

# Glucosamine Plus<sup>TM</sup> Extra Strength

## A Readily Available Form of Glucosamine and Chondroitin

### DESCRIPTION

Glucosamine Plus Extra Strength capsules, provided by Douglas Laboratories®, contain a synergistic combination of glucosamine sulfate and chondroitin sulfate. Glucosamine sulfate is a well-absorbed source of glucosamine, an important precursor for the synthesis and maintenance of connective tissues. Chondroitin sulfate also supports formation of connective tissues, primarily joint cartilage, and helps protect existing cartilage. The potassium stabilized form of glucosamine sulfate is used, making these sodium-free products.

### FUNCTIONS

Glucosamine is a naturally occurring amino sugar found ubiquitously in glycoproteins and glycosaminoglycans. Glycosaminoglycans, formerly named mucopolysaccharides, are an integral component of all connective tissues.

Connective tissue, a fibrous type of body tissue, has various functions. It supports and connects internal organs (ligaments), forms bone, cartilage, and the walls of blood vessels, attaches muscles to bones (tendons), and replaces tissues that have been damaged following injury.

The two main components of connective tissue are collagen and proteoglycans. Collagen is the strong, fibrous protein that physically connects our tissues. Proteoglycans are large carbohydrate-rich structures, resembling a bottlebrush in three-dimensional structure, i.e., a central protein rod with many strings of glucosamine-containing glycosaminoglycans extending outwards. Proteoglycans hold large amounts of water forming a stiff gel by virtue of their dense negative charges from sulfates. Proteoglycans are linked to collagen fibers to help form connective tissues, and proteoglycans provide resiliency, load distribution, shock-absorbing, compressive and lubricating properties to connective tissues and joints.

Glycosaminoglycans and proteoglycans are continuously being formed and replaced in connective tissues.

Remodeling of connective tissues is also continuous, albeit slowly, with turnover half-lives of almost two years in healthy human joints. Turnover is accelerated in wound healing, arthritic joints, and burns. New synthesis of glycosaminoglycans has clinical importance in skin during

normal wound healing, in bone during fracture repair and osteoporosis, and in joints. In these instances, glycosaminoglycan synthesis is necessary for healing, and enhancement of glycosaminoglycan and proteoglycan deposition may improve tissue repair. Glycosaminoglycans are synthesized primarily by fibroblasts (skin, tendons, ligaments), osteoblasts (bone), and chondrocytes (cartilage). Thus, the cell's ability to manufacture glycosaminoglycans and secrete proteoglycans is crucial during any healing or joint disease process.

The availability of glucosamine is the key, rate-limiting step in glycosaminoglycan and proteoglycan synthesis in all connective tissues, such as skin, bone, cartilage, tendons, and ligaments. Only with sufficient glucosamine, the synthesis can proceed.

The body has a long metabolic pathway to synthesize a glucosamine derivative, UDP-*N*-acetylglucosamine, which is used for glycosaminoglycan synthesis. In addition, exogenous, i.e., dietary, glucosamine serves as an immediate precursor for glycosaminoglycan synthesis, and also stimulates incorporation of other precursors into the connective tissue matrix.

Chondroitin sulfate, a glycosaminoglycan formed in the body, is also used for the synthesis and maintenance of connective tissue, primarily within the cartilage matrix. In addition, chondroitin sulfate protects existing cartilage by reducing water loss from the matrix and by inhibiting the enzymatic breakdown of the cartilage.

The overlapping activities as well as functional differences of glucosamine and chondroitin sulfate offer several advantages for combined supplementation. Although glucosamine is a precursor for chondroitin synthesis, this process requires large amounts of metabolic energy. Dietary preformed chondroitin sulfate spares the use of glucosamine for this purpose. Instead glucosamine can be used for formation of other important glycosaminoglycans and proteoglycans. When adequate chondroitin sulfate is thus available to help protect tissues from premature breakdown, glucosamine can more readily stimulate synthesis of healthy new tissue. Glucosamine is almost universally found in small amounts in most foods. However, bioavailability of glucosamine from foods is largely unknown. Bioavailability

of oral glucosamine sulfate is excellent. It is absorbed intact, and utilized very quickly by all tissues, including connective tissues. Chondroitin sulfate is found in most animal tissues. Orally ingested chondroitin sulfate is also well absorbed and distributed to tissues.

In summary, glucosamine sulfate is a well documented, highly effective source of glucosamine for glycosaminoglycan and proteoglycan synthesis in all connective tissues. Chondroitin sulfate is an excellent source of n-acetylgalactosaminoglycan for synthesis and protection of proteoglycans associated with cartilage tissues.

## INDICATIONS

Glucosamine Plus Extra Strength capsules may be a useful nutritional adjunct for individuals who wish to support the body's connective tissues, such as skin, tendons, ligaments, bone, and cartilage.

## FORMULA (GCSPX)

**Each Glucosamine Plus Extra Strength capsule contains:**

Glucosamine sulfate 2KCl .....	500 mg
Chondroitin sulfate.....	400 mg

## SUGGESTED USE

Glucosamine Plus Extra Strength: One to three capsules daily. It is recommended that Glucosamine Plus and Glucosamine Plus Extra Strength be taken with meals.

## SIDE EFFECTS

No adverse effects have been reported.

## STORAGE

Store in a cool, dry place, away from direct light. Keep out of reach of children.

## REFERENCES

- Böhmer D, Ambrus P, Szögy A, and Haralambie G. Treatment of chondropathia patellae in young athletes with glucosamine sulfate. In: Current Topics Sports Medicine (Bachl N et al., eds.) Urban & Schwarzenberg, Vienna, 1984, p.799.
- Crolle G, and D'Este E. Glucosamine sulfate for the management of arthrosis: a controlled clinical investigation. *Curr. Res. Med. Opin.* 1980; 7:104.
- D'Ambrosio E, Casa B, Bompani R, Scali G, and Scali R. Glucosamine sulfate: a controlled clinical investigation in arthrosis. *Pharmatherapeutica* 1981; 2:504.
- Drovanti A, Bignamini AA, and Rovati AL. Therapeutic activity of oral glucosamine sulfate in osteoarthritis: a placebo-controlled double-blind investigation. *Clin. Ther.* 1980; 3:260.
- Engel M, Maurel P, Margolis RK. Chondroitin sulfate proteoglycans in the developing central nervous system. I. Cellular sites of synthesis of neurocan and phosphacan. *J Comparative Neurology* 1996;366:34-43.
- Lopes Vaz A. Double-blind clinical evaluation of the relative efficacy of ibuprofen and glucosamine sulfate in the management of osteoarthritis of the knee in outpatients. *Curr. Res. Med. Opin.* 1982; 8:145
- McCarty MF. Glucosamine for wound healing. *Medical Hypothesis* 1996;47:273-275.
- Morreale P, et al. Comparison of the antiinflammatory efficacy of chondroitin sulfate and diclofenac sodium in patients with knee osteoarthritis. *J Rheumatol* 1996;23:1385-91.
- Piptone VR. Chondroprotection with chondroitin sulfate. *Drugs Exp Clin Res* 1991;17 (1):3-7.
- Pujalte JM, et al. Double-blind clinical evaluation of oral glucosamine sulfate in the basic treatment of osteoarthritis. *Curr Med Res Opin* 1980;7:110-114.
- Tapadinhas MJ, Rivera IC, Bignamini AA. Oral glucosamine sulfate in the management of arthrosis: report on a multi-centre open investigation in Portugal. 1982;3(3):157-168.

**These statements have not been evaluated by the Food and Drug Administration.  
This product is not intended to diagnose, treat, cure, or prevent any disease.**

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