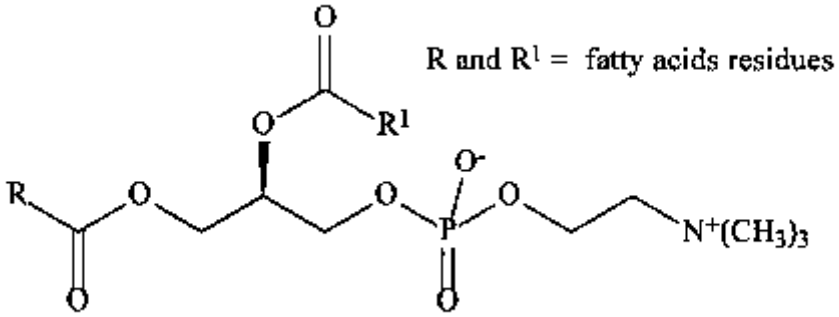
Phosphatidylcholine

DESCRIPTION

Phosphatidylcholine is a phospholipid that is a major constituent of cell membranes. Phosphatidylcholine is also known as 1, 2-diacyl-:ussn:ue-glycero-3-phosphocholine, PtdCho and lecithin. It is represented by the following chemical structure:



Phosphatidylcholine

The term lecithin itself has different meanings when used in chemistry and biochemistry than when used commercially. Chemically, lecithin is phosphatidylcholine. Commercially, it refers to a natural mixture of neutral and polar lipids. Phosphatidylcholine, which is a polar lipid, is present in commercial lecithin in concentrations of 20 to 90%. Most of the commercial lecithin products contain about 20% phosphatidylcholine.

Lecithins containing phosphatidylcholine are produced from vegetable, animal and microbial sources, but mainly from vegetable sources. Soybean, sunflower and rapeseed are the major plant sources of commercial lecithin. Soybean is the most common source. Plant lecithins are considered to be GRAS (generally regarded as safe). Egg yolk lecithin is not a major source of lecithin in nutritional supplements. Eggs themselves naturally contain from 68 to 72% phosphatidylcholine, while soya contains from 20 to 22% phosphatidylcholine.

The fatty acid makeups of phosphatidylcholine from plant and animal sources differ. Saturated fatty acids, such as palmitic and stearic, make up 19 to 24% of soya lecithin; the monounsaturated oleic acid contributes 9 to 11%; linoleic acid provides 56 to 60%; and alpha-linolenic acid makes up 6 to 9%. In egg yolk lecithin, the saturated fatty acids, palmitic and stearic, make up 41 to 46% of egg lecithin, oleic acid 35 to 38%, linoleic acid 15 to 18% and alpha-linolenic 0 to 1%. Soya lecithin is clearly richer in polyunsaturated fatty acids than egg lecithin. Unsaturated fatty acids are mainly bound to the second or middle carbon of glycerol.

Choline comprises about 15% of the weight of phosphatidylcholine. (See monograph on Choline.)

ACTIONS AND PHARMACOLOGY

ACTIONS

Phosphatidylcholine may have hepatoprotective activity.

Phosphatidylcholine is important for normal cellular membrane composition and repair. Phosphatidylcholine is also the major delivery form of the essential nutrient choline. Choline itself is a precursor in the synthesis of the neurotransmitter acetylcholine, the methyl donor betaine and phospholipids, including phosphatidylcholine and sphingomyelin among others. (See the Choline monograph for further discussion.) Phosphatidylcholine is involved in the hepatic export of very-low-density lipoproteins.

MECHANISM OF ACTION

Phosphatidylcholine's role in the maintenance of cell-membrane integrity is vital to all of the basic biological processes. These are: information flow that occurs within cells from DNA to RNA to proteins; the formation of cellular energy and intracellular communication or signal transduction. Phosphatidylcholine, particularly phosphatidylcholine rich in polyunsaturated fatty acids, has a marked fluidizing effect on cellular membranes. Decreased cell-membrane fluidization and breakdown of cell-membrane integrity, as well as impairment of cell-membrane repair mechanisms, are associated with a number of disorders, including liver disease, neurological diseases, various cancers and cell death.

PHARMACOKINETICS

Phosphatidylcholine is absorbed into the mucosal cells of the small intestine, mainly in the duodenum and upper jejunum, following some digestion by the pancreatic enzyme phospholipase, producing lysophosphatidylcholine (lysolecithin). Reacylation of lysolecithin takes place in the intestinal mucosal cells, reforming phosphatidylcholine, which is then transported by the lymphatics in the form of chylomicrons to the blood. Phosphatidylcholine is transported in the blood in various lipoprotein particles, including very-low-density lipoproteins (VLDL), low-density lipoproteins (LDL) and high-density lipoproteins (HDL); it is then distributed to the various tissues of the body. Some phosphatidylcholine is incorporated into cell membranes.

Phosphatidylcholine is also metabolized to choline, fatty acids and glycerol. The fatty acids and glycerol either get oxidized to produce energy or become involved in lipogenesis. Choline is a precursor of acetylcholine. Serum choline levels peak between 2 to 6 hours after oral intake.

INDICATIONS AND USAGE

Phosphatidylcholine may be indicated to help restore liver function in a number of disorders, including alcoholic fibrosis, and possibly viral hepatitis. It may also be indicated for the treatment of some manic conditions. There is some evidence that Phosphatidylcholine may be useful

in the management of Alzheimer's disease and some other cognitive disorders. A possible future role in cancer therapy is also suggested by recent research. It may also be indicated in some with tardive dyskinesia.

RESEARCH SUMMARY

Clinical studies have demonstrated that choline is essential for normal liver function. Phosphatidylcholine is a better delivery form and is also more tolerable than choline. But, in addition, research has shown that phosphatidylcholine, independent of its choline content, has striking hepatoprotective effects. In two animal studies using baboons fed diets high in alcohol, some supplemented with a soy-derived polyunsaturated lecithin (60% phosphatidylcholine) and some unsupplemented, both fibrosis and cirrhosis were largely prevented in the phosphatidylcholine group. Most of the unsupplemented animals in these studies, which continued for up to eight years, developed fibrosis or cirrhosis.

Because these researchers had previously found that choline, equal in amounts contained in the phosphatidylcholine-rich lecithin they subsequently used, had no comparable protective effects on the liver, they concluded that the polyunsaturated phospholipids themselves may have been responsible for the benefits observed.

In vitro studies have shown that these phospholipids increase hepatic collagenase activity and may thus help prevent fibrosis and cirrhosis by encouraging collagen breakdown. Several other mechanisms under investigation may also contribute.

Others have reported similarly encouraging results in animal models. Clearly, human trials are warranted.

In addition, phosphatidylcholine has demonstrated other protective effects in non-alcoholic liver disorders, including protection against various other toxic substances. Its benefits in viral hepatitis were reported some years ago by several different research groups in Europe and elsewhere. In one of these studies, individuals suffering from hepatitis type A and B were given 1.8 grams of phosphatidylcholine daily. Compared with unsupplemented controls, the phosphatidylcholine group enjoyed quicker recoveries, fewer relapses and quicker normalization of liver function tests.

Researchers in Great Britain treated chronic active hepatitis C patients with 3 grams daily of phosphatidylcholine in double-blind fashion. The phosphatidylcholine patients had significantly reduced symptoms, compared with controls. All histologic evidence of the disease disappeared in some cases. These researchers, like others, have hypothesized that phosphatidylcholine's possible antiviral effects are related to the supplement's apparent ability to increase cellular membrane fluidity and repair the membranes of liver cells.

Phosphatidylcholine may help some with tardive dyskinesia, a neurological disorder characterized by defective cholinergic nerve activity. Both supplemental choline and phosphatidylcholine were found to reduce the muscular hyperactivity of this disorder by about 50% in some studies. However, one significant trial did not see a beneficial effect.

There is some very preliminary evidence that phosphatidylcholine may help control manic symptoms in some.

There has been hope, for some time, that phosphatidylcholine would demonstrate clear-cut benefits in cognitive disorders, such as age-related memory loss and Alzheimer's disease. There are a few reports that supplemental choline can improve short-term memory skills and enhance the memories of those who are initial poor learners.

Those with Alzheimer's disease have a diminished ability to synthesize and/or utilize the neurotransmitter acetylcholine, particularly in those areas of the brain related to memory, thus the hope that supplemental choline/phosphatidylcholine might be of benefit. A few studies have suggested some small benefit in memory restoration, but most have not. Research continues.

Recently it has been suggested that phosphatidylcholine might eventually have some therapeutic role in some cancers. There is no evidence of this to date, but animal studies indicate that deficiencies in choline and phosphatidylcholine may disrupt cell membrane signal transduction in ways that could lead to various cancers. There is ample evidence that liver cancer is promoted in various animals by choline-deficient diets, and it has been shown that excess choline can protect against liver cancer in a mouse model.

Phosphatidylcholine has been used to lower serum cholesterol levels, based on the premise that lecithin cholesterol acyltransferase (LCAT) activity has an important role in the removal of cholesterol from tissues. A few studies have shown reduction in serum cholesterol with phosphatidylcholine intake. The results were quite modest, and most studies have not shown any significant cholesterol-lowering activity.

CONTRAINDICATIONS, PRECAUTIONS, ADVERSE REACTIONS

CONTRAINDICATIONS

There are no reported or known contraindications of phosphatidylcholine supplementation.

PRECAUTIONS

Those with malabsorption problems may develop diarrhea or steatorrhea when using phosphatidylcholine supplements. Those with the antiphospholipid-antibody syndrome should exercise caution in the use of phosphatidylcholine supplements.

ADVERSE REACTIONS

No major side effects have been reported. Mild side effects have been noted occasionally such as nausea, diarrhea and increased salivation in some. This holds for all forms of phosphatidylcholine.

INTERACTIONS

There are no known interactions.

OVERDOSAGE

There are no reports of overdosage.

DOSAGE AND ADMINISTRATION

There are several forms of phosphatidylcholine supplements. Typical commercial lecithin supplements contain 20 to 30% phosphatidylcholine. Softgel capsules containing 55% and 90% phosphatidylcholine are available. Liquid concentrates containing 3 grams of phosphatidylcholine per 5 milliliters (one teaspoon) are also available.

Recommended doses range from 3 to 9 grams of phosphatidylcholine daily in divided doses.

LITERATURE

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