

# S E R I N E

The patented FIA™ is a unique biochemical assessment that measures the intracellular function of serine. It is performed in the FIA™ Comprehensive Profile and may also be ordered individually.

## WHAT IS SERINE?

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Serine is a dispensable non-essential amino acid but this categorization applies only to dietary intake. Serine is, in fact, essential for life and health. It is synthesized from other amino acids and metabolites of glucose, and participates in protein synthesis, energy production, phospholipid synthesis (phosphatidyl serine and ethanolamine), and one-carbon unit metabolism which is necessary for DNA and RNA synthesis. Quantitatively, serine supplies more one-carbon units than any other nutrient and is an attachment point for carbohydrates on protein chains. It is a methyl group donor for the synthesis of cystathionine, i.e., it supplies the methyl group that is transferred to folate and B12 to reduce homocysteine - an independent risk factor for atherosclerosis and other forms of vascular disease.

Serine is made from 3-phosphoglyceric acid (3-PGA) which is produced during the metabolism of glucose (sugar). Two metabolic pathways utilize 3-PGA to produce serine: one pathway transfers the amino group from alanine, and the other pathway transfers the amino group from glutamic acid. Transaminations are B6-dependent, thus, one possible reason for the lack of sufficient serine synthesis is a B6 deficiency. Deficiencies of other B-vitamins can slow the production of 3-PGA. Serine can also be produced directly from glycine and one of the forms of folate.

Some serine residues have sugars attached to them after protein synthesis, forming glycoproteins. Sugars added to proteins are extremely important for function and recognition by membranes, immune system cells and neighboring cells. A serine deficiency may depress glycoprotein synthesis which can adversely affect almost every body system and function.

Serine can contribute to the energy needs of cells when excess amounts are provided by diet or metabolism. It can be deaminated to form pyruvate which can be used for energy production or the synthesis of glucose and/or fatty acids. It is also used to provide molecular pieces for the synthesis of other amino acids, especially glycine, tryptophan and cysteine.

Serine is also a major component of cell membranes. Phosphatidyl serine is one of the four major phospholipids that make up membranes, and phosphatidyl ethanolamine is derived from phosphatidyl serine. Thus, serine is vital for proper cell membrane function which can impact every cellular function.

## **THE FIA™ SERINE TEST**

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The FIA™ test for serine involves the removal of serine, glycine and B12 from SpectraCell's patented serum and protein-free control media. Vitamin B6 and folate are added in excess to saturate their respective enzyme systems, in the event that an individual is deficient in these micronutrients. Without serine or glycine in the media, lymphocyte growth is strictly dependent upon the cells' ability to synthesize and utilize serine. If the intracellular function of serine is adequate, then the methyl groups are donated for thymidine synthesis for optimal cell growth (DNA synthesis). If serine is not synthesized and utilized adequately, then the lymphocyte growth response is suboptimal compared to the control media, and a functional intracellular deficiency of serine is detected.

## **CLINICAL APPLICATIONS**

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Clinical symptoms of a serine deficiency include neuropathy and neuritis. Behavioral disturbances may also be associated with a serine deficiency. In addition, some persons may have a metabolic defect in serine synthesis or conditional need for it during periods of cell growth or physiological stress. A serine deficiency also mimics folate and/or B12 neurological deficiency symptoms.

## **REPLETION SUGGESTIONS**

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Since serine is a dispensable amino acid, there is no RDA. Serine supplementation of 1 to 2 grams daily for adults is considered safe, as there is no evidence of serine toxicity from oral administration at this dosage. However, in persons with renal disease, serine intake should be counted as equivalent to protein. Thus, for every gram of serine intake, 1 gram of dietary protein intake should be subtracted, and care should be taken to ensure that serine intake does not exceed 2 grams daily.

## **SUMMARY**

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SpectraCell's FIA™ test for serine is a unique scientific method to assess the intracellular function of this amino acid. Serine is more important than is generally recognized for metabolism, and several important health conditions are associated with deficient intracellular function.