

Beta Plus™ & Beta-TCP™

Nutritional Support for Bile Production & Biliary Status

In the 16th century, Paracelsus introduced the concept of the *tartaric diseases* to explain how stones are formed in the human body by the precipitation of substances from body fluids, analogous to the deposition of *tartar* in wine casks. Today we know that in industrialized countries more than 80% of gallstones consist mainly of cholesterol, the prevalence of gallstones is about 10%, and in people between 40 and 50 years of age the 5-year incidence is about 3%.

Bile, Defined

Bile functions as the body's emulsification and absorption of lipids, critical for fat digestion and assimilation. Bile is produced by the liver, and is temporarily stored in the gall bladder. Bile is released into the small intestine in response to hormones, such as cholecystokinin, when fat enters the intestine. Bile consists of a mixture of bile salts, bile acids, cholesterol, bilirubin and phospholipids, chiefly phosphatidylcholine. The ratio of individual lipids are critical to maintain a stable micellar concentration. The molar ratios are typically 5:15:80 for cholesterol/phosphatidylcholine/bile salts. If the bile concentration becomes too high, cholesterol will precipitate and gallstones will form in the gall bladder, a condition known as cholelithiasis.⁽¹⁾

Bile Formation

Bile salts and acids represent oxidized derivatives of cholesterol. About 80% of the cholesterol in the body will eventually be disposed of as cholic acid. The primary bile acids, cholic acid and chenodeoxycholic acid, possess a carboxylic acid side chain, which confers hydrophilic properties to the lipophilic sterol ring and creates detergent-like molecules. The liver attaches taurine and glycine to bile acids to create bile salts (taurocholate or taurochenodeoxycholate and glycocholate or glycdeoxycholate, respectively). Bacterial enzymes in the colon can convert these to secondary bile acids, deoxycholate and lithocholate.

Bile and Digestion

Bile is needed for efficient uptake of oily nutrients (fats). When bile acids and bile salts first encounter ingested fats, they act as emulsifiers to create suspensions which can be broken down enzymatically. The process involves several important steps; sequentially indicated as:

1. The combined action of bile salts and pancreatic lipase initiates hydrolysis of triglycerides to free fatty acids and diglycerides, resulting in the formation of emulsions containing other lipid-soluble nutrients, including vitamins and carotenoids. The particle size of these emulsions ranges from 200 to 5,000 nanometers in diameter.

2. Lipase is then able to hydrolyze both di- and triglycerides to monoglycerides and free fatty acids. Lipase requires a smaller protein called colipase, another pancreatic product, to bind to triglycerides and activate the lipase.

3. Upon further release of bile salts, the lipid aggregates become smaller, from 3 to 10 nanometers in diameter. The normal endpoint of triglyceride digestion is a product containing 70% free fatty acid anions, 25% beta monoglycerides and 5% cholesterol. The micelles are then taken up by the epithelial cells of the brush border membrane via passive diffusion. After absorption, the fate of fatty acids depends upon their sizes. Medium chain fatty acids, with less than 10–12 carbons, pass directly from the mucosal cells into the portal blood and bind to serum albumin. Longer chain fatty acid anions are re-esterified with beta monoglycerides in the smooth endoplasmic reticulum to reform triglycerides. The newly synthesized triglycerides are complexed with apoproteins, cholesterol and phospholipids, to produce particles called chylomicrons. Chylomicrons are released from mucosal cells by exocytosis and enter the lymph, rather than entering the bloodstream directly.

Enterohepatic Circulation

Bile salts do not cross the mucosal barrier into the lymphatic system but rather they are reabsorbed as micelles in the lower region of the small intestine. Most of the bile salts released into the intestine are reabsorbed in the lower ileum where bacteria can reduce free bile acids to lithocholate and deoxycholate. The absorbed bile acids and salts are transported via the portal vein to the liver as complexes with serum albumin. The liver efficiently extracts them, conjugates them with amino acids and again secretes them as bile, which is returned to the gall bladder to continue to aid digestion. Bile salts are recirculated 2–3 times through the liver with each meal.

Betaine

Beets are a concentrated source of Betaine, which functions in the methylation of homocysteine, converting it into methionine and dimethylglycine. An elevated level of homocysteine, termed



**BIOTICS**
RESEARCH
CORPORATION
Utilizing "The Best of Science and Nature"
to Create Superior Nutritional Supplements



(905)476-3554

Biotics Research Canada
Box 283 Keswick On L4P 3E2
orders@bioticscan.com

These statements have not been evaluated by the Food and Drug Administration. These products are not intended to diagnose, treat, cure, or prevent any disease.

homocysteinemia, is a risk factor for cardiovascular complications.⁽¹⁾ Dimethylglycine, in turn, functions as a methyl donor, thus aiding in both the detoxification and immune pathways. Betaine is often referred to as a "lipotropic factor" as it assists the liver in the processing of fats. Studies with betaine have correlated its use with liver protection. For example in one study, subjects exposed to carbon tetrachloride (CCl₄), were followed with an oral treatment of betaine. They were observed to have a significant reduction in liver necrosis, which was attributed to betaine use.⁽²⁾ In another study, following CCl₄ injection in test animals, supplemental betaine was observed to reduce liver triglycerides as well as centrilobular hepatic lipidosis.⁽³⁾

Fiber and the Binding of Bile Components

Certain kinds of dietary fiber bind bile salts. Examples include pectin (found in fruits and berries), hemicelluloses (found in cereal grains), and certain types of fiber that occur in legumes. When the diet is rich in partially soluble fiber, more bile is excreted (not reabsorbed). As a consequence, blood cholesterol levels may be reduced to account for more bile salt formation, consequently slowing the development of atherosclerosis.

Nutritional Support of Bile Formation

Bile. Bile salts, along with other components, including cholesterol, electrolytes and water, are stored in the gallbladder. Bile salts act as an enzyme aide, and serve to enhance the absorption of fatty acids and some fat-soluble vitamins. Bile also serves as a fat emulsifier, thus increasing the surface area of the fat and allowing it to become water-soluble. Thus bile salts aide in the absorption of fatty acids and cholesterol via the formation of micelles. The micelles, soluble in chyme, are then easily absorbed by epithelial cells. Bile also serves in a protective capacity, functioning to maintain the intestinal barrier against invading microorganisms.^(4,5)

Pancrelipase. (*Pancreatic lipase*) Pancrelipase functions in the hydrolysis of triacylglycerol in the presence of bile salts, and therefore functions in the absorption of dietary fats and lipids. Accordingly, in the presence of gastric lipase, triacylglycerol is hydrolyzed to monoglycerides and free fatty acids. Pancrelipase preparations have been shown to reduce fecal fat, indicating an improvement in the fat digestive process with the use of pancrelipase.^(6,7)

In addition to organic beet concentrate and pancrelipase, **Beta Plus™** contains ox bile extract. Desiccated bile helps support the biliary system in cases where the gall bladder has been removed or when the gall bladder needs additional support to function optimally. The healthcare professional can determine how to cycle and/or compound doses of **Beta Plus™** to optimize biliary function. Oftentimes, **Beta-TCP™** is added to the protocol.

Beta-TCP™ includes taurine and vitamin C in its formula to help support bile viscosity, and assist with cholesterol to bile acid conversion. Taurine is a highly charged cysteine derivative, synthesized *in vivo* from the essential amino acid methionine. When conjugated to bile acids, an increased polarity of the bile acid results, thus increasing its amphiphatic (emulsification) properties. In one study, dietary taurine was demonstrated to enhance the degradation of cholesterol and subsequent excretion via bile acids.⁽⁸⁾ In animal studies, supplementary taurine was demonstrated to both increase serum HDL, and significantly decrease total cholesterol.⁽⁹⁾

Additionally, a significant increase in the concentration of fecal total bile acids has been observed with taurine supplementation.⁽¹⁰⁾ The action of taurine on serum cholesterol was attributed to the facilitation of hepatic cholesterol 7-alpha-hydroxylase activity.⁽¹¹⁾

Vitamin C. The enzyme noted above, cholesterol 7-alpha-hydroxylase, is the enzyme responsible for the initial step in the catabolism of cholesterol to conjugated bile acids. This enzyme is a vitamin C-dependent enzyme. In studies, supplemental vitamin C was shown to reduce total plasma cholesterol and triglycerides, which was correlated to a marked modification in apolipoprotein patterns.^(12,13) In patients with gallstones, vitamin C was shown to influence the environment of the gallbladder, resulting in a higher concentration of phospholipids, along with a changed ratio of bile acids, indicating an influence of vitamin C on the formation of gallstones.⁽¹⁴⁾ Additionally, in women, an inverse correlation between serum ascorbic acid and the prevalence of both clinical and asymptomatic gallbladder symptomatology was observed.⁽¹⁵⁾

References

1. Welch GN, Loscalzo J. Homocysteine and atherothrombosis. *N Engl J Med.* 1998;338:1042-1050.
2. Murakami T, Magamura Y, Hirano K. The recovering effect of betaine on carbon tetrachloride-induced liver injury. *J Nutr Sci Vitaminol (Tokyo)* 1998 Apr;44(2):249-55.
3. Junnila M, Barak *et al.* Betain reduces hepatic lipidosis induced by carbon tetrachloride in Sprague-Dawley rats. *Vet Hum Toxicol* 1998. Oct;40(5):263-6.
4. Ogata Y, Nishi M, Nakayama H, Ohnishi Y, Tashiro S. Role of bile in intestinal barrier function and its inhibitory effect on bacterial translocation in obstructive jaundice in rats. *J Surg Res.* 2003 Nov;115(1):18-23.
5. Walls CL, Jechorek RP, Erlandsen SL. Inhibitory effect of bile on bacterial invasion of enterocytes: possible mechanism for increased translocation associated with obstructive jaundice. *Crit Care Med.* 1995 Feb;23(2):301-7.
6. Delhave M, Meuris S, Gohimont AC, Buedts K, Cremer M. Comparative evaluation of a high lipase pancreatic enzyme preparation and a standard pancreatic supplement for treating exocrine pancreatic insufficiency in chronic pancreatitis. *Eur J Gastroenterol Hepatol.* 1996 Jul;8(7):699-703.
7. Valerio D, Whyte EH, Schlamann HT, Ruggiero JA, Blackburn GL. Clinical effectiveness of a pancreatic enzyme supplement. *JPN J Parenter Enteral Nutr.* 1981 Mar-Apr;5(2):110-4.
8. Yokogoshi H, Oda H. Dietary taurine enhances cholesterol degradation and reduces serum and liver cholesterol concentrations in rats fed a high-cholesterol diet. *Amino Acids.* 2002;23(4):433-9.
9. Yokogoshi H, Nanami K, Hida Y, Miyachi, Oda H. Dietary taurine enhances cholesterol degradation and reduces serum and liver cholesterol concentrations in rats fed a high-cholesterol diet. *J Nutr.* 1999 Sep;129(9):1705-12.
10. Kishida T, Ishikawa H, Tsukaoka M, Ohga H, Ogawa H, Ebihara K. Increase of bile acids synthesis and excretion caused by taurine administration prevents the ovariectomy-induced increase in cholesterol concentrations in the serum low-density lipoprotein fraction of Wistar rats. *J Nutr Biochem.* 2003 Jan;14(1):7-16.
11. Nishimura N, Umeda C, Oda H, Yokogoshi H. The effect of taurine on the cholesterol metabolism in rats fed diets supplemented with cholestryamine or high amounts of bile acid. *J Nutr Sci Vitaminol (Tokyo).* 2003 Feb;49(1):21-6.
12. Santillo M, Santangelo F, Belfiore A, Masturi M, Mondola P. Effect of ascorbic acid administration on B and E apoproteins in rats fed a cholesterol enriched diet. *Horm Metab Res.* 1993 Mar;25(3):156-9.
13. Santillo M, Mondola P, Santangelo F, Gioielli A, Iossa S, Basilisco A, De Mercato R. Changes in apoprotein distribution between lipoprotein classes of hypercholesterolemic rats treated with ascorbate. *Int J Biochem Cell Biol.* 1995 Mar;27(3):257-62.
14. Gustafsson U, Wang FH, Axelson M, Kallner A, Sahlin S, Einarsson K. The effect of vitamin C in high doses on plasma and biliary lipid composition in patients with cholesterol gallstones: prolongation of the nucleation time. *Eur J Clin Invest.* 1997 May;27(5):387-91.
15. Simon JA, Hudes ES. Serum ascorbic acid and gallbladder disease prevalence among US adults: the Third National Health and Nutrition Examination Survey (NHANES III). *Arch Intern Med.* 2000 Apr 10;160(7):931-6.

To place your order for **Beta Plus™ & Beta-TCP™** or for additional information please contact us below.



(905)476-3554

Biotics Research Canada
Box 283 Keswick On L4P 3E2
orders@bioticscan.com

These statements have not been evaluated by the Food and Drug Administration. These products are not intended to diagnose, treat, cure, or prevent any disease.