Lipo-B (MIC) Injection

General Information

The Lipo-B (MIC) injection is a product that contains a combination of compounds that have been shown to exhibit lipotropic effects. The lipotropic effects facilitate the burning of adipose tissue within the human body which may, consequently, result in some degree of weight loss. Lipo-B injections are typically used as fat loss supplements, in combination with diet and exercise, in weight loss plans. The combination of products that make up the Lipo-B (MIC) injection are methionine, inositol, choline, and cyanocobalamin (vitamin B12).

Methionine

Methionine is one of the four sulfur-containing amino acids; the other three are cysteine, homocysteine, and taurine. Additionally, it is one of the nine essential amino acids in the human body. As an essential amino acid, it cannot be synthesized de novo by the human body due to a lack of the require metabolic pathway needed for its synthesis. Therefore, methionine has to be exogenously introduced into the human body either within the diet or as a supplement.12

Methionine serves several key roles in the human body such as:

- Substrate in the production of critical hormones and proteins including L-cysteine, carnitine, adrenaline, choline, and melatonin, among others.
- Increasing liver production of lecithin which helps lower serum cholesterol levels.
- Provides sulfur which aids development of nails and promotes hair growth.
- Chelating agent which helps get rid of heavy metals such as mercury.
- Provides protection against hepatotoxins such as acetaminophen.34

Inositol

Originally isolated from muscle extracts in 1850, inositol is a cyclic carbohydrate with six hydroxyl groups. It has nine different stereoisomers, with the most common form being myo-inositol, followed by D-chiro-inositol as the next most common. Most texts, however, use the term inositol to describe its most common variant, myo-inositol. Once considered to be an essential vitamin, it has since been discovered that inositol can be produced by the liver and the kidneys; these organs are able to produce up to 4 grams daily of inositol. Additionally, inositol can be found in food sources such as beans and fruits. It is also synthesized in the placenta in pregnant women and can be found in high concentrations in breast milk.567

One of the major roles of inositol in the body is the production of inositol triphosphate, which is an essential second messenger for hormones such as insulin and follicle stimulating hormone.6

Choline

Choline is an essential nutrient that plays a key role in a number of metabolic pathways in the human body. Even though choline is produced endogenously in the liver, it is still considered an essential nutrient because the quantities produced is not sufficient to meet the body's metabolic needs; as such, dietary supplementation of choline is necessary. Choline can be found in both animal and plant food sources, with animal food sources generally having more choline per gram of food product.

Some functions that choline serves in the body are:

- Production of sphingomyelin and phosphatidylcholine, which are needed to maintain cell membrane integrity.
- Production of acetylcholine, which is one of the major neurotransmitters in the body.
- Modulation of gene expression and cell membrane signaling.
- Early brain development in fetuses.[8][9]

Cyanocobalamin

Otherwise known as vitamin B12, cyanocobalamin derives its name from the fact that it has a cyanide group attached to its molecule and also contains the mineral cobalt. It is essential for cellular energy production as well as DNA synthesis. It is an essential water-soluble vitamin and must be obtained from food or as dietary supplements. Some good food sources of vitamin B12 are meat, fish, milk, eggs, and cheese, among others. Some of the roles that cyanocobalamin serves in the body include:

- Cofactor for methionine synthase and L-methymalonyl-CoA mutase.
- Synthesis of methionine from homocysteine.
- Regeneration of tetrahydrofolate from 5-methyltetrahydrofolate.[10][11]

Mechanisms of Action

Methionine

Methionine exerts its effect in the body through the production of S-adenosylmethionine in the methionine cycle; this process is catalyzed by the enzyme methionine adenosyltransferases. Methionine adenosyltransferases combines methionine, water, and adenosine triphosphate (ATP) to produce S-adenosylmethionine, pyrophosphates, and inorganic phosphates. S-adenosylmethionine participates in a number of processes in the body such as biotin and polyamine synthesis. It is also involved in the synthesis of phospholipids and some neurotransmitters within the body. These methylation reactions also regulate gene expression during fetal development. One of the by-products of methionine metabolism is homocysteine which, in high serum quantities, has been linked to developmental disorders, learning disabilities, and skeletal deformities, among others.[2][12]

Inositol

There are serves means by which inositol exerts its effects in the human body. Inositol is a key substrate in glucose metabolism and is a second messenger in insulin action. It binds to insulin which then initiates a cascading pathway of metabolic events through the action of the enzyme phosphatidylinositol-3-kinase and the activation of insulin-1 receptor substrate. These convert phosphatidylinositol2-phosphate (PIP2) into phosphatidylinositol-3-phosphate (PIP3) and, by so doing, activates protein kinase B (PKB), the metabolic pathway for glycogen synthesis.[13][14]

In addition to the conversion to phosphatidylinositol-3-phosphate, inositol also acts by activating pyruvate dehydrogenase kinase, isoenzyme 1. This enzyme acts on glucotransporter 4 and facilitates the transport of glucose into cell across the plasma membrane for their use as an energy substrate.[14]

Choline

The primary way through which choline acts within the body is through its derivative phosphatidylcholine. The biosynthesis of phosphatidylcholine occurs via the CDP-choline pathway. After absorption from the intestine, choline is transported into cells using choline transporters. Within the cells, choline is phosphorylated into phosphocholine or oxidized into betaine; the phosphorylation of choline is catalyzed by the enzyme choline kinase. The final step in this pathway is the conversion of phosphocholine into phosphatidylcholine, a process catalyzed by the enzyme 1,2-diacylglycerol cholinephosphotransferase. Phosphatidylcholine is a major constituent of all cell membranes within the body and is also required for the biosynthesis of lipoproteins.[1516]

Cyanocobalamin

After oral ingestion, cyanocobalamin binds to intrinsic factor as well as other cobalamin binding proteins before absorption. Once absorbed, it binds to plasma proteins before it is transported around the body. Within body tissues, the specific B12 binding proteins transcobalamin I and II facilitate the absorption of cyanocobalamin into the cells.[1017]

Cyanocobalamin is a cofactor for the synthesis of two major enzymes in the body namely methionine synthase and L-methymalonyl-CoA mutase. L-methymalonyl-CoA mutase converts L-methymalonyl-CoA to succinyl-CoA, which is essential for the metabolism of protein and fat. Methionine synthase plays a role in the production of purines and pyrimidines, which are building blocks in DNA synthesis.[1017]

Pharmacokinetics

Methionine

Methionine is typically ingested oral as part of a food source such as eggs, meat, and fish. It can also be orally ingested as a supplement or parenterally as part of a complex compound. After oral ingestion, absorption of methionine occurs in the small intestine through an active transport process. Following absorption, methionine is then transported to the liver where it is then metabolized. As earlier stated, methionine is an important substrate in the development of a number of products within the body. One of the most essential products of methionine metabolism is S-adenosylmethionine which is important in polyamine and biotin synthesis, phospholipid synthesis, and production of some neurotransmitters. While not entirely clear, methionine is believed to be excreted from the body through urine.[12]

Inositol

After oral ingestion, inositol is actively absorbed and transported by intestinal cells using a sodium-dependent transport mechanism. Following intestinal absorption, it then binds to plasma proteins and is then transported to the cells and tissues around the body where it is then metabolized. If produced endogenously, myo-inositol is derived from glucose-6-phosphate, which is isomerized to inositol-3-phosphate by the enzyme D-3-myo-inositol-phosphate synthase. Inositol may also be produced through the recycling of inositol-1,4,5-triphosphate as well as inositol-1,4-biphosphate. Inositol is catabolized is the kidneys and its metabolites are excreted in urine.[1819]

Choline

After oral ingestion, choline is absorbed by enterocytes in the small intestine by means of transporter proteins. It is then transported throughout the body where it is absorbed by cells by both diffusion and cell-mediated transport. Within the tissues, choline undergoes phosphorylation to cytidine diphosphocholine, and from there to phosphatidylcholine. Alternatively, phosphatidylcholine may be produced from the methylation of phosphatidylethanolamine. Some choline is also oxidized to form betaine in the liver and kidney.20

Cyanocobalamin

Cyanocobalamin can be administered orally, intramuscularly, or subcutaneously. After oral ingestion, it binds to intrinsic factor before making its way down the gastrointestinal tract. In the terminal ileum, cyanocobalamin is cleaved from intrinsic factor and is then absorbed by the mucosal cells. In the bloodstream, cyanocobalamin binds to the plasma proteins transcobalamin 1 and 2 before it is transported throughout the body. It has a half-life of about 6 days, with a peak plasma concentration of 8-12 hours after oral administration and is excreted mainly in urine.21

Contraindications/Precautions

There are certain clinical conditions under which Lipo-B (MIC) should be avoided or administered with caution. Some of these conditions include:

- **Hypersensitivity**: Lipo-B (MIC) is absolutely contraindicated in individuals who have a demonstrated hypersensitivity to any components of the product.
- **Acidosis**: This can be worsened by methionine administration.
- **Liver disease**: This may impair the metabolism of the product components.
- **Hereditary optic nerve atrophy (Leber's disease)**: Individuals with Leber's disease may experience a worsening of their symptoms if administered products containing cyanocobalamin.22

Adverse Reactions/Side Effects

Lipo-B (MIC) is generally well tolerated in most individuals. As stated earlier, hypersensitivity to any of the product components is one of the adverse reactions that may occur after Lipo-B (MIC) injections. Additionally, toxic effects may occur if Lipo-B (MIC) is administered to individuals with hepatic diseases due to impaired metabolism. Some individuals may also experience generalized non-specific symptoms such as nausea and vomiting, diarrhea, and dizziness, among others.

References

1. Lopez, M.J., Mohiuddin, S.S, "Biochemistry, Essential Amino acids", StatPearls. April 2020. Available: https://www.ncbi.nlm.nih.gov/books/NBK557845/
2. Parkhitko, A.A., Jouandin, P., Mohr, S.E., Perrimon, N.," Methionine metabolism and methyltransferases in the regulation of aging and lifespan extension across species", Aging Cell, vol.18 issue 6. December 2019. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6826121/
3. "What is methionine?", amino acid studies. Available: https://aminoacidstudies.org/l-methionine/
4. "Methionine", Drug Bank. Available: https://go.drugbank.com/drugs/DB00134
5. Formoso, G., Baldassarre, M.P.A., Ginestra, F., Carlucci, M.A., Bucci, I., Consoli, A., "Inositol and antioxidant supplementation: Safety and efficacy in pregnancy", Diabetes/Metabolism Research and Reviews, vol.35 issue 5. July 2019. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6617769/
6. Hallman, M, "Inositol During Perinatal Transition", Neoreviews. Vol.16 issue 2. February 2015. Available: https://neoreviews.aappublications.org/content/16/2/e84
7. "Inositol", Drug Bank. Available: https://go.drugbank.com/drugs/DB13178
8. Korsmo, H.W., "Choline: Exploring the Growing Science on its Benefits for Moms and Babies", Nutrients, vol.11 issue 8. August 2019. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6722688/#:~:text=The%20choline%20adequate%20intake%20(AI,day%20during%20lactation%20%5B3%5D.
9. "Choline", Fact Sheet for Health Professionals. Available: https://ods.od.nih.gov/factsheets/Choline-HealthProfessional/#h8
10. Vasavada, A., Sanghavi, D., "Cyanocobalamin", StatPearl. Available: https://www.ncbi.nlm.nih.gov/books/NBK555964/#:~:text=Mechanism%20of%20Action&text=Tissues%20absorb%20vitamin%20B12%20by,particularly%20in%20erythroid%20progenitor%20cells.
11. "Vitamin B12 Fact Sheet for Health Professionals", National Institutes of Health. Available: https://ods.od.nih.gov/factsheets/VitaminB12-HealthProfessional/
12. Markham, G.D., Pajares, M.A., "Structure-function relationships in methionine adenosyltransferases", Cellular and Molecular Life Sciences, vol.66 issue 4, pp. 636-648. February 2009. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2643306/#
13. Facchinetti, F., Menichini, D.," Myoinositol: mechanisms of action and role in the treatment of metabolic diseases, infertility and polycystic ovary syndrome", Nutrafoods, vol.16., pp. 147-151. Available: https://www.nutrafoods.eu/wp-content/uploads/2019/08/DOI_10.17470NF-017-1008-3.pdf
14. Ferrari, F., Facchinetti, F., Ontiveros, A.E., Roberts, R.P., Saade, M.M., Blackwell, S.C., Sibai, B.M., Refuerzo, J.S., Longo, M., "The effect of combined inositol supplementation on maternal metabolic profile in pregnancies complicated by metabolic syndrome and obesity", American Journal of Obstetrics and Gynecology", vol.503.2016. Available: https://www.ajog.org/article/S0002-9378(16)30254-X/pdf
15. Korsmo, H.W., Jiang, X., Caudill, M.A., "Choline: Exploring the Growing Science on Its Benefits for Moms and Babies", Nutrients, vol.11 issue 8.2019. Available:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6722688/#:~:text=The%20choline%20adequate%20intake%20(AI,day%20during%20lactation%20%5B3%5D.
16. Li, Z., Vance, D.E., "Phosphatidylcholine and choline homeostasis", Journal of Lipid Research. Available: https://www.jlr.org/content/early/2008/01/19/jlr.R700019-JLR200.full.pdf
17. "Vitamin B12", Drug Bank. Available: https://go.drugbank.com/drugs/DB00115
18. Bevilacqua, A., Bizzarri, M., "Inositols in Insulin Signaling and Glucose Metabolism", International Journal of Endocrinology. November 2018. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6286734/
19. Bizzarri, M., Fuso, A., Dinicola, S., Cucina, A., Bevilacqua, A., "Pharmacodynamics and pharmacokinetics of inositol(s) in health and disease", Expert Opinion on Drug Metabolism & Toxicology. 2016. Available: https://www.inositolgroup.com/wp-content/uploads/2020/06/Pharmacodynamics_pharmacokinetics_inositol.pdf
20. "Choline", Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin, and Choline. Available: https://www.ncbi.nlm.nih.gov/books/NBK114308/
21. "Hydroxycobalamin". Available: https://go.drugbank.com/drugs/DB00200
22. "Cyanocobalamin - Drug Summary", Prescribers' Digital Reference. Available: https://www.pdr.net/drug-summary/Nascobal-cyanocobalamin-2286