue, with rancidity of an oil product a potential issue. This makes phosphatidyl choline enriched powders an attractive form of lecithin supplement.

We will go on to discuss how the addition of beta-sitosterol, a plant sterol, will afford even more health benefits to supporting liver health and cell membrane integrity and function. This means one would be wise to investigate a phosphatidyl choline enriched lecithin powder containing plant sterols like beta-sitosterol for optimal liver and health benefits.
KEY BIOLOGICAL FUNCTIONS OF PHOSPHATIDYL CHOLINE

CELL MEMBRANE INTEGRITY

The dual hydrophilic / hydrophobic property of phospholipid molecules, including phosphatidyl choline, gives them a special place in the formation of cell membranes throughout the body. This is because the fat-seeking fatty acid ends of the molecules orientate themselves towards the inside of the membrane whilst the water-seeking phosphate base ends orientate themselves outward towards the surrounding watery medium. This arrangement leads to the formation of the cell membrane lipid bilayer at the cell surface. A lipid bilayer is not composed entirely of phospholipid. Other fatty acids such as omega essential fatty acids and cholesterol also play a role in the cell surface structure. Proteins - which are relatively larger molecules – also become embedded in the membrane. They act as communication posts (e.g. receptors) for signals between the extracellular and intracellular environment to be transferred across the cell membrane barrier. Fat-soluble antioxidants, such as vitamin E and astaxanthin, are also closely situated to the cell membrane. They serve to protect the delicate fats and structural proteins from damage by reactive oxygen species or free radicals produced during metabolic processes that occur within the cells every second of every day.10 The nature and layout of these membranes is illustrated in Figure 2.

All cells are profoundly sensitive to any alteration in the integrity of their outer membrane. That is because the cell membrane has such a vital role to perform. Its properties determine just what can and what cannot enter the cell. It is therefore the crucial guardian of the cell’s internal economy and in many cases protects the cell from the entry of substances, which could be harmful. If there is an inadequate supply of phospholipids such as phosphatidyl choline then membrane properties are altered. Increased levels of cholesterol replace phospholipid in the membrane so the fluidity of the membrane becomes depressed and cells become “leaky.” 6 Naturally then, if the cell membrane becomes “leaky” it lets harmful substances in and allows much needed metabolites to diffuse out. This leads to deterioration of the cell structure and function. Of course, such deterioration of cell membranes will be of a general kind, with a wide range of different cellular functions throughout the body being affected. Deterioration of cell membranes means the whole environment inside the cell will become less conducive to maintenance of the cell economy, enzyme reactions will take place under less favourable circumstances and biological transformations will be less efficiently performed. It is very probable that the whole energy-producing system of the cells will become compromised and ATP (adenosine triphosphate - the principal energy currency of the cell) will soon be in short supply. Then the entire cell’s energy consuming reactions will become limited by the deficiency of energy.

One such reaction that will be greatly affected by cell membrane alterations is that involving the sodium pump (see image on the right) – the enzyme at the cell surface which pumps sodium out of the cell and potassium into it. Once this is affected by a relative lack of ATP, then sodium begins to move into the cell and a certain amount of the cellular potassium is lost. The delicate electrolyte balance between the extracellular and intracellular space is upset and the cellular environment then begins to deteriorate further. The intracellular biochemical processes do not function well in a high sodium environment. Sodium brings water into the cell with it, reducing the concentration of intracellular solutes and slowing down crucial enzyme pathways. As this process advances so the cell moves towards a moribund condition and if this is unchecked, then the cell will eventually die. If many others like it also die then discernible areas of necrosis (tissue death) begin to appear in the organ.11 Understanding the crucial role of phospholipids, especially phosphatidyl choline, and cholesterol to membrane structure and integrity paves the way to putting in place naturopathic nutrition programmes to holistically support health. The fate of poor liver cell (hepatocyte) function due to inadequate phosphatidyl choline supply as well as balancing cholesterol with plant sterols will be discussed in later sections of this newsletter.

LIVER FUNCTION

Phosphatidyl choline is well known for its stimulation of liver activity.12 This organ is very much concerned in fat handling. Research has shown that, through profoundly influencing the properties of the membranes of the liver cells (hepatocytes), phosphatidyl choline affects many subtle cellular control mechanisms within the liver, including both hormonal and immune responses.13 Through these mechanisms, adverse liver changes, which arise either from infection, from adverse lifestyle, or from modern environmental effects, can be reversed.

METABOLIC FUNCTIONS OF THE LIVER

Hepatocytes are primarily responsible for the principal metabolic actions of the liver.10 They make up the greater part of the cell mass within this organ. Their metabolic functions are very numerous and diverse and are fundamental to the viability of the body as a whole. These special cells could be viewed as the metabolic super-achievers in the body! Complete loss of liver function by reason of disease, such as in very advanced cirrhosis of the liver, is nearly always fatal. The liver is often spoken of as being a major “biochemical factory” within the body. It has a most complex and essential role in processing, handling and transforming nutrients and fabricating from them special substances for use elsewhere in the body. The wide range of liver functions (some of which are outlined in the table on the next page) shows just why poor or blocked liver function impacts so greatly on our health.
THE MANY FUNCTIONS OF OUR LIVER

CARBOHYDRATE METABOLISM
- Glucose uptake and glycogen synthesis (glycogenesis) to reduce blood sugar
- Splitting of glycogen, secretion of glucose into the blood (glycogenolysis) to increase blood sugar
- Formation of glucose from protein (gluconeogenesis) to increase energy when glycogen reserves are depleted

FAT METABOLISM
- Fatty acid and triglyceride synthesis from excess carbohydrate and proteins (these fats are stored in adipose tissue)
- Esterification and oxidation of fatty acids to produce energy
- Production of ketone bodies
- Production of fatty acid binding proteins (lipoproteins)
- Synthesis of cholesterol and phospholipids that are either packaged with lipoproteins or excreted in bile

PROTEIN METABOLISM
- Removal of ammonia by synthesis of urea and glutamine
- Synthesis of non-essential amino acids
- Synthesis of plasma proteins such as albumin and clotting factor thrombin
- Production of blood transport proteins for minerals, vitamins and hormones

DETOKIFICATION AND ELIMINATIONS
- Detoxification of drugs and environmental toxins
- Secretion of bile acids and bile pigments into the bile
- Storage and release of vitamins and minerals
- Kupffer Cells clear the blood coming from the intestines of infectious agents (bacteria and viruses) and of other antigens which otherwise would invoke immune responses and induce allergies

PHOSPHATIDYL CHOLINE ENHANCES LIVER FUNCTION

CONSIDERING THE PREVIOUS DISCUSSION ABOUT THE ROLE OF PHOSPHOLIPIDS LIKE PHOSPHATIDYL CHOLINE IN THE CELL MEMBRANE, IT WILL CAUSE NO SURPRISE THAT MEMBRANE EFFECTS ARE THOUGHT TO BE AT THE VERY ROOT OF PHOSPHATIDYL CHOLINE’S EFFECTS UPON THE LIVER CELLS.

An important theory about how phosphatidyl choline improves the general condition of the liver is that it works by improving the functional integrity of the hepatocyte membrane. If there is an inadequate supply of phospholipids such as phosphatidyl choline then membrane properties are altered. Phospholipid in the membrane is replaced by cholesterol and the fluidity of the membrane is depressed.

All these adverse changes and losses of viable cells obviously will detract enormously from the liver’s functions, resulting in blockages and a state of liver hypofunction. When the detoxification functions of the liver are significantly affected, toxins must inevitably build up in the organ, causing more cell damage and cell death. The list in the blue box above outlines the many functions of our liver and the importance of healthy hepatocytes.

One of the cell functions that start to fail under these conditions is the synthesis of new phospholipids. The liver has to produce a lot of phospholipids to carry out its functions connected with the processing of fats. Liver phospholipids are also required to produce bile, which aids digestion of fat in the digestive tract. In some ways this will sound like a contradiction because one is saying that the liver needs phospholipid in order to synthesize phospholipid, but this is actually the case. The liver has to produce its own phospholipids to its own particular specifications. The dietary phospholipid - even the phosphatidyl choline - is not precisely in the form the liver needs, and the liver cell must transform it. However, the dietary phospholipid, or phosphatidyl choline supplements, contains all the building blocks which the liver requires in order to do this.

The key component which cannot be supplied sufficiently in other ways is choline - a nitrogen base containing three active methyl groups in each molecule. The body can make some choline from the amino acid methionine, but methionine is rarely greatly in excess in the diet. Therefore, without sufficient choline in the diet, preferably in the form of phosphatidyl choline, the hepatocyte membrane deteriorates, as has been described, the cell itself deteriorates and metabolic energy becomes relatively unavailable. Bereth of both raw materials and energy, the hepatocytes can no longer carry out their many crucial functions, including making anything like enough phospholipid for the bile. Low bile levels, as we shall see below, is a triggering factor for poor digestion of fats and contributes to the generation of gallstones.
FAT TRANSPORT INTO AND AROUND THE BODY

Phospholipids, such as phosphatidyl choline, have a major importance in connection with the transportation of fats both into and within the body. Hence how phosphatidyl choline supports the ability of the liver to handle incoming fats from the intestine.

To start with, endogenous lecithin (i.e. phospholipids such as phosphatidyl choline) in the bile, synthesised in the liver, plays an important role in absorption of dietary fats through the intestines. Fats are insoluble in water and therefore require special digestive processes to break them down ready for absorption. This is achieved by the secretion of bile from the gallbladder. Bile is comprised mainly of bile salts, as well as lecithin and cholesterol. In fact bile is also an important route of elimination of excess cholesterol by the liver.

Bile liquid is synthesised in the liver using phosphatidyl choline and other phospholipids, stored in the gallbladder then released into the small intestines via hormone signals triggered when we start to eat. The lecithin in bile helps break fats into smaller fat globules called micelles by the process of emulsification. Micelle formation creates a larger surface area for the fat digesting lipase enzyme, which is secreted by the pancreas in pancreatic juices during digestion, to break the fats down further ready for absorption across the gut barrier. Digested fats are converted into chylomicrons within the intestinal epithelial cells, which are then absorbed into the lacteal system and eventually into the blood stream and to the liver via the hepatic portal vein. Fats are required for many functions throughout the body including provision of energy sources and metabolism of fat-soluble vitamins like vitamin A, D, E and K. This means without a ready supply of phosphatidyl choline, the liver would struggle to produce adequate levels of bile, severely compromising fat digestion and greatly impacting on health.

The presence of phosphatidyl choline within the body also avoids the pathological fatty depositions collecting around the body, including arterial walls. Phosphatidyl choline is an important element of the lipoproteins that transport cholesterol around the body. Whilst there is emerging evidence to suggest that cholesterol is not the sole contributory risk factor to cardiovascular disease, as the general public is led to believe, regulation of cholesterol levels throughout the body is necessary for optimal health. Adequate intake of phosphatidyl choline and plant sterols (see p8) can help to achieve this.

THE ROLE OF CHOLESTEROL IN OUR HEALTH

ONE OF THE FAT METABOLISING ROLES OF THE LIVER IS TO REGULATE THE LEVELS OF CHOLESTEROL IN OUR BODIES.

Our bodies produce up to 1g cholesterol each day for synthesis of hormones, such as oestrogen and testosterone, and bile acids. We also absorb a little cholesterol from the food we eat (around 0.3g each day) but the liver produces the majority of the cholesterol in our bodies. Cholesterol that the body does not need is broken down by the liver and transported in bile into the gallbladder and then released into the small intestines for elimination via the faeces. At this stage some cholesterol may be reabsorbed back into the blood stream and to the liver via the enterohaepatic circulation. Of course, it is more desirable for excess cholesterol to be eliminated via the gut, as it has been oxidised and is essentially a waste product that the body does not need. Some waste cholesterol is also digested by beneficial gut bacteria in the colon.

Over the past few years cholesterol has had a bad press. High cholesterol was believed to be a causative factor of cardiovascular disease including heart attacks and strokes. However, research has also shown a direct link between high cholesterol and heart disease. As we’ve discussed, regulated levels of cholesterol are actually important for several areas of our health including cell membrane structure and absorption of fat soluble vitamins like vitamins A, D, E and K as well as hormone synthesis. It’s for this reason that drugs that suppress levels of cholesterol, known as statins, are now being linked to side effects such as depression and poor memory as the brain cells are literally “starved” of the cholesterol they need for structure and function.

More recent research now shows that increasing the risk of developing cardiovascular disease is more complicated than just having high cholesterol. In fact, in the short-term high cholesterol might be part of the body’s natural protection mechanism against cardiovascular disease processes. That is to say that more cholesterol is produced in the body to “plug” damage to vascular cells walls that occurs in some types of cardiovascular disease like artherosclerosis and vascular strokes (i.e. plaque formation). It’s also becoming clear that high levels of homocysteine and inflammation within the body, associated with conditions such as obesity and diabetes, also contribute to cardiovascular disease.

So high cholesterol may not be the sole risk factor or cause of cardiovascular disease. However we have to consider that long-term high cholesterol levels in the body are not desirable for the health of our cells. Too much cholesterol in the cell membrane, at the expense of phospholipids such as phosphatidyl choline, leads to rigidity and inflexibility of the lipid bilayer structure. A fundamental biological maxim is that the structure of a cell suberves its function so high levels of cholesterol in the cell membrane will eventually impact on cell function. It is for this reason that cholesterol levels need to remain tightly regulated within the body.

So why does the body sometimes produce more cholesterol than is needed? There are two major reasons: 1. The liver produces more cholesterol when we are under stress such as during illness or poor diet and/or lifestyle choices. This makes sense because remember that cholesterol is required for synthesis of stress hormones. 2. Deficiency of phosphatidyl choline and other phospholipids leads to abnormal cholesterol deposition in cell membrane lipid bilayer.

The aim of a naturopathic nutrition programme is to restore the structure and therefore optimise function of the cell. In order to do this the levels of phospholipids and fats like cholesterol in the cell membrane need to be rebalanced. One approach is to supply phosphatidyl choline, maybe in the form of lecithin powder, to support liver synthesis of phospholipids and fat handling. Of course, by supplying luxury levels of phosphatidyl choline one could theorise that excess cholesterol is released from the cell membrane. We do not want to lower cholesterol through blocking production, such as by using statins, but rather gently support liver fat handling processes and ensure excess waste cholesterol is efficiently eliminated from the body. Bile, and therefore phosphatidyl choline (lecithin), is required for eliminating excess cholesterol. Plant sterols, which occur naturally in diets rich in vegetables and other plant matter can also be found in supplements, can be used to ensure excess cholesterol in the bile is eliminated from the gut. We will discuss plant sterols and naturopathic nutrition programmes in later sections of this newsletter.
HEALTH BENEFITS OF PHOSPHATIDYL CHOLINE (LECITHIN)

PHOSPHATIDYL CHOLINE AND PHOSPHATIDYL CHOLINE ENRICHED POWDERED FORMS OF LECITHIN ARE ESSENTIAL TO SUPPORT MANY AREAS OF HEALTH.

LIVER CONDITIONS

GALLSTONES

Factors affecting the composition of bile are known to be a trigger for transforming the cholesterol content of bile into gallstones. This is why it has long been said - with every reason - by Alternative Medicine Practitioners - that cholecystectomy (i.e. removal of the gallbladder) is no cure for the problem which caused the gallstones to be formed. Transformation of cholesterol into stones suggests that bile of inadequate quality has been synthesised and secreted by the liver. This makes gallstones a liver problem not a gallbladder problem. Cholesterol precipitates if the bile is too low in either bile salts (glycocholate and taurocholate) or in phospholipids, or both. We have provided plenty of evidence that hepatocytes compromised by lack of dietary phosphatidyl choline or other factors will tend to produce insufficient phospholipid in the bile. They may well also produce insufficient bile salts, since these must either be synthesised by the hepatocytes or else recovered from the hepatic portal blood stream for re-use. Either function requires actively metabolising hepatocytes. A ready supply of phosphatidyl choline may help support gallbladder health through optimising liver function.21

FATTY LIVER AND CIRRHOSIS

Fatty Liver is a condition in which triglyceride fat droplets accumulate in the hepatocytes, sometimes to massive proportions in relation to cell size, and it becomes clear from microscopic examination of the tissue that the normal functions of the cells must be greatly compromised, and the organ performs poorly in tests of liver function. Markers for liver damage are raised in the blood.

This condition of steatohepatitis (“steato”-meaning fat and “hepatitis” meaning inflammation of the liver) has long been known to be associated with exposure to hepatotoxins e.g. chlorohydrocarbons, or to alcohol.22,23,24 However, people who do not drink alcohol may also develop fatty livers, defined as Non-Alcoholic Fatty Liver Syndrome (NAFLS) or Non-Alcoholic Steatohepatitis (NASH). This is commonly seen in people with diabetes and obesity and if left unchecked may develop into cirrhosis (or scarring) of the liver with permanent damage to the hepatocytes. Unfortunately the symptoms of NASH may well be minor and up to 20% of adults with this condition remain undiagnosed.

It has long been known that substances that are donors of active methyl groups, such as choline and methionine, have a protective action in the liver.21 The likely sequence of events here is that damage or disadvantage to the hepatocyte, for whatever reason, such as toxicity or nutrient deficiency (e.g. choline), interferes with the economy of the cell, decreasing the synthesis of phospholipids such as phosphatidyl choline. These phospholipids are very much required for handling and transport of fat, leaving the hepatocytes unable to export the fat onward in the bloodstream to other sites for oxidation or storage. Several papers show that feeding a choline-deficient diet results in a rise in the fat content of the liver.26 The very serious condition of cirrhosis seems to be an advanced stage of this condition when much hepatocyte death has occurred followed by replacement with fibrous tissue. When scanned, the liver appears full of visible scar tissue.

Studies show that dietary choline deficiency leads to accumulation of fat in the liver. These effects occur quickly, around 2 days after withdrawal of choline from the diet. Clinical observations suggest that lecithin (phosphatidyl choline) helps improve the problems of liver dysfunction by preventing this accumulation of fat in the liver.22 Lecithin also enhances both the absorption and utilisation of Vitamin A and carotene and increases the blood level and storage of the former.

HEPATITIS - ACUTE AND CHRONIC

Hepatitis is defined as inflammation of the liver with symptoms such as jaundice, flu-like symptoms and malaise. Hepatitis can be acute when it lasts for less than 6 months or chronic when it persists for longer. Most cases of hepatitis worldwide occur as a result of a group of viruses (e.g. hepatitis A and C). However, toxic substances, most notably alcohol, certain medications, some industrial organic solvents and certain plants, as well as infection and autoimmune disease can all cause inflammation of the liver.

There is a dearth of effective orthodox treatment for viral hepatitis, so it is fortunate that most cases (about 90%) recover without medication. However, there are dangers of the condition leading to a carrier state, chronic hepatitis, cirrhosis or even liver carcinoma. There is good reason to expect phosphatidyl choline (lecithin) to protect against viral hepatitis, both by its effect in maintaining the hepatocytes in good condition, as discussed above, but also by the immunosupportive effects discussed in the next section.24,25

DIET AND FAITTY LIVER

TRIGLYCERIDE FATS IN THE LIVER ARE MADE IN RESPONSE TO HIGH INTAKE OF CARBOHYDRATES IN THE DIET.

After liver synthesis, triglyceride fats are then packaged and transported in the blood to adipose tissue. Dietary carbohydrate also stimulates the releases of the hormone insulin, which lowers the levels of sugar in the blood. However insulin also increases absorption of fat uptake by cells. Refined carbohydrate foods (i.e. foods high in sugar and starch) stimulate the release of insulin, which not only balances levels of blood sugar but also increases absorption of fat uptake by cells. In short, carbohydrate can stimulate the production of fat in the liver as well as increasing the chance of accumulating fat elsewhere in the body.20

This means that continually eating a diet high in refined carbohydrates leads to the liver producing more fat than it can handle resulting in fat accumulation and NASH or NAFLS. In fact a 4 week study showed that a group of men and women eating two fast food meals each day for just 4 weeks put on average 6.5kg weight, especially around the waist (believed to be the more dangerous metabolically active fat tissue).

The study was more than just appearances as liver enzyme levels that mark liver damage increased 4 fold and the fat in liver cells increased by over 150% - no mean feat for just 4 weeks of eating a poor diet.21 This suggests that approaches to reduce fatty liver should include a low refined carbohydrate diet rich in alkalisng foods such as vegetables. A daily supply of phosphatidyl choline enriched lecithin may also help to support liver function and fat handling.
IMMUNE-SUPPORTIVE EFFECTS

Lecithin has been shown to stimulate resistance to infection by increasing supplies of gamma globulin in the blood stream, helping to build immunity against infectious bacteria.24

Although the immune response, together with the production of antibodies, is a function of the immune system, which is mostly located within the intestines rather than within the liver, it is clear that the normal liver plays a major role in this process through its synthesis of phospholipids and plasma proteins. In liver damage, reduced phospholipid synthesis occurs as discussed above, and this reduces the amount of these fatty acids available to the lymphocytes and macrophages. The result is increased accumulation of cholesterol in the immune cells. Therefore in the case of immune functions generally, one is looking at a primarily non-hepatic function, which is nonetheless much influenced by the well being of the liver. However, chronic hepatitis is a condition of the liver itself which is characterised by immune disorder.

COGNITIVE FUNCTION

MEMORY

The choline-containing phospholipid, along with sphingomyelin, are precursors for certain signaling pathways within cells of the nervous system. Metabolites of phosphatidyl choline (platelet activating factor and sphingophosphorylcholine) are also cell-signalling molecules.

Choline from phosphatidyl choline is also a precursor for acetylcholine, an important neurotransmitter involved in muscle control, memory and many other functions. Studies have shown that increased dietary intake of phosphatidyl choline very early in life can diminish the severity of memory deficits in aged rats. Choline supplementation of the mothers of unborn rats, as well as rat pups during the first month of life, leads to improved performance in spatial memory tests months after supplementation has been discontinued.29 There are suggestions that the availability of phosphatidyl choline during prenatal development may affect cognitive function in the offspring. More research is needed to determine the role of phosphatidyl choline in the developing brain.33

DEMENTIA (ALZHEIMER’S DISEASE)

Alzheimer’s disease has been associated with a deficit of the neurotransmitter, acetylcholine, in the brain.32 One possible cause for the acetylcholine deficit is a decrease in the expression of an enzyme that converts choline into acetylcholine in the brain. Large doses of lecithin (phosphatidylcholine) have been used to treat patients with dementia associated with Alzheimer’s disease in hope of raising the amount of acetylcholine available in the brain.32-34,35,36,37

CANCER

Udo Erasmus in his book “Fats that Heal, Fats that Kill” says “Poor liver function is a common forerunner of cancer. According to some healers, cancer always involves the liver. Deficiency of either choline or EFAs (Essential Fatty Acids) can induce cancer in experimental animals, and is likely involved in causing some human cancers.”

It seems that deteriorating cellular condition - with loss of active metabolism and a susceptibility, therefore, to toxin accumulation - always does predispose to cancerous change due to the relative inability of the compromised cell to protect and repair its own DNA.

Studies show that animals fed diets low in choline and methionine experience enhanced development of cancer of the liver, pancreas and, to a lesser extent, the colon. Such studies indicate that methyl group deficiency in rats and mice results in malignant liver cell tumour.34

One could therefore consider the presence of hepatotoxins and liver cell necrosis to be precancerous conditions.35 This lends support to the idea that generalised deterioration of liver cell condition predisposes to a cancerous transformation. This may well be the way that phosphatidyl choline works in discouraging the formation of cancers, but it is also possible that another mechanism involving the active methyl groups of choline are, in fact, decisive in protecting the cellular DNA.40,41

CARDIOVASCULAR DISEASE

As we discussed in a previous section, high cholesterol is not necessarily the cause of cardiovascular disease.42 A large body of research now indicates that even moderately elevated levels of homocysteine in the blood increases the risk of cardiovascular diseases. Homocysteine seems to damage arteries by changing the ratio of collagen to elastin in the blood vessel walls. This may well explain why elevated homocysteine levels have been linked to vascular dementia and stroke.43

Homocysteine needs to be converted in the body to SAMe and glutathione, both of which are fundamental to good health. Homocysteine metabolism is aided by phosphatidyl choline in which it is oxidised to form betaine which, along with vitamins B6, B12 and folic acid, helps convert homocysteine to methionine by the enzyme, betaine-homocysteine methyltransferase (BHMT).43,45

Despite its relevance, the relationship of betaine and phosphatidyl choline to homocysteine metabolism has been only lightly investigated in humans. In preliminary studies, pharmacological doses of betaine (1.7 to 6 grams/day) were found to reduce blood levels of homocysteine in a small number of patients with vascular disease and elevated homocysteine levels.46 Additionally, a small study in 26 healthy men reported that phosphatidyl choline supplementation decreased plasma homocysteine concentrations. However, a prospective cohort study in 14,430 middle-aged men and women participating in the Atherosclerosis Risk in Communities study found that dietary choline or dietary choline and dietary betaine, together, was not associated with reducing coronary heart disease.47 This does not mean to say that phosphatidyl choline is not of use in heart health, rather that it is almost impossible to control all the variables (such as diet and lifestyles) in such large human population studies therefore it can be very difficult to draw conclusions between specific nutrients and their impact on health. For more information on homocysteine and cardiovascular diseases, see the Nutrigold newsletter on Cardiovascular Health.

STOMACH ULCERS

We have discussed the importance of phospholipids, including phosphatidyl choline, to digestive processes such as fat digestion because of their presence in bile. However, phosphatidyl choline also plays an important role in structure of the mucosal lining (the barrier between the contents of the gut and our blood stream) especially in the upper part of the digestive tract.48 This places phosphatidyl choline as an important nutrient for many aspects of digestive function.

One study used a twice daily dose of 450mg phosphatidyl choline enriched lecithin to reduce the damage caused by non-steroidal anti-inflammatory drugs (NSAIDs) such as aspirin to the stomach and upper intestine lining. They hypothesised that phosphatidyl choline would also protect against similar damage caused by alcohol and other drugs.49,50 Aspirin and other NSAIDs are very common pain-relieving medications but can cause untold damage to the delicate lining of the stomach resulting in ulcer and gastric bleeding.51,52,53 In fact over 12,000 emergency admissions and over 2,000 people diet every year in the UK due to NSAID-associated gastric ulcers. There are many reasons to consider natural and safe alternatives to NSAIDs, not least because of the increased risk of many serious side effects such as gastric bleeding and stroke.51,52,53,54,55 This means one could supplement phosphatidyl choline to repair structural damage to the gastrointestinal lining alongside using natural and safe pain-relieving alternatives like hop alpha acids.56 A qualified nutrition practitioner will be able to offer advice for suitable programmes (www.fntp.org.uk).
PLANT STEROLS

WHAT ARE PLANT STEROLS?

Plant sterols, or phytosterols, are naturally occurring plant molecules that have a very similar structure to cholesterol. It’s for this reason that plant sterols have had so much press in recent years as they have been found to have blood cholesterol lowering properties. However, unlike cholesterol, the body does not synthesise plant sterols so these natural compounds are derived solely from the diet.

Plant sterols are found in plant cells. They contribute to the regulation of the fluidity and permeability of plant cell membranes, are substrates for the synthesis of numerous secondary plant metabolites and act as precursors of compounds involved in growth. More than 200 plant sterols have been identified but many of these are only present in tiny amounts in the foods that we eat.

PLANT STEROLS IN THE DIET

The most commonly occurring plant sterols in the human diet include beta-sitosterol (65%), campesterol (30%) and stigmasterol (3%). They naturally occur in many vegetable oils, nuts and seeds, grains, and in lower amounts in vegetables, fruits and legumes. Since sterols have powerful cholesterol lowering properties, in recent years they have been added to foods like margarine spreads and yoghurt drinks. These "functional" foods are then marketed as being able to lower cholesterol.

SAFETY OF PLANT STEROLS

Due to their cholesterol lowering properties, plant sterols have been added into many “functional” foods. In fact this area of functional foods is one of the fastest growing and most lucrative areas of the food market. This is most likely due to a (rare) approved European Food Safety Authority (EFSA) authorised claim that allows food manufacturers to state that “plant sterols contribute to the maintenance of normal blood cholesterol levels” with a “daily intake of at least 0.8g of plant sterols”.

However, one has to consider the levels and quality of plant sterols that are added into functional foods like margarine spreads. We naturally consume around 200-400mg/day plant sterols. Some vegetarian diets may even reach levels of around 700mg/day. However, the amount of plant sterols that is recommended on a daily basis in foods that are marketed as lowering cholesterol is upwards of 2.4mg/day and people may eat more than this as portion sizes of these foods are often underestimated. This could mean that people who consume these foods may be eating over twelve times more plant sterols on a daily basis than are naturally found within the diet. Even though the absorption rate of plant sterols through the gut is low (0.4-0.5%) eating very high levels of plant sterols may not be suitable for everyone, especially for those with a genetic mutation that causes increased absorption of plant sterols (sitosterolemia) resulting in higher than normal serum levels of plant sterols. Recent research now suggests that it may be better far to consume plant sterols in levels that are found more naturally within the diet (e.g. 1-2g/day).

We also have to remember that these functional foods are not natural forms of oils or yoghurts even though they may be marketed as containing “natural” ingredients like plant sterols. These food products may also contain added sugar or artificial sweeteners, preservatives and additives that place a strain on the digestive system and liver. The quality of oils in the diet is also of utmost importance to maintain health. Oils should always be cold-pressed and not solvent extracted or chemically converted into solid states at room temperatures, such as margarines based on vegetable oils. This type of chemical processing of oils can result in the formation of harmful trans fats. It’s worth knowing that manufacturers can declare their product to contain 0% trans fats if the levels are less than 0.5g trans fats per serving. Suggested servings of some spreads can be over 10g with 2.3 servings recommended on a daily basis for cholesterol lowering benefits. This means you could end up eating over 1g trans fats and poor quality oils on a daily basis if including cholesterol lowering functional foods in your diet. Trans fats are toxic and place a great strain on the liver function and general health.

One has to conclude that the health benefits derived from plant sterols, of which there are many, are best achieved through combination of natural dietary plant sterol sources and balanced levels of plant sterol supplementation, not in the form of chemically altered, industrially processed foods. This balanced approach is advocated in naturopathic nutrition programmes.

Combining phosphatidyl choline enriched lecithin and plant sterols provides a novel approach to supporting liver function and fat handling in the body.
HEALTH BENEFITS OF PLANT STEROLS

FAT HANDLING

BALANCING CHOLESTEROL LEVELS

The structure of plant sterols means that when they are ingested they latch onto cholesterol receptors in the small intestine but are not absorbed. Absorption of plant sterols across the gastrointestinal tract is estimated to only be around 0.4-0.5%. Plant sterols, including beta-sitosterol, therefore blocks the reabsorption of waste cholesterol from the bile that is destined for elimination via the gut and also prevents absorption of some of the cholesterol that’s present in the foods that we eat. In fact, several studies have shown the reduction of blood cholesterol by beta-sitosterol, and other plant sterols.

As we have already discussed, balancing blood cholesterol levels is not necessarily the way to prevent cardiovascular disease. However, regulating cholesterol levels within the body through diet and plant sterols, such as beta-sitosterol, has many subtle and far-reaching implications on health through supporting cell membrane integrity and liver function.

BALANCING TRIGLYCERIDE LEVELS

Plant sterols reduce blood triglyceride levels, which are raised in NASH (see Fatty Liver and Cirrhosis on p.6) and may also be a risk factor for atherosclerosis. This automatically places plant sterols in a strong position for supporting fat handling processes in the liver.

ANTI-INFLAMMATORY

Plant sterols have been shown to reduce inflammatory compound activity such as tumour necrosis factor (TNF) and nuclear factor kappa B (NF-κB). Anti-inflammatory diets are plentiful in sources of plant sterols including cold-pressed oils and nuts.

STOMACH ULCERS

Recent research suggests that it is not just phosphatidyl choline that may play an important role in protecting the lining of the stomach and upper digestive tract from ulcers. This damage can be caused by common factors such as alcohol and certain medications, e.g. aspirin and other NSAIDs. One study has shown that plant sterols, rich in beta-sitosterol, may support the lining of the stomach and upper digestive tract, possibly in part through anti-inflammatory actions. However this effect has only been demonstrated in rats. We do not support animal testing but from previous studies identifying a reduced risk of peptic ulcers in diets rich in vegetables and plant matter one could begin to see the use of ensuring a plentiful intake of plant sterols for supporting gastric health. A combination of plant sterols and phosphatidyl choline would have a potentially even greater supportive effect on the structure of the digestive tract.

MALE PATTERN BALDNESS

A contributory factor in male pattern baldness is the disorder of conversion of testosterone to dihydrotestosterone (DHT) via the enzyme 5-alpha reductase (5AR). This metabolism is also key to the onset and progression of benign prostatic hyperplasia (BPH). The study tested different botanical 5AR inhibitors and found that there was a positive effect on reducing male hair loss using beta-sitosterol in combination with Saw Palmetto.

CANCER

Experiments have shown that plant sterols have positive effects that directly inhibit tumour growth, including the slowing of tumour progression through preventing lipoprotein oxidation, the induction of tumour cell apoptosis and the inhibition of tumour cell metastasis, suggesting that these compounds have anticancer properties.

In Europe, beta-sitosterol is used in herbal therapy, especially for benign prostatic hyperplasia. In fact one study highlights the benefits of using nutrition and supplements to modify the pathogenesis of benign prostatic hyperplasia BPH symptomology in men suffering from lower urinary tract symptoms. Their findings showed that dietary patterns associated with increased risk of BPH included starches and red meats, whereas polyunsaturated fat and vegetable consumption decreased risks. Dietary supplements of zinc as well as beta-sitosterol were also used to reduce symptoms and pathogenesis of BPH.
SYNERGISTIC ACTIONS OF LECITHIN (PHOSPHATIDYL CHOLINE) AND PLANT STEROLS

SUPPORTING FAT HANDLING AND LIVER FUNCTION HAS A PROFOUNDED EFFECT ON PHYSIOLOGICAL AND BIOCHEMICAL FUNCTIONS IN THE BODY. COMBINING THE POWER OF LECITHIN (PHOSPHATIDYL CHOLINE) AND PLANT STEROLS WILL ONLY SERVE TO OPTIMISE HEALTH AT A VERY DEEP LEVEL.

LECITHIN (PHOSPHATIDYL CHOLINE) AND PLANT STEROL SUPPLEMENTS

We have seen how effective phosphatidyl choline is in supporting membrane structure and liver function as well as lecithin being a vital part for efficient digestion of fats in the intestines.

However, one can go a step further in supporting metabolism by combining phosphatidyl choline with natural plant sterols. We have discussed the importance of ensuring excess waste cholesterol is efficiently eliminated from the body via the gut. This can be achieved by the use of plant sterols such as beta-sitosterol, which help to regulate cholesterol levels thus supporting optimum cellular membrane structure and function. So combining these two powerful nutrients provides a novel approach to supporting optimum liver function and fat handling in conjunction with dietary and lifestyle changes in a holistic naturopathic programme.

FORMULATION

Powdered phosphatidyl choline supplements (both as phosphatidyl choline and phosphatidyl choline enriched lecithin powder) can be recommended over liquid forms or capsules containing liquid on the grounds of concentration of active components. The liquid forms are dissolved in oil, which diminish the concentration. Many oils are encapsulated in gelatin, often from bovine origin, making these types of lecithin supplement unsuitable for many people including vegetarians, vegans and those who wish to avoid gelatin.

It’s for this reason that a powdered form of phosphatidyl choline enriched lecithin is easier for many people to incorporate into their daily diet (see recipes below). Lecithin and beta-sitosterol are both suitable for vegetarians and vegans. The lecithin powder should be from a non-GM soya source for benefits to health and the planet. A powdered lecithin also allows for the addition of other special health promoting nutrients like plant sterols.

RECOMMENDED USAGE

As we have discussed in detail throughout this newsletter, phosphatidyl choline and plant sterols are important nutrients for supporting our health, particularly that of our cells and liver. Why not try our delicious recipes on page 11 which include phosphatidyl choline enriched lecithin with natural levels of plant sterols including beta-sitosterol? Your liver will thank you for it!

SUPPORITIVE SUPPLEMENTS

GUT BACTERIA SUPPLEMENTS

Certain gut bacteria in the colon also help digest and eliminate excess waste cholesterol. Enhancing levels of beneficial gut bacteria may therefore also support the actions of plant sterols in balancing cholesterol levels. A suitable dietary approach to supporting beneficial gut bacteria could include building up daily vegetable intake, balancing levels of grains and proteins and avoiding sugary foods. One could also include small amounts of fermented foods such as sauerkraut, tempeh and miso. A daily supplement containing scientifically proven strains of probiotic gut bacteria could also be taken to support levels.

DIGESTIVE ENZYMES

Fat digestion requires the presence of not only lecithin but also the digestive enzyme lipase. Digestive enzyme levels can be reduced during times of illness, advancing age and also poor diet. A premium quality broad-spectrum plant enzyme formulation taken before a meal can help to support efficient fat digestion.

NUTRIGOLD WEBINARS ON LIVER AND GALLBLADDER HEALTH, USES OF LECITHIN AND PLANT STEROLS, MENTAL HEALTH AND CARDIOVASCULAR HEALTH ARE AVAILABLE AT UPDATES. NUTRIGOLD.CO.UK
ENERGY BOOST BREAKFAST

BASIC INGREDIENTS:
- ½ cup organic jumbo oats
- 2 tbsp mixed seeds (e.g. sunflower and pumpkin seeds)
- 1 tbsp ground organic flaxseeds
- 1 sliced pear or 2 tbsp stewed apples
- 1 tsp powdered phosphatidyl choline enriched lecithin powder with added plant sterols

METHOD:
Mix seeds and jumbo oats together in a bowl and soak in filtered water overnight. Make sure water level is covering all the ingredients. In the morning stir in 1 tsp powdered phosphatidyl choline enriched lecithin powder with added plant sterols and a little more water to loosen the ingredients. Add a sliced pear or 1 tbsp stewed apples to taste.

**NB.** You can prepare batches of freshly ground whole organic flaxseeds with a hand or coffee blender. Store in a jam jar with fitted lid in the fridge. Use within 1 week to stop the oils from degrading.

SUPER CHARGED DAILY SMOOTHIE

BASIC INGREDIENTS:
- 10g brazil nuts
- 10g almonds
- 10g sunflower seeds
- ⅛-¼ avocado
- 2 tbsp mixed berries (fresh or frozen – defrosted before use)
- 1 tsp powdered phosphatidyl choline enriched lecithin powder with added plant sterols
- ½-1 pint good quality filtered water

METHOD:
Blend all the ingredients together in a smoothie maker or with a handheld blender, gradually adding water until the consistency is like a thick milkshake.

YOU COULD ALSO ADD:
- 1-2 tsp raw (unpasteurised) honey
- Grated zest of ½-1 lemon
- 10 p size of fresh root ginger

RAW ENERGY BARS

BASIC INGREDIENTS:
- 1 cup organic rolled or raw oats
- 1 cup organic dates
- ½ cup mixed seeds (e.g. sunflower, pumpkin, flaxseeds, sesame seeds)
- ½ cup organic almonds
- 4 tsp powdered phosphatidyl choline enriched lecithin powder with added plant sterols

METHOD:
- Place all the ingredients except the dates in a food processor and whizz until ground into small but still chunky pieces.
- Add the dates and whizz again to combine all the ingredients.
- Turn out the mixture onto the work surface and bring together into a ball.
- Flatten to about 1 inch thickness and use a knife or square cookie cutter to shape pieces. You can also roll them into little truffle balls.
- Bars can be eaten immediately or store in the fridge.
- Eat within 3-4 days but they won’t last that long!

YOU COULD ALSO ADD TO THE MIX:
- 1 tbsp raw organic cocoa powder
- 1 tsp organic ground cinnamon
- 2 tbsp concentrated greens powder
Alternatively if you would like a more personalised approach, addressing dietary recommendations, lifestyle changes etc., we would suggest you consider consulting a qualified nutritionist or therapist, which you can do by either asking us for details of your local practitioners, or contacting The Federation of Nutritional Therapists on 0870 312 0042 or by emailing them at admin@fntp.org.uk.

For more information visit the website: www.fntp.org.uk.