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Joint Health Supplements Review (Glucosamine, Chondroitin, MSM, Boswellia, Collagen and Turmeric)

18% of Joint Health Supplements Failed to Pass Our Tests. See Which Passed or Failed, and Our *Top Picks*.

Latest Update

Boswellia for Knee Osteoarthritis?

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Summary

Do supplements for joint pain and joint health work?

Several dietary supplement ingredients may help reduce joint pain (particularly of the knee or hands, but not the back or hip) due to osteoarthritis (worn joints), although the evidence is not overwhelming (see What It Does). As noted below, ConsumerLab.com tested the quality of products containing one or more of these ingredients.

Which joint health supplements are best?

About 12% of products selected for testing were ***NOT* Approved** by ConsumerLab because they failed to provide the amounts of ingredients listed on their labels — containing just 2.3% to 57% of listed amounts (see What CL Found and How Products Were Evaluated). Seventeen products were **Approved** for their quality and one product was **Partially Approved** (see the Results Table). Approved products that provided appropriate doses of key ingredients at lowest cost — indicating superior value -- were selected as CL's ***Top Picks***). Products tested include *ArthroMax*, *Cosamin*, *Dona*, *Joint Food*, *Instaflex*, *Osteo Bi-Flex*, *OsteoMove*, *Previnex*, *Synovx*, *Triflex*, and many other combinations containing glucosamine, chondroitin, MSM, and/or boswellia.

How much to take?

- **Glucosamine (including NAG) and chondroitin:** These may be used separately, but most studies have looked at these in combination. Modest pain relief may take several months. Look for products providing a total daily dose of 1,200 mg of glucosamine (sulfate or HCl) with or without 800 mg to 1,500 mg of chondroitin sulfate. See What it Does — Glucosamine and Chondroitin and ConsumerTips: Glucosamine and Chondroitin.

- **MSM:** Although in many products, the evidence is very limited for MSM. In animals, it is used to treat muscle soreness. An optimal dose has not been established, but daily dosage typically ranges from 500 mg to 3,000 mg. See What It Does — MSM and ConsumerTips: MSM.

- **Boswellia:** The resin of this plant contains an anti-inflammatory compound, AKBA, so its effects should be felt within a few days or weeks. Note that if only Boswellia *resin* is listed, it is likely less potent than Boswellia *extract* (i.e., an extract from the resin), as only about 1% of resin is AKBA, while 6% to 40% of extract is AKBA. (We show the amount of AKBA found in each product in the Results table.) A typical daily dose of Boswellia extract is 100 mg to 250 mg. Taking Boswellia extract along with fatty foods may enhance absorption. See What It Does — Boswellia and ConsumerTips: Boswellia.

- **Turmeric:** Curcuminoids and other compounds in turmeric provide an anti-inflammatory effect that may provide modest benefit in rheumatoid arthritis and osteoarthritis, although no better than anti-inflammatory medicines. The typical daily dose ranges from 500 mg to 2,000 mg of curcuminoids (most of which is curcumin) from turmeric *extracts*, which may be as much as 95% curcuminoids. Products that have shown benefit are typically formulated for enhanced absorption, as curcuminoids are otherwise not well absorbed unless taken with a meal containing fats. (For tests of additional turmeric products and more details about their use, see our separate **Turmeric and Curcumin Supplements Review**, which includes our tests of the combination supplement *Zyflamend*, promoted for pain relief and joint support.)

- **Collagen:** Collagen may modestly improve joint pain and flexibility in osteoarthritis, although improvements can require two to six months of daily use. The type of collagen most studied for this use is undenatured collagen (such as UC-II and Vital 3), which is different from the hydrolyzed collagen typically used to improve skin appearance. (For tests of additional collagen products and more details about their use, see our separate **Collagen Supplements Review**.)

- **Combinations:** Although combinations are convenient, many marketed formulas (other than glucosamine and chondroitin) have not been clinically tested. Before trying a combination, try products with specific, single ingredients and see which, if any, help. This approach can also be less expensive, as combinations are often more expensive than buying each of the ingredients separately.

Joint health supplements safety, side effects and drug interactions:

Most of these ingredients can cause some gastrointestinal upset (such as nausea) and, although generally safe, some can interact with drugs (such as those for blood thinning), trigger allergies, or cause other side-effects. See **Concerns and Cautions**.

For other types of supplements that may be helpful in treating joint pain, see ConsumerLab.com's Reviews of SAMe, Ashwagandha, Cinnamon, and Ginger.

Be aware that muscle **strengthening exercises** and physical activity can also reduce joint pain and improve function associated with osteoarthritis.

(See Separate Review of Joint Health Supplements for *Pets*.)

Products tested in 2025

What It Is:

Glucosamine and chondroitin

Glucosamine and chondroitin sulfate occur naturally in the body. The glucosamine used in supplements is typically derived from the shells of shrimp or crabs although a corn source is also available (look for products identifying as non-shellfish). Glucosamine is available in a variety of chemical forms, such as glucosamine hydrochloride and glucosamine sulfate. These differ in terms of the amount of actual glucosamine available for use in the body from an equal weight of each form (See ConsumerTips: Glucosamine and Chondroitin for more information). Chondroitin sulfate is generally derived from pig or cow cartilage, but even shark and chicken cartilage has been used. "Vegan" chondroitin, such as the product *Mythochondro* (which is derived from fermented bacteria) and chondroitin-like mucopolysaccharides from algae, are also available.

MSM

MSM (methylsulfonylmethane) occurs naturally in the body but MSM in supplements is produced synthetically.

Boswellia

The gum resin of the Indian frankincense tree (*Boswellia serrata*) contains compounds (boswellic acids) thought to have anti-inflammatory properties. Most supplements contain an extract of this resin, often standardized to contain specific amounts of one or more of these boswellic acids, such as AKBA and KBA.

Turmeric

Curcuminoids and other compounds in turmeric provide an anti-inflammatory effect. Turmeric *extracts* may be as much as 95% curcuminoids. Products that have shown benefit are typically formulated for enhanced absorption, as curcuminoids are otherwise not well absorbed unless taken with a meal containing fats. (See our separate **Turmeric and Curcumin Supplements Review**.)

Collagen

Collagen is the most abundant protein in the body. It is a rich source of amino acids -- especially glycine, proline, and hydroxyproline, which are used by the body to build new collagen. Collagen supplements are typically derived from animal sources such as cows, pigs, chicken, or fish, and occasionally, from other sources, such as eggshell membranes. There are many types of collagen, but supplements for joint health typically contain type II collagen, which is found most abundantly in cartilage. (See our separate **Collagen Supplements Review**.)

What It Does:

Glucosamine and Chondroitin

Osteoarthritis

Glucosamine and chondroitin sulfate supplements are used in hopes of slowing the progression of osteoarthritis (the deterioration of cartilage between joint bones) and reducing the associated pain. Glucosamine is thought to promote the formation and repair of cartilage. Chondroitin is believed to promote water retention and elasticity in cartilage and inhibit enzymes that break down cartilage.

Many studies have been conducted with glucosamine and chondroitin (some are described below) and the results have been mixed. In short, they may **modestly reduce knee pain if you have moderate to severe knee pain, although benefits may not occur for several months**. In addition, if you have mild to moderate osteoarthritis, particularly of the knee, these agents may, over a period of years, **slightly reduce the extent of further loss of cartilage volume**. These agents generally **do not appear to improve functioning of the knee, nor do they help with back pain or hip pain caused by osteoarthritis**. However, chondroitin sulfate has shown **some benefit over a 6-month period in people with hand osteoarthritis**.

Due to concerns about the quality of evidence (i.e. most of the studies showing a benefit have been company-funded, while studies with the least risk of bias have not found a benefit) the American College of Rheumatology/Arthritis Foundation has **advised against supplementation with glucosamine for knee, hip or hand osteoarthritis**. It also **advised against chondroitin supplementation for knee and hip osteoarthritis, but noted that one trial suggests a benefit with chondroitin sulfate for hand osteoarthritis** (Kolasinki, Arthritis Rheumatol 2020).

Interestingly, one possible way in which glucosamine and chondroitin may work is by changing the bacterial population of the gut toward bacteria known to produce short-chain fatty acids, such as butyrate -- which can act as an anti-inflammatory agent. This was shown in a small, placebo-controlled study in which 10 subjects took three capsules (*Cosamin DS*, each containing 500 mg of glucosamine hydrochloride and 400 mg of chondroitin sulfate) daily for two weeks (Navarro, Microorg 2019).

Two major studies of the combination of glucosamine and chondroitin for **knee osteoarthritis** have been conducted, with somewhat different results -- although this may be due to differences in the form of glucosamine used and in the study populations. A study sponsored by the National Institutes of Health (NIH), called the Glucosamine/Chondroitin Arthritis Intervention Trial (or GAIT study), showed that the combination of glucosamine hydrochloride (1,500 mg per day) and chondroitin sulfate (1,200 mg per day) did not reduce narrowing of the joint space of the knee and only reduced knee pain among people starting with moderate to severe knee pain, not those with mild pain.

A later study in Australia (the Long-term Evaluation of Glucosamine Sulfate or LEGS study) used glucosamine *sulfate* (1,500 mg per day) instead of glucosamine hydrochloride, as well as chondroitin sulfate (800 mg per day). That study focused primarily on people with early disease and mild pain. Although all patient groups receiving glucosamine and/or chondroitin reported a reduction in pain, the reduction was not significantly greater than among those receiving placebo. However, the amount of joint space narrowing which occurred during the study (an indicator of disease progression) among those taking the combination of glucosamine and chondroitin was only half the amount of narrowing that occurred among those who received placebo, and taking either glucosamine or chondroitin alone had no significant effect on narrowing. It would seem that the combination of these two ingredients may be important, and glucosamine sulfate may be more useful than glucosamine hydrochloride in slowing the progression of knee osteoarthritis.

A 6-month study in Europe found that 800 mg of pharmaceutical-grade chondroitin sulfate (95% pure, Chondrosulf, IBSA, Switzerland) was similar to 200 mg of celecoxib (Celebrex) in reducing pain and improving function relative to placebo in people with mild to moderate knee osteoarthritis. It should be noted, though, that improvement took longer with chondroitin (6 months vs. 3 months for celecoxib), and the improvement for both treatments was only somewhat greater than with placebo, i.e., on a pain scale of 0-100, pain fell by 42.6 points with chondroitin, 39.6 points with celecoxib, and 33.3 points with placebo. All treatments (taken with a glass of water every evening) demonstrated excellent safety profiles. Due to the potential for side-effects with celecoxib (a non-steroidal anti-inflammatory), the researchers suggested that chondroitin sulfate should be considered as a first-line treatment for knee osteoarthritis (Reginster, BMJ Ann Rheum Dis 2017).

A small study in Italy among overweight men and women (average age 62) with mild to moderate knee osteoarthritis (or impaired knee mobility and pain) found that 600 mg of non-animal derived chondroitin sulfate (Mythocondro, by Gnosis Inc., which funded the study) taken once daily for three months modestly improved knee function and mobility, and reduced knee pain, compared to placebo. Certain measures of inflammation in the body (CRP and erythrocyte sedimentation rate (ESR)) also decreased among those taking chondroitin compared to placebo. Mythocondro is produced through fermentation of sugar by a specific strain of *E. coli*, resulting in the formation of chondroitin, to which sulfate is chemically added. The final product is purified and endotoxins are monitored to "guarantee the safety of the final product" (Rondenelli, Nutrients 2019). It is sold in the U.S. as "vegetarian chondroitin sulfate sodium" in *Health Logics Mytho Condro*. ConsumerLab has not yet tested any products containing this form of chondroitin.

A 6-year study among people who reported using glucosamine and chondroitin (no specific product) and had knee osteoarthritis without total loss of cartilage found no effect on pain reduction but a slight (1%) reduction in cartilage volume loss, particularly in the lateral compartment of the knee (Raynauld, Arthritis Care Res, 2016).

A short-term (6-month) study in Spain of 164 patients with moderate to severe pain from knee osteoarthritis, taking 1,500 mg of glucosamine sulfate with 1,200 mg of chondroitin sulfate daily failed to demonstrate superiority over placebo in reducing pain and improving joint function limitation (Herrero-Beaumont, Osteoarth Cartlg 2016 OARSI abstract).

A 6-month study of glucosamine hydrochloride (1,500 mg daily from Regenasure as a beverage) in patients with mild to moderate knee pain found that it did not decrease pain, reduce worsening of cartilage damage, or improve bone marrow lesions in the knee (thought to be a source of pain in those with osteoarthritis) compared to placebo (Kwoh, Arth & Rheum 2014). Glucosamine also did not decrease urinary levels of peptides considered predictors of cartilage destruction. The report notes that some longer-term studies using glucosamine sulfate, rather than glucosamine hydrochloride, have shown benefit in knee osteoarthritis.

A well-controlled study of glucosamine sulfate (1,500 mg per day) versus placebo for **lower back pain** caused by osteoarthritis showed that both glucosamine and placebo improved symptoms reported by patients. However, there was no significant difference in the level of improvement between the groups, suggesting that glucosamine is not truly effective for lower back pain (Wilkens, JAMA 2010).

A 2007 review of several past, large-scale studies of chondroitin alone concluded that it did not provide a benefit in **osteoarthritis of the knee or hip** (Reichenbach, Ann Intern Med 2007). However, a 2015 review of past studies concluded that chondroitin "may improve pain slightly in the short-term (less than 6 months)" and in 6 out of 100 people it may improve pain by 20%. In addition, chondroitin "slightly slows down narrowing of the joint space" and people taking it actually reported fewer adverse effects than those taking placebo (Singh, Cochrane Library 2015).

A six-month study of chondroitin sulfate (800 mg once daily) versus placebo in patients with **hand osteoarthritis** showed a significantly greater decrease in hand pain and improvement in hand function among those taking chondroitin sulfate (Gabay, Arth & Rheum 2011). The duration of morning stiffness was also slightly reduced. These benefits were not noticeable until after 3 months of treatment. There was no significant difference in grip strength or the amount of analgesic used by patients. The chondroitin tested in the study was a tablet containing highly purified (95% pure) chondroitin of fish origin marketed at that time as Chondrosulf (IBSA, Switzerland) in Europe. Similarly, patients with hand and knee osteoarthritis who were given 1,500 mg of glucosamine sulfate daily to help treat osteoarthritis of their knees showed, after 3 months, a significantly greater decrease in hand pain and improvement in hand function as compared to patients not given glucosamine. Both groups were prescribed hand exercises and anti-inflammatory medication — although the patients receiving glucosamine chose to use lower amounts of the anti-inflammatories. Weaknesses of the study were that it was conducted retrospectively, lacked a placebo, and both doctors and patients were aware of the treatment given (Tenti, Aging Clin Exp Res 2019). The glucosamine used was a patented crystalline glucosamine sulfate made by Rottapharm which is sold in the U.S. as *Dona*, which ConsumerLab tested in 2016 and was Approved for quality.

Cardiovascular disease

There is *mixed evidence as to whether glucosamine and chondroitin affects the risk of cardiovascular disease and death*. It is important to keep in mind that none of the evidence, in either direction, is based on clinical studies, but on associations seen in populations using these supplements.

A study of Washington state residents aged 50 to 76 years found that use of glucosamine and use of chondroitin were each associated with a statistically significant **decrease in mortality** (a 17% lower risk of death during a 5-year study period), while there was no such association for 13 different vitamins and minerals, fish oil, fiber, or several herbal supplements. The authors proposed that the apparent benefit with glucosamine and chondroitin may relate to their anti-inflammatory properties (Pocobelli, Am J Clin Nutr 2010). Further analysis of the data revealed that the benefit may primarily rest with glucosamine (which is in most chondroitin supplements), as there was an even greater reduction (22%) in risk of death associated with glucosamine without chondroitin. Glucosamine was also associated with a particularly large (41%) reduction in risk of death from respiratory diseases such as lung cancer (Bell, Eur J Epidemiol 2012). Similarly, a study of nearly half a million adults in the UK found that self-reported glucosamine use was associated with a 15% lower **risk of cardiovascular disease**, a 22% **lower risk of death**, an 18% **lower risk of coronary heart disease** (with an even greater effect in current smokers -- a 37% lower risk), and a 9% lower risk of **stroke** over a period of about 7 years after adjusting for potentially confounding variables. Although information about the dose and type of glucosamine was not collected, glucosamine is a prescription medication in the UK (and Europe) and most products are glucosamine sulfate (Ma, BMJ 2019). Additional analysis of the same data found regular use of glucosamine was also associated with a 17% lower **risk of type 2 diabetes**, even after adjusting for common risk factors (Ma, Diabetes Care 2020).

On the other hand, glucosamine supplementation was associated with an ***increased*** **risk of cardiovascular disease among people with osteoarthritis** in a large observational study in China. Those who took glucosamine supplements had a 12% increased risk of being diagnosed with coronary heart disease and a 10% increased risk of being diagnosed with overall cardiovascular disease, compared to those who never took glucosamine, after adjusting for confounding factors. There was no association with the risk of stroke. Overall cardiovascular risk was greatest among those who took the highest doses of glucosamine most regularly, with a 68% increased risk among those with high adherence and 26% increased risk with partial adherence, respectively. There was no increased risk among those with low adherence, although dosage ranges were not provided. The analysis did not adjust for severity of osteoarthritis or other risk factors for cardiovascular disease such as obesity and physical activity level (Yu, Nutrients 2022).

Cancer

A study that followed 20,541 *new-users* of glucosamine and the same number of non-users for about 8 years found that glucosamine use was *not* associated with an increased or decreased risk of lung cancer, colorectal cancer, breast cancer in women, or prostate cancer (Suissa, Arthritis Care Res (Hoboken) 2024). Some earlier studies had suggested a lower risk of lung cancer (Brasky, Cancer Causes Control 2011) and colorectal cancer (Kantor, Cancer Causes Control 2018) among people taking glucosamine, but these studies may have been skewed by the fact that they included individuals who had already been taking glucosamine *prior* to the studies, i.e., people who may have "survived" potential negative effects of glucosamine (Suissa, Pharmacoepidemiol Drug Saf 2022).

Depression

Glucosamine does *not* appear to have an antidepressant effect according to a study in India in which only four out of twenty people (20%) with **major depression** reported a reduction in symptoms. The study had no placebo-control, but analysis of other studies of depression have shown that, on average, about 37% of people receiving placebo medications show a benefit, which is better than what was found with glucosamine. In the study, glucosamine was given as 1 gram daily for one week followed by 2 grams daily for 3 weeks (Kumar, Asian J Psychiatr 2020). Although depression and depressive mood has been reported as *a side effect* by a small percentage (6% or less) of people taking glucosamine sulfate (1,500 mg daily) for osteoarthritis, the frequency of this side effect was not significantly different than that reported by placebo groups (Reginster, Lancet 2001; Hughes, Rheumatology 2002).

Other uses

In veterinary medicine, glucosamine and chondroitin, often in combination, are commonly used in the treatment of degenerative joint disease typically in older dogs and cats as well as in horses. (See separate review of Joint Health Supplements for Pets).

NAG

Inflammatory bowel disease (IBD)

A form of glucosamine called **N-acetyl-glucosamine**, or NAG, may be beneficial for **inflammatory bowel diseases (IBD)** such as **Crohn's disease** and **ulcerative colitis** — although the supporting evidence is far from conclusive and based on studies that lacked placebo controls. NAG is naturally produced in the body and helps to maintain and repair the mucus lining of the gastrointestinal tract. In Crohn's disease and ulcerative colitis, the body's ability to produce NAG may be reduced (Goodman, Gut 1997). A study in children with severe treatment-resistant Crohn's disease or ulcerative colitis found 8 of 12 children who received NAG powder (3 - 6 grams taken with water in three divided doses daily) had clinical improvement; 4 had no improvement and required surgery (Salvatore, Aliment Pharmacol Ther 2000). In another small study, adults with IBD who were given 6 grams of NAG powder (*Villicote*, Wellesley Therapeutics Inc.) daily -- as three divided doses of 2 grams each, added to water — experienced improvements in symptoms: 58.8% reported improvement in abdominal pain (average symptom score decreased by 49%), 64.7% reported improvement in diarrhea symptoms (average symptom score decreased by 47%) and 41.2% reported improvement in nausea symptoms (average symptom score decreased 55%) (Zhu, Natr Med J 2015). Health Canada allows the claim, "Helps promote a healthy intestinal lining in people with symptoms associated with inflammatory bowel disease," for a product providing a daily dose of 3,000 mg of N-acetyl-glucosamine and 600 mg vitamin C (*C-NAG*, Vitex). There are no published clinical studies of the effects of NAG on **irritable bowel syndrome (IBS)**, but one is underway (NCT02504060).

Joint pain

NAG may also be beneficial for joints, according to a placebo-controlled study that found that a daily dose of 500 mg N-acetyl-glucosamine slowed the breakdown and increased the production of type II collagen in healthy adults (average age 48) *without* arthritis (Tomonaga, Exp Ther Med 2016). In older adults in Japan with knee pain and stiffness, a combination N-acetyl glucosamine (100 mg) and chondroitin sulfate (180 mg) taken daily for five months modestly improved function during household activities, but did not improve leisure time physical activity or reduce pain, compared to placebo (Tsuji, Aging Clin Exp Res 2016).

MSM

MSM is used primarily for treating pain associated with osteoarthritis and has been proposed for treating other conditions including rheumatoid arthritis, inflammation of the bladder wall (interstitial cystitis), snoring, muscle spasm, and cancer. All of these uses for MSM, including those for arthritis, are based on limited research, so its effectiveness hasn't been well established. Examples of this research include the following:

A small placebo-controlled study of MSM in women and men competing in a half-marathon found that those taking MSM (3,000 mg per day for 21 days prior to the race and 2 days afterward) experienced less **muscle and joint pain** after the race, but the reductions were *not* deemed statistically significant and MSM did not reduce biological markers of oxidative stress and muscle damage (Withee, J Int Soc Sports Nutr 2017).

A study among 63 women ages 35 to 59, none of whom regularly used nutritional supplements, showed that taking 1,000 mg or 3,000 mg of MSM (*OptiMSM® 1,000* by Bergstrom Nutrition, which funded the study) once daily in the morning (with or without food) for 4 months improved **nail shine as well as hair shine and volume** (but not split ends) compared to baseline. *However, this study did not include a placebo group, which is needed to prove benefit.* The higher dose seemed to work faster than the lower dose, as hair improvements were observed starting at 4 weeks for those given 3,000 mg of MSM compared to 8 weeks for those given 1,000 mg (Muizzuddin, Nat Med J 2019).

The mechanism by which MSM may work isn't well understood, although it is known to contribute sulfur to the body, which can then be used to synthesize certain amino acids (building blocks for proteins), and it can act as an antioxidant. As a veterinary medicine, MSM is used to treat muscle and tendon soreness and inflammation in horses -- see separate review of Joint Health Supplements for Pets.

Be aware that MSM **eye drops** have been marketed to treat **dry eye**, *but MSM is not legally marketed for use in eye-related products in the U.S.* One brand of MSM eye drops was recalled in 2023 for bacterial and fungal contamination. (Learn about other supplements for dry eye.)

Boswellia

One particular boswellic acid known as AKBA (3-O-acetyl-11-keto-beta-boswellic acid) appears to be the most potent anti-inflammatory component in Boswellia. AKBA is a potent inhibitor of 5-lipoxygenase (5-LOX), a key enzyme in the biosynthesis of leukotrienes, which are compounds that cause inflammation. Extracts of Boswellia appear to have a variety of other biochemical effects, including inhibiting matrix metalloproteinases (MMP-3s), enzymes that break down cartilage, collagen and connective tissues (Roy, Antioxid Redox Signal 2006; Sengupta, Arthritis Res Ther 2008). *Boswellia resin and extracts have shown benefit in reducing symptoms of knee osteoarthritis and ulcerative colitis, although studies have typically been small and have involved company funding and/or company employees as investigators. Boswellia extract, in combination with other ingredients, does not appear to reduce pain due to hand osteoarthritis.*

Osteoarthritis

Several studies have found Boswellia extracts to improve symptoms of osteoarthritis of the knee.

A study in India among 48 men and women with **knee osteoarthritis** found that a Boswellia extract taken twice daily for four months reduced knee pain and stiffness and improved physical function, compared to placebo. X-ray imaging showed that those who took the Boswellia had a significant increase in the knee joint space and a decrease in bone spurs relative to those who took the placebo (in whom knee joint space decreased due to loss of cartilage). The boswellic extract used in the study (*Boswellin* by Sabinsa, which funded the study) contained 87.3 mg of total boswellic acids including 53.27 mg of AKBA per tablet, and one tablet was taken twice daily. The participants did not take other medications to treat osteoarthritis during the study. No serious adverse events were reported (Majeed, Phytother Res 2019). Unfortunately, when we tested a product containing this branded ingredient, *Natures Plus Boswellin*, we found only 61.8% of the claimed boswellic acids and it provided only 10.2 mg of AKBA per capsule (see What CL Found). However, other products tested in our review can provide amounts of AKBA comparable to the 53.27 mg per dose used in the study, although it may require adjusting the suggested serving size.

A study among 89 men and women with mild to moderate degenerative hypertrophy osteoarthritis of the knee (a type of osteoarthritis that can cause bony growths, or osteophytes, also known as "bone spurs," on the edges of bones in joints) who took one tablet containing 150 mg of Boswellia extract (*Boswellin Super*, by Sabinsa) twice a day (after breakfast and dinner) for three months had significant decreases in self-reported pain and stiffness, and modest increases in walking distance, compared to placebo. Those who took the extract had an average decrease in pain of 21 points (on a scale of 0 to 100) as measured by the Visual Analog Scale (VAS), and a decrease of 27 points (on a scale of 0 to 96), as measured by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), compared to no decrease in VAS scores and a decrease of only 8.9 points in WOMAC scores among those who took the placebo. Those who took the extract also had modest increases in walking distance compared to placebo, and a greater percentage of participants who took the extract had a decrease in osteophytes and an improvement in joint spacing compared to placebo (42% vs. 13%). A higher dose of extract (300 mg twice daily) resulted in similar improvements as the lower, 150 mg, dose. *Boswellin Super* is standardized to 30% AKBA, 7.5% β-boswellic acid, 3.5% of 3-O-acetyl-β boswellic acid, and 1.5% 11-Keto-β-boswellic acid. Several of the study authors were employees of Sabinsa, but the company did not directly fund the study (Majeed, Front Pharmacol 2024).

Another study in India using a lower daily dose of AKBA also showed a benefit. In the study, among 67 men and women (average age 51) with mild to moderate knee osteoarthritis, 50 mg of Boswellia extract standardized to 20% AKBA (Aflapin/AprèsFlex — as found in *Life Extension ArthroMax* in this review) taken twice daily (a daily total of 100 mg extract providing 20 mg of AKBA) for one month

reduced knee pain, stiffness, and functional limitation by 50%, 65%, and 46%, respectively, compared to placebo, as measured by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Those who took boswellia also had modest reductions in certain blood markers of inflammation, including TNFa and hsCRP, compared to placebo. The study was funded by Laila Nutraceuticals, which manufactures this extract (Karlapudi, J Am Nutr Assoc 2023). A subsequent study (by the same research group) that included 73 adults (average age 48) with mild to moderate knee osteoarthritis showed that taking the same dose of Aflapin/AprèsFlex once daily in the morning after breakfast for 6 months reduced pain, stiffness and functional limitations by 70%, 72%, and 71%, respectively, compared to baseline, and these reductions were statistically significant compared to the placebo group, which showed reductions of only 26%, 16%, and 18%, respectively. Taking Boswellia also increased 6-minute walk distance by 69.1 meters and reduced by 3.43 seconds the time needed to climb a set of stairs compared to placebo. Boswellia supplementation slightly increased (i.e., improved) joint spacing and cartilage thickness compared to the placebo group, which showed significant decreases (i.e., worsening) in these outcomes (Kumar, J Am Nutr Assoc 2024).

One study found that capsules containing a **combination of *Boswellia* and curcumin** (*Curamin* -- 350 mg curcuminoids and 140 mg boswellic acid, not tested in this Review) were modestly effective in reducing pain related symptoms of knee osteoarthritis and were slightly more effective than curcumin alone in improving physical function. The capsules were taken three times a day (Haroyan, BMC Compl Alt Med 2018).

A study among 106 adults (average age 66) with moderate to severe **hand osteoarthritis** showed that taking a combined supplement containing 250 mg of Boswellia extract along with 100 mg of pine bark extract, 1,500 mg of MSM and 168 mg of curcumin daily for 12 weeks did *not* significantly reduce hand pain (based on patient assessment) compared to placebo, although both groups showed significant reductions in pain compared to baseline, which suggests a large placebo effect. The study also found that the combined supplement did *not* reduce work impairment or activity impairment, or improve function or quality of life compared to placebo (Liu, Arthritis Rheumatol 2024).

Other uses

Preliminary studies suggest possible benefit in **asthma**, **Crohn's disease**, and **cancer**. Studies in **rheumatoid arthritis** have yielded mixed results.

Turmeric

Curcuminoids and other compounds in turmeric provide an anti-inflammatory effect that may provide modest benefit in rheumatoid arthritis and osteoarthritis, although no better than anti-inflammatory medicines. The typical daily dose ranges from 500 mg to 2,000 mg of curcuminoids (most of which is curcumin) from turmeric *extracts*, which may be as much as 95% curcuminoids. Products that have shown benefit are typically formulated for enhanced absorption, as curcuminoids are otherwise not well absorbed unless taken with a meal containing fats. For more details, see the What It Does section of the Turmeric and Curcumin Supplements Review.

Collagen

Collagen supplementation for at least three to six months may, at best, modestly reduce joint stiffness and/or pain according to several preliminary studies using various forms of collagen, including undenatured collagen, hydrolyzed collagen (collagen hydrolysate or collagen peptides), and eggshell membrane hydrolysates. Some studies have shown no benefit. For more details see the Joint Pain section of the Collagen Supplements Review.

Quality Concerns and Tests Performed:

Quality concerns

Glucosamine and Chondroitin

Although prior testing has shown most glucosamine products to meet label claims, glucosamine from shellfish such as shrimp and crabs may potentially be contaminated with lead. Chondroitin, on the other hand, is an ingredient with which ConsumerLab.com has found problems in the past — with products not always providing the listed amount of this expensive ingredient.

During the 1990s, there was concern with bovine (cow) sources of chondroitin due to Mad Cow disease (known scientifically as bovine spongiform encephalitis or BSE). However, there have not been any reported cases of the disease from chondroitin and the risk seems to be miniscule because the prion thought to be the causative agent of the disease exists only in very low levels in cartilage; it's most abundant in nervous and glandular tissues. The issue of BSE, however, may be avoided by choosing a product made from the cartilage of other animals, such as pigs (now a common source), chickens, or sharks -- although most products do not list the source of chondroitin.

Boswellia

An important distinguishing feature among Boswellia products is the concentration and amount of boswellic acids, such as AKBA. Consequently, the amounts of these acids in each product were determined and compared to the amounts claimed on products or, if no claim was made, expected minimum amounts based on the amount and type of Boswellia listed. In tests reported in 2016 and 2021, ConsumerLab.com has found that some products contained significantly less Boswellia extract than listed, based on the amounts of boswellic acids found.

Turmeric

As discussed in our **Turmeric and Curcumin Supplements Review**, supplements containing turmeric may be contaminated with lead, and turmeric extracts may not always provide their claimed amounts of curcuminoid compounds.

Tests performed

Because no government agency is responsible for routinely testing glucosamine, chondroitin, MSM, and Boswellia supplements for their contents for quality, ConsumerLab.com independently purchased and evaluated products to determine whether they contained the amounts of these ingredients, as well as turmeric and collagen, stated on their labels. Products containing glucosamine and/or chondroitin from a non-bovine source were tested for lead, and products containing whole herbs or 250 mg per suggested daily serving of minerals were tested for lead, arsenic, cadmium, and mercury.

In addition, all tablets and caplets (excluding chewable, sublingual or time-release) were tested for their ability to properly disintegrate ("break-apart").

What CL Found:

Among the 17 supplements ConsumerLab.com selected and tested, only 14 were **Approved** for meeting ConsumerLab's quality standards and FDA labeling requirements, while two were ***NOT* Approved** and one was **Partially Approved**, as described below, and shown in the Results table.

Through ConsumerLab.com's voluntary Quality Certification Program, in which products undergo the same testing, an additional four products were found to meet quality standards and were **Approved.**

NOT Approved

The two products that were ***NOT* Approved** all had lower amounts of at least one key ingredient than claimed. These deficiencies were confirmed in tests in a second independent laboratory. The most common problem was with Boswellia.

- ***Arazo Nutrition Joint Support*** contained less than 2.6 mg of its claimed 65 mg of boswellic acids — less than 4% of the listed amount. It fell even shorter on its claimed 100 mg of turmeric powder, which should provide a minimum of at least 3 mg of curcuminoid compounds but contained only 0.07 mg — just 2.3% of what we expected. It did, however, provide its listed amounts of glucosamine, chondroitin, and MSM.

- ***Natural Factors OsteoMove Extra Strength Joint Care*** provided only 57% of its listed 60 mg of boswellic acids from boswellia extract. It did, however, provide its listed amounts of glucosamine, chondroitin, MSM, collagen, and turmeric extract (based on curcuminoids found).

[**UPDATE (6/20/25)**: *Osteo Bi-Flex Triple Strength* was originally NOT Approved due to an incorrect assumption by ConsumerLab. It is now Approved. The product lists 100 mg of 5-Loxin "Advanced" which ConsumerLab assumed should contain 30% AKBA since that is the defined amount in 5-Loxin, and we found only 25%. However, 5-Loxin Advanced apparently contains a lower amount of AKBA — only 20% -- than in 5-Loxin and is the same ingredient as AprèsFlex, which is also 20% AKBA. This information does not appear to be published, but we were informed of this today in a conversation with representatives of Nestlè USA which owns Rexall Sundown, the manufacturer of *Osteo B-Flex*.]

Problems with Boswellia were also common in our Review in 2021, when three products failed for having less boswellic acids than expected: *Standard Process MediHerb Boswellia Complex M1152*, *Vimerson Health Glucosamine Chondroitin Turmeric & MSM*, and *NaturesPlus Boswellin*). Also in that Review, *1MD MOVEMD* failed for collagen and *Nature's Nutrition Joint Support Gummies* failed for glucosamine.

Joint Food could only be **Partially Approved**. This is because it is comprised largely of proprietary blends, including "Tamasteen," and does not disclose specific amounts of constituent ingredients that we could test and verify. It did, however, pass our tests for heavy metals, showing little to no contamination from lead, arsenic, cadmium, and mercury.

Heavy Metals and Disintegration

As noted in the 3rd column of the Results table, no supplement prone to heavy metal contamination was found to have an unacceptable level of lead, arsenic, cadmium, or mercury. The largest amount of lead found was 0.44 mcg per daily serving in *Natural Factors OsteoMove*, but this is below the strict **California Prop 65** 0.5-mcg level that would require a warning of potential reproductive harm, and it is far below the 15-mcg level requiring a cancer warning. All tablets and caplet products passed disintegration testing.

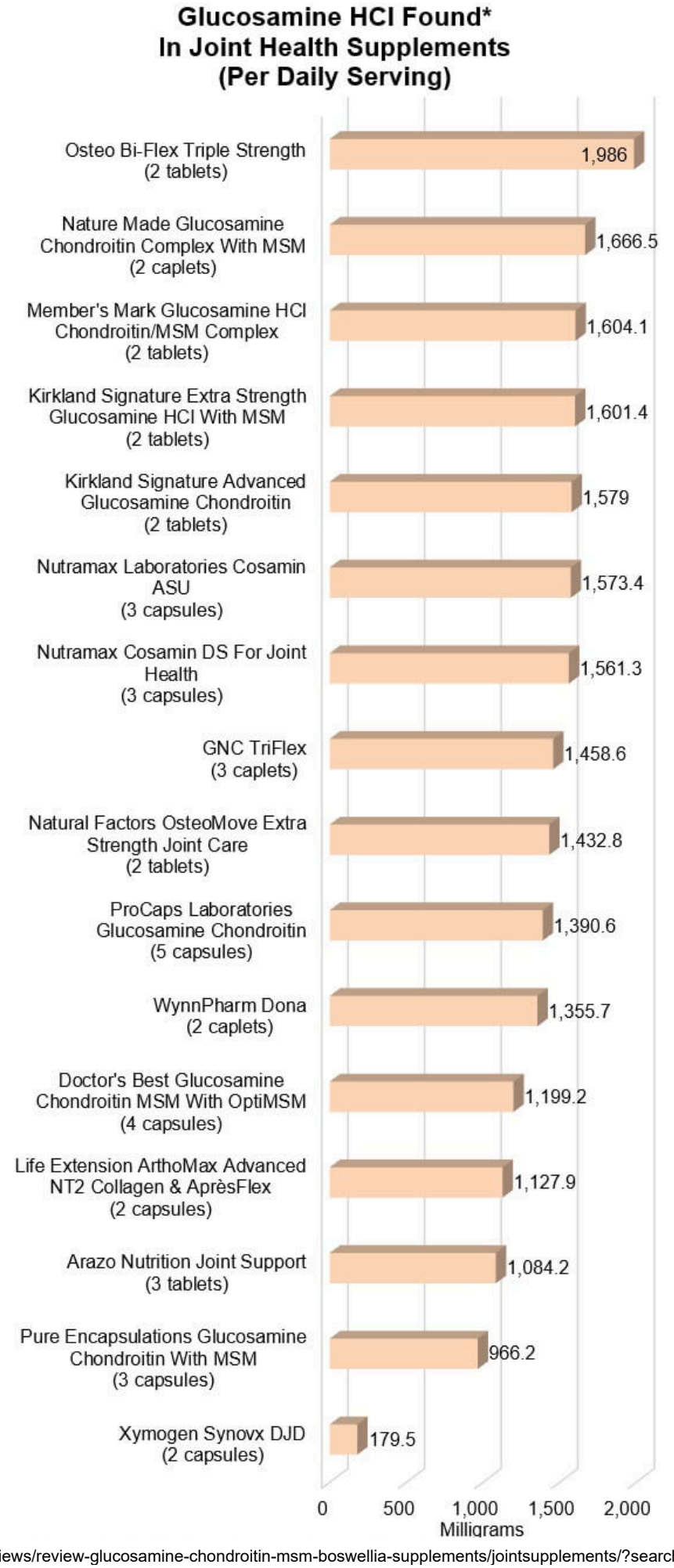
Differences in Formulas: Glucosamine as an example

The ingredients in joint health products differ greatly, as do the amounts of these ingredients — with some offering clinically relevant doses and others providing less. (See the Results table for the ingredients claimed and the amounts of key ingredients found.)

The most common ingredient across the reviewed joint health supplements is glucosamine, which has a long track record of use and has shown moderate benefit on knee osteoarthritis at a daily dose of 1,500 mg of glucosamine HCl (or 1,500 mg of glucosamine sulfate, which provides somewhat less glucosamine because the sulfate form is about 60% glucosamine while the HCl form is 83% glucosamine).

As an example of the differences among products, the graph below shows the amount of glucosamine HCl (or equivalent amount of glucosamine sulfate) found in a daily serving of each product that listed a specific amount of glucosamine. You can see that the amount of glucosamine HCl (or equivalent) ranges from as little as 179.5 mg in *Xymogen Synovx DJD* to 1,989 mg in *Osteo Bi-Flex Triple Strength*. Products with lower amounts of glucosamine, like *Xymogen*, tend to provide it in combination with other ingredients, although such combinations have not necessarily been clinically studied.

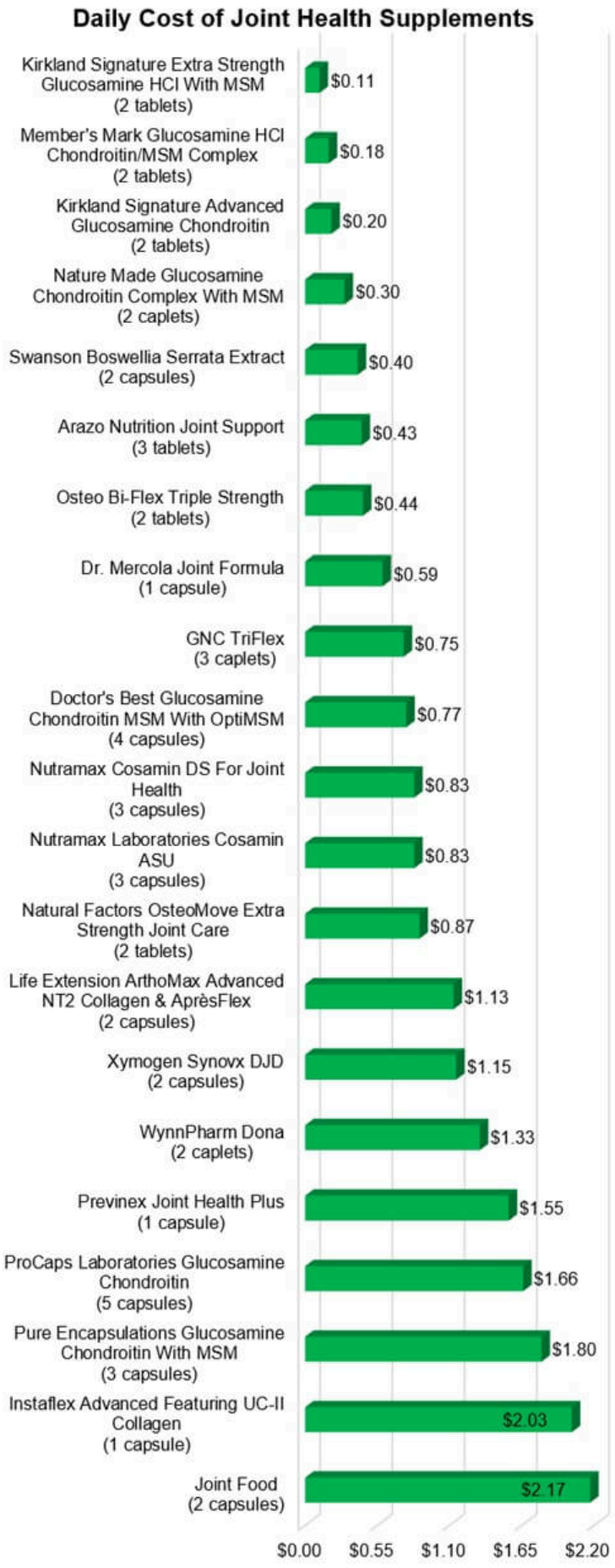
Note: Five products are not included in this graph because they don't list glucosamine, or a specific amount of it, as an ingredient.


Glucosamine HCl Found*
In Joint Health Supplements
(Per Daily Serving)
Osteo Bi-Flex Triple Strength (2 tablets)
1,986
Nature Made Glucosamine Chondroitin Complex With MSM (2 caplets)
1,666.5
Member's Mark Glucosamine HCl Chondroitin/MSM Complex (2 tablets)
1,604.1
Kirkland Signature Extra Strength Glucosamine HCl With MSM (2 tablets)
1,601.4
Kirkland Signature Advanced Glucosamine Chondroitin (2 tablets)
1,579
Nutramax Laboratories Cosamin ASU (3 capsules)
1,573.4
Nutramax Cosamin DS For Joint Health (3 capsules)
1,561.3
GNC TriFlex (3 caplets)
1,458.6
Natural Factors OsteoMove Extra Strength Joint Care (2 tablets)
1,432.8
ProCaps Laboratories Glucosamine Chondroitin (5 capsules)
1,390.6
WynnPharm Dona (2 caplets)
1,355.7
Doctor's Best Glucosamine Chondroitin MSM With OptiMSM (4 capsules)
1,199.2
Life Extension ArthoMax Advanced NT2 Collagen & AprèsFlex (2 capsules)
1,127.9
Arazo Nutrition Joint Support (3 tablets)
1,084.2
Pure Encapsulations Glucosamine Chondroitin With MSM (3 capsules)
966.2
Xymogen Synovx DJD (2 capsules)
179.5
0
500
1,000
1,500
2,000
Milligrams

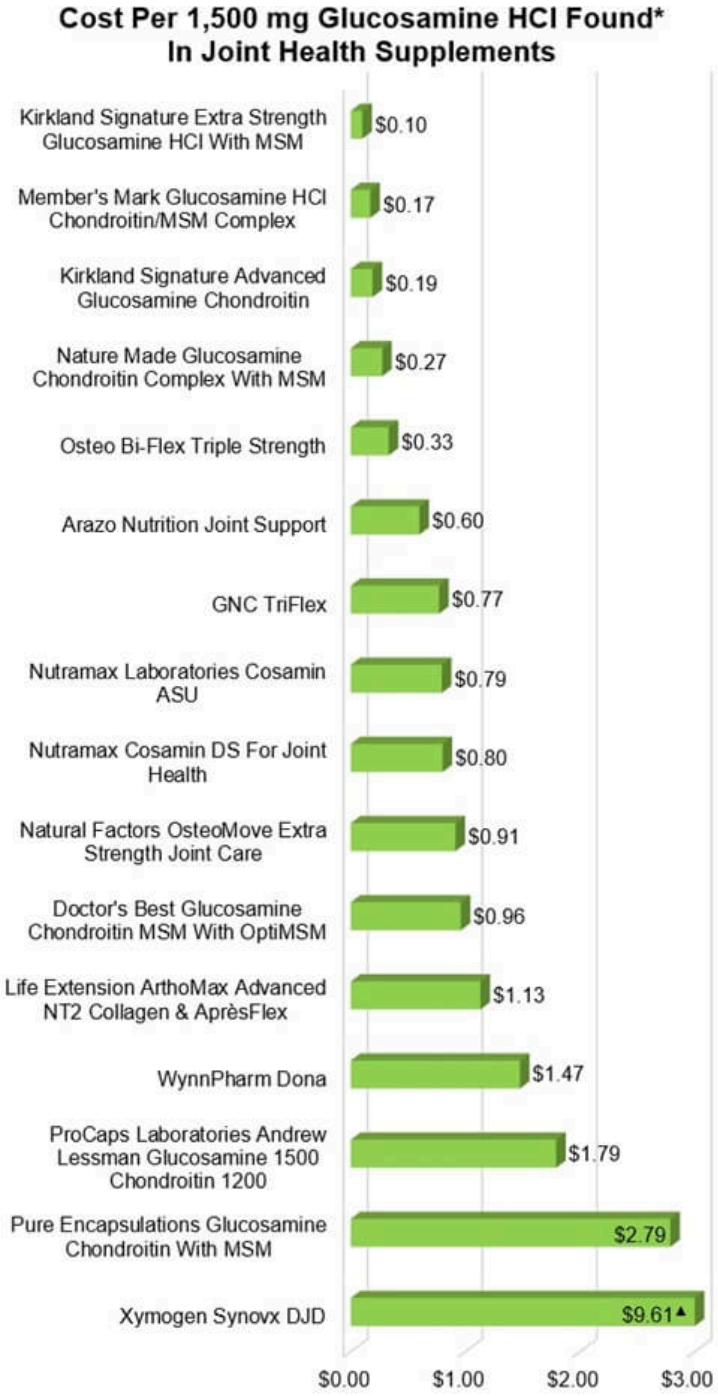
* For products claiming a form of glucosamine other than glucosamine HCl, amount was calculated to obtain an equivalent of amount of glucosamine HCl.

Cost

As shown below (and in the 5th column of the Results table), the daily cost of these supplements varies considerably — from as little at 11 cents (for 2 tablets of *Kirkland Signature* [Costco] *Extra Strength Glucosamine HCl With MSM*) to over $2 (for 2 capsules of *Joint Food* or a single capsule of *Instaflex Advanced*). Paying more doesn't necessarily mean you are getting a better product. In fact, five Approved products each cost less than any of the products that were *NOT* Approved.


Daily Cost of Joint Health Supplements
Kirkland Signature Extra Strength Glucosamine HCl With MSM (2 tablets)
$0.11
Member's Mark Glucosamine HCl Chondroitin/MSM Complex (2 tablets)
$0.18
Kirkland Signature Advanced Glucosamine Chondroitin (2 tablets)
$0.20
Nature Made Glucosamine Chondroitin Complex With MSM (2 caplets)
$0.30
Swanson Boswellia Serrata Extract (2 capsules)
$0.40
Arazo Nutrition Joint Support (3 tablets)
$0.43
Osteo Bi-Flex Triple Strength (2 tablets)
$0.44
Dr. Mercola Joint Formula (1 capsule)
$0.59
GNC TriFlex (3 caplets)
$0.75
Doctor's Best Glucosamine Chondroitin MSM With OptiMSM (4 capsules)
$0.77
Nutramax Cosamin DS For Joint Health (3 capsules)
$0.83
Nutramax Laboratories Cosamin ASU (3 capsules)
$0.83
Natural Factors OsteoMove Extra Strength Joint Care (2 tablets)
$0.87
Life Extension ArthoMax Advanced NT2 Collagen & AprèsFlex (2 capsules)
$1.13
Xymogen Synovx DJD (2 capsules)
$1.15
WynnPharm Dona (2 caplets)
$1.33
Previnex Joint Health Plus (1 capsule)
$1.55
ProCaps Laboratories Glucosamine Chondroitin (5 capsules)
$1.66
Pure Encapsulations Glucosamine Chondroitin With MSM (3 capsules)
$1.80
Instaflex Advanced Featuring UC-II Collagen (1 capsule)
$2.03
Joint Food (2 capsules)
$2.17
$0.00
$0.55
$1.10
$1.65
$2.20

Another way to compare products on cost is to look at the cost to obtain an equal amount of glucosamine from them, as most of the products include glucosamine. The graph below compares the cost to obtain a standard dose of 1,500 mg of glucosamine HCl (or an equivalent amount of glucosamine sulfate) from products that list specific amounts of these ingredients. This cost ranged from just 10 cents from *Kirkland Signature Extra Strength Glucosamine HCl with MSM* to 96 times that amount, or $9.61, from *Xymogen Synovx DJD*. Cost tended to be higher for products providing multiple ingredients and/or smaller amounts of glucosamine per daily serving — both of which were the case with *Xymogen*.



* For products claiming a form of glucosamine other than glucosamine HCl, cost was calculated to obtain an equivalent of amount of glucosamine from the claimed form.
▲ Cost exceeds scale of graph.

Top Picks:

Here are our *Top Picks* among Approved products for joint health. Although there are many combination products on the market — and many were Approved for quality in our tests — it may be best to try products with fewer ingredients first, to help determine which ingredients seem to help you and if they cause side effects.

Note: As discussed earlier, there is not as much supporting evidence for using chondroitin or MSM *alone*, so we did not test products that contain these as *single ingredients*, nor do we have *Top Picks* for such products.

Glucosamine

If you want **glucosamine**, it turns out that one of the least expensive ways to get a daily dose of about 1,500 mg of glucosamine HCl or glucosamine sulfate is from combination products. We tested just one glucosamine-only product, *WynnPharma Dona*, and, although it passed our tests, it was extremely expensive -- $1.33 per 2-caplet daily serving ($39.99 for 60 caplets), making it hard to justify as a *Top Pick*. You can spend much less to get the same amount of glucosamine plus 1,200 mg of chondroitin sulfate sodium from ***Kirkland Signature (Costco) Advanced Glucosamine Chondroitin*** for just 20 cents for 2 tablets, making it our *Top Pick* for glucosamine and chondroitin. Just be aware that this form of chondroitin has some sodium (about 80 mg per daily serving), and chondroitin may have a blood thinning effect.

Also Approved, but more expensive, is *Cosamin DS for Joint Health*. The amounts and forms of glucosamine and chondroitin listed in it are the same as in *Kirkland's* version, but only *Cosamin DS* has been clinically tested. It sells for 83 cents per day for its initial suggested dose of 3 capsules daily, which may be reduced to a lower maintenance dose. *ProCaps Laboratories Andrew Lessman Glucosamine 1500 Chondroitin 1200* is also similar but costs much more -- $1.66 per day — and it contains the sulfate form of glucosamine rather than the HCl form.

The lowest-cost option for getting glucosamine is ***Kirkland Signature (Costco) Extra Strength Glucosamine HCl with MSM***, which provides the same amount of glucosamine HCl as *Kirland's Advanced* product (above) but with MSM. It costs only 11 cents for 2 tablets. While it is our *Top Pick* for the combination of glucosamine and MSM, be aware that there is less research with glucosamine in combination with MSM than with chondroitin.

If you want **glucosamine, chondroitin and MSM**, our *Top Pick* is ***Nature Made Glucosamine Chondroitin With MSM***. It provides 1,500 mg of glucosamine HCl, 800 mg of chondroitin sulfate sodium, and 750 mg of MSM for 30 cents per 2-caplet daily dose. However, it also includes 2,000 IU (50 mcg) of vitamin D3, which is more than double the daily adult requirement (600 IU or, if over 71 years, 800 IU) but lower than the Tolerable Upper Intake Level of 4,000 IU. If you want to avoid this vitamin D, good alternatives (although more than twice the cost) are *Doctor's Best Glucosamine Chondroitin MSM with OptiMSM* (77 cents per day) and *GNC TriFlex* (75 cents per day), both of which provide more chondroitin sulfate than *Nature Made*. We don't recommend *Pure Encapsulations Glucosamine Chondroitin With MSM*, as it provides less glucosamine and chondroitin than these two products yet costs much more ($1.80 per day).

We also don't recommend *Member's Mark Glucosamine HCl Chondroitin/MSM Complex* because, although relatively inexpensive, it does not disclose its amounts of chondroitin or MSM, listing them only as parts of a proprietary "complex." It did, however, contain its listed amounts of glucosamine HCl and Boswellia extract.

Boswellia

When buying **Boswellia** you *really need to know the amount of AKBA in the product*, as this is believed to be the active component. However, AKBA is not always listed on labels. Only 1% of a Boswellia "resin" product is likely to be AKBA, while 6% to 40% of a Boswellia "extract" will be AKBA. Because we tested for AKBA, we show the amounts in each product in the Results table. Clinical studies suggest benefits with daily doses of Boswellia providing about 7 to 75 mg of AKBA.

We tested nine products claiming to provide specific amounts of Boswellia extract, most of which were combination products.

Among *Boswellia-only* products, our *Top Pick* is ***Swanson Boswellia Serrata Extract***, which claimed and provided a substantial dose of AKBA (we found 34 mg per capsule, although a bit less than the claimed 37.5 mg). The label suggests that one capsule be taken two times per day with food. At just 20 cents per veggie capsule, it was a far less expensive way to get a good dose of AKBA from Boswellia than from other products. For example, *Previnex Joint Health Plus* provides somewhat less AKBA but costs a whopping $1.55 per capsule — although it does include 500 mg of eggshell membrane and 75 mg of calcium. Those ingredients (as well as vitamin C, hyaluronic acid, and astaxanthin) are also in *Dr. Mercola Joint Formula*, which costs 59 cents per capsule, but we discovered it to provide only 3.2 mg of AKBA from Boswellia extract per capsule — less than 1/10th of the amount in a *Swanson* capsule.

Glucosamine *and* Boswellia

Our *Top Pick for glucosamine with Boswellia* is ***Life Extension ArthroMax*** because a 2-capsule serving (85 cents) provides clinically meaningful amounts of AKBA (21.2 mg — slightly more than claimed) from Boswellia extract, glucosamine sulfate 2KCL (1,583.6 mg — a bit more than claimed), and 40 mg of NT2 collagen (yielding 24.9 mg of collagen), which may also help with joint pain.

Test Results by Product:

Listed alphabetically within each product group below are test results for 21 supplements. Seventeen of these were selected for testing by ConsumerLab.com (based on survey responses from CL members). Four were tested at the request of their manufacturers/distributors through CL's voluntary Quality Certification Program and are included for having passed testing (they are marked with a CL flask).

Products that passed all tests are indicated as **Approved** in the first column, while those that failed one or more tests are listed as ***NOT Approved***, with the reason explained in red text in subsequent columns. One product is listed as **Partially Approved**, since it did not list specific amounts of key ingredients but passed heavy metal testing. Shown in the 2nd column are the claimed amounts of glucosamine, chondroitin, MSM, Boswellia, turmeric, and collagen and the suggested daily serving on its label. Also shown are the amounts found, with a checkmark if the amount was consistent with what was claimed within an acceptable margin. The 3rd column shows amounts of heavy metals found (if applicable) and if pills in tablet or caplet form could properly break apart (disintegrate) in solution. Labeled serving suggestions are in the 4th column along with a description of pill size. Price and cost comparisons are shown in the 5th column, and additional notable features and labeled precautions are shown in the 6th column. A full list of ingredients is found in the last column.

A separate review of Joint Health Supplements for Dogs and Cats is available.

Results of ConsumerLab.com Testing of Joint Health Supplements (Glucosamine, Chondroitin, MSM, Boswellia, Collagen and Turmeric)

(Price Checks are not included in printed reviews)

Approval Status **Product Name**	**Amounts of Key Tested Ingredients**	**Heavy Metals** **Disintegration**	**Suggested Serving on Label** **Description**	**Cost Per Daily Serving** **[Cost Per 1,500 mg Glucosamine HCl *Found*]**	**Notable Features and Precautions on Label**	**Full List of Ingredients Per Serving**
Glucosamine Only:						

APPROVED WynnPharm Dona™  Dist. by WynnPharm, Inc.	2 caplets 1,500 mg glucosamine sulfate sodium chloride (Found 1,887.7 mg ✓)	**Heavy Metals:** Pass Lead: 0.04 mcg (0.02 mcg/g) **Disinte-gration:** Pass	Take two caplets together daily with water or juice. Due to its mechanism of action, it may take 1-2 weeks, or possibly longer, to notice any effects. Optimal effects on joint health have been observed after 12 weeks of daily admini-stration. Large caplet	$1.33/2 caplets [$1.47] $39.99/60 caplets	Sodium 150 mg per 2 caplets **Precaution:** Contains shellfish and crab. If you are allergic to shellfish or crab, please consult your doctor before taking.	2 caplets Calories 0, Sodium 150 mg, Glucosamine Sulfate Sodium Chloride 1,500 mg. Other Ingredients: Micro-crystalline Cellulose, Polyvinyl Pyrrolidone K25, Cross-linked Sodium Carboxymethylcellulose Additional Information 2 caplets Calories 0, Sodium 150 mg, Glucosamine Sulfate Sodium Chloride 1,500 mg. Other Ingredients: Microcrystalline Cellulose, Polyvinyl Pyrrolidone K25, Cross-linked Sodium Carboxy-methylcellulose, Polyethylene Glycol 6000, Hydroxypropyl Methylcellulose, Magnesium Stearate, Titanium Dioxide (Color), Polydextrose FCC, Talc, Maltodextrin, Medium Chain Trigly-cerides.
Boswellia Only:						

APPROVED Top Pick for Boswellia Swanson® Boswellia Serrata Extract  Dist. by Swanson Health Products	2 veggie caps 250 mg boswellia extract (5-LOXIN) 75 mg AKBA (Found 68 mg ✓)	**Heavy Metals:** Pass Lead: 0.01 mcg (0.02 mcg/g) Arsenic: 0.1 mcg (0.17 mcg/g) Cadmium: 0.006 mcg (0.01 mcg/g) Mercury: 0.001 mcg (0.002 mcg/g) **Disinte-gration:**	Take one veggie capsule two times per day with food and water. Large veggie cap	$0.40/2 veggie caps $12.11/60 veggie caps	None.	1 veggie cap 5-LOXIN® *Boswellia serrata* Extract [standar-dized to 30% acetyl-11-keto-beta boswellic acid (AKBA) (gum resin)] 125 mg. Other Ingredients: Brown rice flour, hypromellose Additional Information 1 veggie cap 5-LOXIN® *Boswellia serrata* Extract [standar-dized to 30% acetyl-11-keto-beta boswellic acid (AKBA) (gum resin)] 125 mg. Other Ingredients: Brown rice flour, hypromellose (vegetarian capsules), magnesium stearate.
COMBINATION PRODUCTS						
Glucosamine and Chondroitin Combinations:						

APPROVED Top Pick for glucosamine with chondroitin Kirkland Signature [Costco] Advanced Glucosamine Chondroitin  Dist. by Costco Wholesale Corporation	2 tablets 1,500 mg glucosamine HCl (Found 1,579 mg ✓) 1,200 mg chondroitin sulfate sodium (Found 1,773.2 mg ✓)	**Heavy Metals:** Pass Lead: 0.07 mcg (0.02 mcg/g) **Disinte-gration:** Pass	Adults - Take two (2) tablets daily, preferably with a meal. Large tablet	$0.20/2 tablets [$0.19] $27.99/280 tablets	Sodium 135 mg per 2 tablets *USP Dietary Supplement Verified® seal. No Preservatives Added. No Artificial Colors. No Yeast or Gluten. No Lactose.* **Precaution:** Contains: Shellfish (Crab, Crayfish, Lobster, and Shrimp).	2 tablets Calories 10, Total Carbohydrate 2 g, Sodium 135 mg, Glucosamine Hydrochloride 1,500 mg, Chondroitin Sulfate Sodium 1,200 mg. Ingredients: Glucosamine Hydrochloride, Chondroitin Sulfate Sodium Additional Information 2 tablets Calories 10, Total Carbohydrate 2 g, Sodium 135 mg, Glucosamine Hydro-chloride 1,500 mg, Chondroitin Sulfate Sodium 1,200 mg. Ingredients: Glucosamine Hydro-chloride, Chondroitin Sulfate Sodium (may contain Bovine and/or Porcine), Croscar-mellose Sodium, Cellulose (Plant Origin), Silica, Vegetable Magnesium Stearate, Cellulose Coating, Artificial Flavor.

APPROVED Nutramax® Cosamin® DS For Joint Health®  Dist. by Nutramax Laboratories® Consumer Care, Inc.	3 capsules 1,500 mg glucosamine HCl (Found 1,561.3 mg ✓) 1,200 mg chondroitin sodium sulfate (Found 1,580.1 mg ✓)	**Heavy Metals:** Pass Lead: 0.05 mcg (0.02 mcg/g) **Disinte-gration:**	Take 3 capsules daily until desired comfort is reached. May reduce number of capsules taken daily to maintain comfort level. Capsules may be taken all at once or divided with meals. Large capsule	$0.83/3 capsules [$0.80] $29.99/108 capsules	Sodium 70 mg, vitamin C 6 mg & manganese 1 mg per 3 capsules *NSF Contents Certified seal. Gluten-Free.* Made In The USA From Globally Sourced Ingredients.	3 capsules Calories 10, Sodium 70 mg, Total Carbohydrates 2 g, Vitamin C (as Manganese Ascorbate) 6 mg, Manganese (as Manganese Ascorbate) 1 mg, Glucosamine HCl 1,500 mg, Sodium Chondroitin Sulfate Additional Information 3 capsules Calories 10, Sodium 70 mg, Total Carbo-hydrates 2 g, Vitamin C (as Manganese Ascorbate) 6 mg, Manganese (as Manganese Ascorbate) 1 mg, Glucosamine HCl 1,500 mg, Sodium Chondroitin Sulfate (Contains approxi-mately 8% moisture) 1,200 mg. Other Ingredients: Gelatin. Contains <2% of: Magnesium stearate, capsule colorants (titanium dioxide, red 3 and blue 1).

APPROVED ProCaps® Laboratories Andrew Lessman Glucosamine 1500 Chondroitin 1200®  Mfd. by ProCaps Labs	5 capsules 1,500 mg glucosamine sulfate (Found 1,788 mg ✓) 1,200 mg chondroitin sulfate (Found 1,444.3 mg ✓)	**Heavy Metals:** Pass Lead: 0.06 mcg (0.02 mcg/g) Arsenic: Cadmium: Mercury: **Disinte-gration:**	Consumer five capsules daily - preferably with food. Increase or decrease your intake based upon your needs and as guided by your physician. Large capsule	$1.66/5 capsules [$1.79] $24.90/75 capsules	Vitamin C 10 mg, calcium 80 mg & potassium 230 mg per 5 capsules *Contains No Additives Of Any Kind. Sodium Free. 100% Solar.* **Precaution:** Contains an ingredient derived from the shells of shellfish Additional Information Vitamin C 10 mg, calcium 80 mg & potassium 230 mg per 5 capsules *Contains No Additives Of Any Kind. Sodium Free. 100% Solar.* **Precaution:** Contains an ingredient derived from the shells of shellfish (shrimp, crab and crawfish).	5 capsules Glucosamine Sulfate [as Potassium Glucosamine Sulfate 2,000 mg] 1,500 mg, Chondroitin Sulfate (from calcium chondroitin sulfate) 1,200 mg, Vitamin C (as ascorbyl palmitate) 10 mg Additional Information 5 capsules Glucosamine Sulfate [as Potassium Glucosamine Sulfate 2,000 mg] 1,500 mg, Chondroitin Sulfate (from calcium chondroitin sulfate) 1,200 mg, Vitamin C (as ascorbyl palmitate) 10 mg, Calcium (from calcium chondroitin sulfate) 80 mg, Potassium (from potassium glucosamine sulfate) 230 mg. Other Ingredients: Gelatin capsule.
Glucosamine and MSM Combinations:						

APPROVED Top Pick for glucosamine with MSM Kirkland Signature [Costco] Extra Strength Glucosamine HCl With MSM  Dist. by Costco Wholesale Corporation	2 tablets 1,500 mg glucosamine HCl (Found 1,601.4 mg ✓) 1,500 mg MSM (Found 1,556.6 mg ✓)	**Heavy Metals:** Pass Lead: 0.07 mcg (0.02 mcg/g) **Disinte-gration:** Pass	Take two (2) tablets once a day with a full glass of water, preferably with a meal. Take 4-6 weeks to see results. Results may vary. Large tablet	$0.11/2 tablets [$0.10] $19.99/375 tablets	*USP Dietary Supplement Verified® seal. No Colors Added. No Artificial Flavors. No Gluten. No Lactose.* **Precaution:** Contains: Crustacean Shellfish (Crab & Shrimp).	2 tablets Calories 10, Total Carbohydrate 1 g, Protein less than 1 g, Glucosamine Hydro-chloride 1,500 mg, Methylsulfonylmethane (MSM) 1,500 mg. Ingredients: Methyl-sulfonylmethane, Glucosamine Hydro-chloride, Cellulose Gel, Hypromellose Additional Information 2 tablets Calories 10, Total Carbohydrate 1 g, Protein less than 1 g, Glucosamine Hydro-chloride 1,500 mg, Methylsulfonylmethane (MSM) 1,500 mg. Ingredients: Methyl-sulfonylmethane, Glucosamine Hydro-chloride, Cellulose Gel, Hypromellose, Stearic Acid, Magnesium Stearate, Maltodextrin, Silicon Dioxide, Medium Chain Triglycerides.
Glucosamine, Chondroitin and MSM Combinations:						

APPROVED Doctor's Best® Glucosamine Chondroitin MSM With OptiMSM  Dist. by Doctor's Best, Inc.	4 veggie capsules 1,500 mg glucosamine hydrochloride potassium sulfate (Found 1,683.7 mg ✓) 1,200 mg chondroitin sulfate (Found 1,693.5 mg ✓) 1,000 mg MSM (Found 1,113.9 mg ✓)	**Heavy Metals:** Pass Lead: 0.08 mcg (0.2 mcg/g) **Disinte-gration:**	Take 4 capsules daily with food, or as recommended by a nutri-tionally informed physician. Large veggie capsule	$0.77/4 veggie capsules [$0.96] $22.99/120 veggie capsules	Chloride 172 mg, sodium 150 mg & potassium 180 mg per 4 veggie capsules *Non-GMO / Gluten Free / Soy Free.* **Precaution:** Contains Shellfish (crab and shrimp shells).	4 veggie capsules Chloride (from glucosamine hydro-chloride potassium sulfate) 172 mg, Sodium (from chondroitin sulfate sodium) 150 mg, Potassium (glucosamine hydrochloride potassium sulfate) 180 mg, Glucosamine Hydro-chloride Potassium Sulfate 1,500 mg Additional Information 4 veggie capsules Chloride (from glucosamine hydro-chloride potassium sulfate) 172 mg, Sodium (from chondroitin sulfate sodium) 150 mg, Potassium (glucosamine hydro-chloride potassium sulfate) 180 mg, Glucosamine Hydro-chloride Potassium Sulfate 1,500 mg, Chondroitin Sulfate (from chondroitin sulfate sodium) 1,200 mg, MSM (methyl-sulfonylmethane) (OptiMSM®) 1,000 mg. Other Ingredients: Hypromellose (vegetarian capsule), magnesium stearate (vegetable source), silicon dioxide, micro-crystalline cellulose.

APPROVED GNC Triflex  Dist. by GNC Holdings, LLC	3 caplets 1,500 mg glucosamine HCl (Found 1,458.6 mg ✓) 1,200 mg chondroitin sulfate sodium (Found 1,633.6 mg ✓) 900 mg MSM (Found 899.9 mg ✓)	**Heavy Metals:** Pass Lead: 0.08 mcg (0.02 mcg/g) **Disinte-gration:** Pass	Take three caplets daily, preferably with meals. Large caplet	$0.75/3 caplets [$0.77] $29.99/120 caplets	Hyaluronic acid 5 mg per 3 caplets *Gluten Free. Non GMO.* **Precaution:** Contains: Crustaceans (Shrimp). Contains a bioengineered food ingredient.	3 caplets Sodium 165 mg, Glucosamine Hydro-chloride 1,500 mg, Chondroitin Sulfate, Sodium 1,200 mg, MSM (Methysulfonylmethane) 900 mg, Hyaluronic Acid (as Sodium Hyaluronate) 5 mg Additional Information 3 caplets Sodium 165 mg, Glucosamine Hydro-chloride 1,500 mg, Chondroitin Sulfate, Sodium 1,200 mg, MSM (Methysulf-onylmethane) 900 mg, Hyaluronic Acid (as Sodium Hyaluronate) 5 mg. Other Ingredients: Microcrystalline Cellulose, Hydroxy-propyl Methylcellulose, Croscarmellose Sodium, Crospovidone, Stearic Acid Vegetable Source, Titanium Dioxide, (Mineral Whitener), Magnesium Stearate Vegetable Source, Polyethylene Glycol, Silica, Talc.

APPROVED Top Pick for glucosamine, chondroitin and MSM Nature Made® Glucosamine Chondroitin Complex With MSM  Dist. by Nature Made Nutritional Products	2 caplets 1,500 mg glucosamine HCl (Found 1,666.5 mg ✓) 800 mg chondroitin sulfate sodium (Found 1,127.3 mg ✓) 750 mg MSM (Found 791.5 mg ✓)	**Heavy Metals:** Pass Lead: 0.12 mcg (0.03 mcg/g) **Disinte-gration:** Pass	Adults, take 2 caplets daily with water and a meal. Take 4-6 weeks to see results. Results may vary. Large caplet	$0.30/2 caplets [$0.27] $18.23/120 caplets	Vitamin D3 50 mcg & sodium 75 mg per 2 caplets *USP Dietary Supplement Verified® seal. No Synthetic Dyes - Color Derived from Natural Source. No Artificial Flavors. Gluten Free.* **Precaution:** Contains: Shellfish (Shrimp & crab).	2 caplets Vitamin D3 50 mcg (2,000 IU), Sodium 75 mg, Glucosamine Hydro-chloride 1,500 mg, Chondroitin Sulfate Sodium 800 mg, Methyl-sulfonylmethane (MSM) 750 mg. Ingredients: Glucosamine Hydrochloride, Chondroitin Sodium (Bovine, Porcine, Avian) Additional Information 2 caplets Vitamin D3 50 mcg (2,000 IU), Sodium 75 mg, Glucosamine Hydrochloride 1,500 mg, Chondroitin Sulfate Sodium 800 mg, Methylsulfonylmethane (MSM) 750 mg. Ingredients: Glucosamine Hydro-chloride, Chondroitin Sodium (Bovine, Porcine, Avian), Methyl-sulfonylmethane (MSM), Water, Hypro-mellose, Color Added, Silicon Dioxide, Magnesium Stearate, Glyceryl Behenate, Polyethylene Glycol, Triethyl Citrate, Polysorbate 80, Sodium Citrate, Vitamin D3 (Cholecalciferol).

APPROVED Pure Encapsulations® Glucosamine Chondroitin With MSM  Mfd. by Pure Encapsulations	3 capsules 900 mg glucosamine HCl (Found 966.2 mg ✓) 900 mg chondroitin sulfate (Found 1,129.9 mg ✓) 900 mg MSM (Found 873.9 mg ✓)	**Heavy Metals:** Pass Lead: 0.06 mcg (0.02 mcg/g) **Disinte-gration:**	Take 1 capsule, 3 times daily, with meals. Large capsule	$1.80/3 capsules [$2.79] $71.80/120 capsules	*Gluten-Free Certifi-cation Organization seal. Non-GMO.* **Precaution:** Contains shellfish (crab, shrimp).	1 capsule Glucosamine HCl (from crab, shrimp) 300 mg, Chondroitin sulfate (from bovine) 300 mg, MSM (methylsulfonylmethane) 300 mg. Other Ingredients: Vegetarian capsule Additional Information 1 capsule Glucosamine HCl (from crab, shrimp) 300 mg, Chondroitin sulfate (from bovine) 300 mg, MSM (methylsulfonyl-methane) 300 mg. Other Ingredients: Vegetarian capsule (cellulose, water), ascorbyl palmitate.

APPROVED Xymogen® Synovx® DJD  Dist. by Xymogen®	2 vegetarian capsules 300 mg glucosamine sulfate sodium chloride (Found 250 mg ✓) 300 mg chondroitin sulfate (Found 433 mg ✓) 500 mg MSM (Found 681.8 mg ✓)	**Heavy Metals:** Pass Lead: 0.25 mcg (0.13 mcg/g) **Disinte-gration:**	Take two capsules daily, or as directed by your healthcare professional. Large vegetarian capsule	$1.15/2 vegetarian capsules [$9.61] $68.99/120 vegetarian capsules	Vitamin C 38 mg, manganese 2.5 mg, green-lipped mussel 500 mg & hyaluronic acid 15 mg per 2 vegetarian capsules *Formulated To Exclude: Wheat, gluten, yeast, soy, dairy products, fish, peanuts, tree nuts, egg, ingredients derived from genetically* *Additional Information* *Vitamin C 38 mg, manganese 2.5 mg, green-lipped mussel 500 mg & hyaluronic acid 15 mg per 2 vegetarian capsules* *Formulated To Exclude: Wheat, gluten, yeast, soy, dairy products, fish, peanuts, tree nuts, egg, ingredients derived from genetically, modified organisms (GMOs), artificial colors, artificial sweeteners, and preservatives.*	2 vegetarian capsules Vitamin C (ascorbic acid) 38 mg, Manganese (as manganese bisglycinate chelate) 2.5 mg, Methyl-sulfonylmethane (MSM) 500 mg, Green-Lipped Mussel (*Perna canaliculus*) 500 mg, Chondroitin Sulfate Additional Information 2 vegetarian capsules Vitamin C (ascorbic acid) 38 mg, Manganese (as manganese bisglycinate chelate) 2.5 mg, Methylsulfonyl-methane (MSM) 500 mg, Green-Lipped Mussel (*Perna canaliculus*) 500 mg, Chondroitin Sulfate (as chondroitin sulfate sodium) 300 mg, Glucosamine Sulfate Sodium Chloride 300 mg, Hyaluronic Acid 15 mg. Other Ingredients: Capsule (hypromellose and water), ascorbyl palmitate, silica, and medium-chain triglyceride oil.

					Precaution: *Contains: Crustacean Shellfish (shrimp and crab).*	
Glucosamine, Chondroitin and Boswellia Combinations:						

APPROVED Nutramax® Laboratories Cosamin® ASU  Dist. by Nutramax® Laboratories Consumer Care, Inc.	3 capsules 1,500 mg glucosamine HCl (Found 1,573.4 mg ✓) 350 mg chondroitin sulfate sodium (Found 532.9 mg ✓) 400 mg proprietary concentrates ASU blend containing unspecified amount of boswellia extract	**Heavy Metals:** Pass Lead: 0.06 mcg (0.02 mcg/g) **Disinte-gration:**	Take 3 capsules daily until desired comfort is reached. May reduce number of capsules taken daily to maintain comfort level. Capsules may be taken all at once or divided with meals. Large capsule	$0.83/3 capsules [$0.79] $24.99/90 capsules	Sodium 30 mg & proprietary concentrates ASU blend 400 mg per 3 capsules *Contains Certified NSF® seal.* Made in the USA with globally sourced ingredients. **Precaution:** Contains: Soy.	3 capsules Calories 10, Sodium 30 mg, Total Carbohydrates 2 g, Glucosamine HCl (FCHG49®) 1,500 mg, Sodium Chondroitin Sulfate (TRH122®) (Contains approximately 10% moisture) 350 mg, Proprietary Concentrates ASU Blend [Avocado/Soybean Unsaponifiables Additional Information 3 capsules Calories 10, Sodium 30 mg, Total Carbo-hydrates 2 g, Glucosamine HCl (FCHG49®) 1,500 mg, Sodium Chondroitin Sulfate (TRH122®) (Contains approxi-mately 10% moisture) 350 mg, Proprietary Concentrates ASU Blend [Avocado/Soybean Unsaponifiables (NMX1000®) (Soy (Glycine maximus) Unsaponifiables, Avocado (*Persea gratissima*) Unsapon-ifiables, Soy Protein Isolate, Natural Mixed Tocopherols)] [Boswellia (Quiklox®) [Boswellia Extract (*Boswellia serrata* - gum resin) [3-O-Acetyl-11-Keto-β-Boswellic Acid (AKBA)]]] [Decaffe-inated Green Tea Extract (Camellia

						sinensis - leaf)] 400 mg. Other Ingredients: Gelatin. Contains less than 2% of: Silicon dioxide.
Glucosamine, Boswellia and Collagen Combinations:						
APPROVED Top Pick for glucosamine with Boswellia Life Extension® ArthroMax® Advanced NT2 Collagen™ & AprèsFlex®  Dist. by Quality Supplements and Vitamins, Inc.	2 capsules 1,500 mg glucosamine sulfate 2KCl (Found 1,583.6 mg ✓) 100 mg boswellia extract (AprèsFlex) 20 mg AKBA (Found 21.2 mg ✓) 10 mg collagen (NT2 Collagen™) (Found 24.9 mg ✓)	**Heavy Metals:** Pass Lead: 0.03 mcg (0.01 mcg/g) **Disinte-gration:**	Take two (2) capsules daily with food, or as recommended by a healthcare practitioner. Large capsule	$0.85/2 capsules [$1.13] $25.50/60 capsules	Boron 1.5 mg per 2 capsules *Gluten Free. Non GMO.*	2 capsules Glucosamine sulfate 2KCl (derived from corn) 1,500 mg, AprèsFlex® Indian frankincense (*Boswellia serrata*) extract (gum resin) [std. to 20% AKBA] 100 mg, NT2 Collagen™ [standardized cartilage providing 10 mg total collagen] 40 mg, Boron (calcium fructoborate Additional Information 2 capsules Glucosamine sulfate 2KCl (derived from corn) 1,500 mg, AprèsFlex® Indian frankincense (*Boswellia serrata*) extract (gum resin) [std. to 20% AKBA] 100 mg, NT2 Collagen™ [standar-dized cartilage providing 10 mg total collagen] 40 mg, Boron (calcium fructoborate as patented FruiteX B® OsteoBoron®) 1.5 mg. Other Ingredients: Vegetable cellulose (capsule), silica, vegetable stearate, microcrystalline cellulose.
Boswellia, Collagen and Turmeric Combinations:						

APPROVED Instaflex® Advanced Featuring UC-II® Collagen  Dist. by Adaptive Health	1 capsule 100 mg boswellia extract (AprèsFlex) 20 mg AKBA (Found 19.2 mg ✓) 10 mg collagen (UC-II) (Found 13.6 mg ✓) 200 mg turmeric extract 190 mg curcuminoids (Found 185 mg ✓)	**Heavy Metals:** **Disinte-gration:**	Adults Usage: Take one (1) capsule daily, with or without food. Large capsule	$2.03/capsule $61.04/30 capsules	Resveratrol 100 mg, hyaluronic acid 5 mg & black pepper extract 5 mg	1 capsule Turmeric Extract (rhizome) (95% curcu-minoids) 200 mg, Resveratrol (from Japanese Knotweed Root Extract) 100 mg, AprèsFlex® *Boswellia serrata* Extract (gum resin) 100 mg, UC-II® (3% Type II Collagen) [Total Collagen 10 mg] 40 mg, Hyaluronic Acid Additional Information 1 capsule Turmeric Extract (rhizome) (95% curcu-minoids) 200 mg, Resveratrol (from Japanese Knotweed Root Extract) 100 mg, AprèsFlex® *Boswellia serrata* Extract (gum resin) 100 mg, UC-II® (3% Type II Collagen) [Total Collagen 10 mg] 40 mg, Hyaluronic Acid (from sodium hyaluronate) 5 mg, Black Pepper Extract (fruit) (95% piperine) (BioPerine®) 5 mg. Other Ingredients: Gelatin, cellulose, potassium chloride, magnesium stearate, silica, titanium dioxide, FD&C Blue #1 and glycerin.
Glucosamine, Chondroitin, MSM, Boswellia and Collagen Combinations:						

APPROVED Member's Mark™ [Sam's Club] Glucosamine HCl Chondroitin/MSM Complex  Dist. by Sam's West, Inc.	2 tablets 1,500 mg glucosamine HCl (Found 1,604.1 mg ✓) 1,103 mg chondroitin/MSM complex containing unspecified amounts of chondroitin sulfate sodium, MSM and collagen 100 mg boswellia extract (Found 21.1 mg AKBA+KBA (min. expected 6 mg) [21.1% of extract] ✓, of which 17.2 mg AKBA)	**Heavy Metals:** Pass Lead: 0.05 mcg (0.013 mcg/g) Arsenic: 0.04 mcg (0.01 mcg/g) Cadmium: 0.04 mcg (0.01 mcg/g) Mercury: **Disinte-gration:** Pass	Adults, take two tablets daily with food as a dietary supplement. Large tablet	$0.18/2 tablets [$0.17] $19.98/220 tablets	Vitamin C 60 mg, manganese 2 mg, sodium 30 mg & chondroitin/MSM complex 1,103 mg per 2 tablets *No Synthetic Dyes. No Artificial Flavors. No Gluten. No Lactose.* **Precaution:** Contains: Crustacean Shellfish (Crab, Shrimp).	2 tablets Calories 15, Total Carbohydrate 3 g, Vitamin C 60 mg, Manganese 2 mg, Sodium 30 mg, Glucosamine Hydro-chloride 1,500 mg, *Boswellia serrata* Extract (resin) 100 mg, Chondroitin/MSM Complex [Chondroitin Sulfate Sodium, Methyl-sulfonylmethane (MSM), Collagen (Hydrolyzed Gelatin), *Boswellia serrata* Extract (resin), Boron (as sodium borate) Additional Information 2 tablets Calories 15, Total Carbohydrate 3 g, Vitamin C 60 mg, Manganese 2 mg, Sodium 30 mg, Glucosamine Hydro-chloride 1,500 mg, *Boswellia serrata* Extract (resin) 100 mg, Chondroitin/MSM Complex [Chondroitin Sulfate Sodium, Methyl-sulfonylmethane (MSM), Collagen (Hydrolyzed Gelatin), *Boswellia serrata* Extract (resin), Boron (as sodium borate), Hyaluronic Acid (as sodium hyaluronate)] 1,103 mg. Ingredients: Glucosamine Hydro-chloride, *Boswellia Serrata* Extract,

						Chondroitin Sulfate Sodium, Methylsulfonyl-methane, Collagen (Hydrolyzed Gelatin), Microcrystalline Cellulose. Contains 2% Or Less Of: Ascorbic Acid, Calcium Carbonate, Carnauba Wax, Carboxymethyl-cellulose Sodium, Croscarmellose Sodium, Crospovidone, Glycerin, Hydroxypropyl Methylcellulose, Magnesium Stearate, Maltodextrin, Magnesium Sulfate, Mineral Oil, Polyethylene Glycol, Polyvinyl Alcohol, Povidone, Silica, Sodium Borate, Sodium Hyaluronate, Tartaric Acid, Titanium Dioxide (Color).

APPROVED Osteo Bi-Flex® Triple Strength  Mfd. by Rexall Sundown, Inc.	2 coated tablets 1,500 mg glucosamine HCl (Found 1,986 mg ✓) 1,103 mg chondroitin/MSM complex containing unspecified amounts of chondroitin sulfate, MSM and collagen 100 mg boswellia extract (5-LOXIN Advanced®) (Found 25 mg AKBA+KBA (min. expected 6 mg) [25% of extract] ✓, of which 25 mg AKBA)	**Heavy Metals:** Pass Lead: 0.03 mcg (0.02 mcg/g) **Disinte-gration:** Pass	For Adult Use: Take Two (2) Tablets Per Day Preferably With Food. As a reminder, discuss the supplements and medications you take with your health care providers. Large coated tablet	$0.44/2 coated tablets [$0.33] $17.49/80 coated tablets	Vitamin C 60 mg, manganese 2 mg, sodium 35 mg & chondroitin/MSM complex 1,103 mg per 2 coated tablets *Free of Gluten. Non-GMO.* Made in the USA with select ingredients from around the world. **Precaution:** Contains shellfish (crab, crayfish, lobster, shrimp) ingredients.	2 coated tablets Calories 10, Total Carbohydrate 2 g, Vitamin C (as Ascorbic Acid) 60 mg, Manganese (as Manganese Sulfate) 2 mg, Sodium 35 mg, Glucosamine HCl 1,500 mg, Joint Shield™ 5-LOXIN Advanced® Boswellia serrata Extract (resin) 100 mg, Chondroitin/MSM Complex [Chondroitin Sulfate, Methylsulfonyl-methane (MSM), Collagen Additional Information 2 coated tablets Calories 10, Total Carbohydrate 2 g, Vitamin C (as Ascorbic Acid) 60 mg, Manganese (as Manganese Sulfate) 2 mg, Sodium 35 mg, Glucosamine HCl 1,500 mg, Joint Shield™ 5-LOXIN Advanced® Boswellia serrata Extract (resin) 100 mg, Chondroitin/MSM Complex [Chondroitin Sulfate, Methylsulfonyl-methane (MSM), Collagen (Hydrolyzed Gelatin), Boswellia serrata (resin), Boron (as Bororganic Glycine), Hyaluronic Acid] 1,103 mg. Other Ingredients: Crospovidone. Contains <2% of: Cellulose Coating, Cellulose

						(Plant Origin), Silica, Titanium Dioxide Color, Vegetable Magnesium Stearate.
Glucosamine, Chondroitin, MSM, Boswellia and Turmeric Combinations:						
NOT APPROVED Arazo Nutrition Joint Support  Dist. Arazo Nutrition	3 tablets 1,500 mg glucosamine sulfate (Found 1,394 mg ✓) 1,200 mg chondroitin sulfate (Found 1,099.4 mg ✓) 1,000 mg MSM (Found 1,062.8 mg ✓) 100 mg boswellia extract, 65% boswellic acid (65 mg) (Found less than 2.6 mg of boswellic acids, less than 4% of listed amount) 100 mg turmeric root powder (Found only 0.07 mg curcuminoids, only 2.3% of expected 3 mg and just 0.07% of powder)	**Heavy Metals:** Pass Lead: 0.28 mcg (0.06 mcg/g) Arsenic: 0.15 mcg (0.03 mcg/g) Cadmium: 0.5 mcg (0.1 mcg/g) Mercury: **Disinte-gration:** Pass	Adults take three (3) tablets daily. Large tablet	$0.43/3 tablets [$0.60] $25.95/180 tablets	*No Artificial Dyes.* *Unflavored.* **Precaution:** Contains: Crustacean Shellfish (shrimp and crab).	3 tablets Glucosamine Sulfate (Shrimp and Crab shells) 1,500 mg, Chondroitin Sulfate (Bovine) 1,200 mg, MSM (Methylsulfonyl-methane) 1,000 mg, *Boswellia Serrata* extract (gum) (Standardized to 65% Boswellic acid) 100 mg, Turmeric (*Curcuma longa*) (root) 100 mg, Hyaluronic Acid 25 mg. Other Ingredients: Calcium Carbonate, Stearic Acid, Silicon Dioxide, Vegetable Magnesium Stearate, Hypromellose, Isomalt Medium Chain Trigly-cerides.
Glucosamine, Chondroitin, MSM, Boswellia, Turmeric and Collagen Combinations:						

NOT APPROVED Natural Factors® OsteoMove® Extra Strength Joint Care  Dist. by Natural Factors	2 tablets 1,500 mg glucosamine sulfate (Found 1,842.3 mg ✓) 400 mg chondroitin sulfate (Found 575.5 mg ✓) 600 mg MSM (Found 574.1 mg ✓) 100 mg boswellia extract, 60% boswellic acids (Found only 34.1 mg boswellic acids, only 57% of listed 60 mg (60%) and only 34.1% of extract, of which 4.4 mg AKBA) 15 mg collagen (hydrolyzed collagen type II) (Found 32.2 mg ✓) 60 mg turmeric extract (Found 26.3 mg curcuminoids, 43.8% of extract ✓)	**Heavy Metals:** Pass Lead: 0.44 mcg (0.1 mcg/g) Arsenic: 0.04 mcg (0.01 mcg/g) Cadmium: Mercury: 0.013 mcg (0.003 mcg/g) **Disinte-gration:** Pass	2 tablets daily or as directed by a health care practitioner. Use for a minimum of 4 weeks to see beneficial effects. Large tablet	$0.87/2 tablet [$0.91] $26.15/60 tablets	InflamRelief™ complex 100 mg, hyaluronic acid 7.5 mg, magnesium 0.75 mg & boron 0.225 mg per tablet *Non-GMO. Contains no artificial colours, preservatives, or sweeteners; no dairy, starch, sugar, wheat, gluten, soy, egg, tree nuts, or GMOs.*	1 tablet Glucosamine sulfate (shrimp/crab exoskeleton) 750 mg, MSM (methylsulfonyl-methane) 300 mg, Chondroitin sulfate (bovine cartilage) 200 mg, InflamRelief™ complex (fruit blend) [Proprietary blend of: grape (*Vitis vinifera*), pomegranate (*Punica granatum*), strawberry (*Vaccinium macrocarpon*), blueberry (*Vaccinium corymbosum*), raspberry (*Rubus idaeus*), bilberry (*Viccinium myrtillus*) (standardized to 76% polyphenols)] 100 mg, Boswellia extract (*Boswellia serrata*) (gum oleoresin) (60% boswellic acids) 50 mg, Turmeric extract 25:1 (*Curcuma longa*) (rhizome) 30 mg Additional Information 1 tablet Glucosamine sulfate (shrimp/crab exoskeleton) 750 mg, MSM (methylsulfonyl-methane) 300 mg, Chondroitin sulfate (bovine cartilage) 200 mg, InflamRelief™ complex (fruit blend) [Proprietary blend of: grape (*Vitis vinifera*), pomegranate (*Punica granatum*), strawberry (*Vaccinium macro-carpon*), blueberry (*Vaccinium corymbosum*),

						raspberry (*Rubus idaeus*), bilberry (*Viccinium myrtillus*) (standardized to 76% polyphenols)] 100 mg, Boswellia extract (*Boswellia serrata*) (gum oleoresin) (60% boswellic acids) 50 mg, Turmeric extract 25:1 (*Curcuma longa*) (rhizome) 30 mg, Hydrolyzed collagen type II (*Gallus gallus*) (cartilage) 7.5 mg, Hyaluronic acid (sodium hyaluronate) 7.5 mg, Magnesium (sulfate monohydrate) 0.75 mg, Boron (sodium tetraborate) 0.225 mg.
Other Boswellia Combinations:						

APPROVED Dr. Mercola® Joint Formula  Dist. by NHP	1 capsule 75 mg boswellia extract (Found 4.9 mg AKBA+KBA (min. expected 4.5 mg) [6.5% of extract] ✓, of which 3.2 mg AKBA)	**Heavy Metals:** Pass Lead: 0.03 mcg (0.05 mcg/g) Arsenic: 0.02 mcg (0.03 mcg/g) Cadmium: Mercury: **Disinte-gration:**	Adults, take one (1) capsule daily. Large capsule	$0.59/capsule $53.00/90 capsules	Vitamin C 1 mg, calcium 60 mg, eggshell membrane 500 mg, low density hyaluronic acid 30 mg & organic astaxanthin 2 mg per capsule **Precaution:** Contains Egg.	1 capsule Vitamin C (from Ascorbic Acid) 1 mg, Calcium (from Eggshell Membrane) 60 mg, Eggshell Membrane 500 mg, Indian Frankincense (*Boswellia serrata*) Gum Resin Extract 75 mg Additional Information 1 capsule Vitamin C (from Ascorbic Acid) 1 mg, Calcium (from Eggshell Membrane) 60 mg, Eggshell Membrane 500 mg, Indian Frankincense (*Boswellia serrata*) Gum Resin Extract 75 mg, Low Density Hyaluronic Acid (as Sodium Hyaluronate) 30 mg, Organic Astaxanthin (from Microalgae *Haematococcus pluvialis*) 2 mg. Other Ingredients: Capsule (Hydroxypropyl Methylcellulose), Micro-crystalline Cellulose, Silicon Dioxide, Rice Bran, Extract, Rice Hull, Gum, Gum Acacia, Sunflower Oil, Mixed Tocopherol (from Sunflower).

APPROVED Previnex® Joint Health Plus®  Dist. by Previnex, LLC	1 capsule 100 mg boswellia extract (Boswellin®) 20 mg β-boswellic acids (Found 31.4 mg ✓, of which 3.7 mg AKBA)	**Heavy Metals:** Pass Lead: 0.03 mcg (0.05 mcg/g) Arsenic: 0.04 mcg (0.05 mcg/g) Cadmium: Mercury: 0.001 mcg (0.001 mcg/g) **Disinte-gration:**	Take one (1) capsule daily. Not formulated for children. If you're pregnant or nursing, please contact your physician. Large capsule	$1.55/capsule $43.50/28 capsules	Calcium 75 mg & NEM® eggshell membrane 500 mg per capsule **Precaution:** Contains: Egg.	1 capsule Calcium 75 mg, NEM® Eggshell Membrane 500 mg, Boswellin® *Boswellia serrata* extract (gum resin exclude) [70% Total Organic Acids (70 mg), 20% β-Boswellic Acids (20 mg)] 100 mg Additional Information 1 capsule Calcium 75 mg, NEM® Eggshell Membrane 500 mg, Boswellin® *Boswellia serrata* extract (gum resin exclude) [70% Total Organic Acids (70 mg), 20% β-Boswellic Acids (20 mg)] 100 mg. Other Ingredients: Hypromellose, rice flour, magnesium stearate, and silica.
Undefined blends (Tested for only heavy metals):						

PARTIALLY APPROVED Only tested for heavy metals Joint Food  Dist. by Nordic Healthy Living	2 capsules 300 mg Tamasteen™ proprietary blend containing unspecified amount of turmeric extract 367 mg proprietary blend containing unspecified amounts of MSM, boswellia extract and collagen	**Heavy Metals:** Pass Lead: 0.03 mcg (0.02 mcg/g) Arsenic: 0.24 mcg (0.19 mcg/g) Cadmium: Mercury: **Disinte-gration:**	Adults, take 2 capsules with water daily, preferably with a meal, as a dietary supplement or as directed by a doctor. Large capsule	$2.17/2 capsules $64.95/60 capsules	Vitamin C 50 mg, Tamasteen™ proprietary blend 300 mg & proprietary blend 367 mg per 2 capsules Manufactured In The USA with Globally Sourced Ingredients.	2 capsules Vitamin C (As Ascorbic Acid) 50 mg, Tamasteen™ Proprietary Blend [*Tamarindus indica* Extract (seed), *Curcuma longa* Extract (rhizome), *Garcinia mandostana* Extract (fruit rind)] 300 mg, Proprietary Blend [Methysulfonylmethane (MSM) Additional Information 2 capsules Vitamin C (As Ascorbic Acid) 50 mg, Tamasteen™ Proprietary Blend [*Tamarindus indica* Extract (seed), *Curcuma longa* Extract (rhizome), *Garcinia mandostana* Extract (fruit rind)] 300 mg, Proprietary Blend [Methysulfonylmethane (MSM), Bromelain, Hyaluronic Acid (as Sodium Hyaluronate), *Boswellia serrata* (Gum Resin) Extract, Cetyl Myristoleate (CMO), Collagen Complex (containing undenatured Type II Collagen)] 367 mg. Other Ingredients: Hydroxypropyl Methyl-cellulose, Rice Bran Extract, Microcrystalline Cellulose, Maltodextrin, Silica, Vegetable Magnesium Stearate, Starch.

Products tested in 2025

ConsumerTips™:

Glucosamine and Chondroitin

Glucosamine in supplements can be purchased in different chemical forms. Glucosamine *hydrochloride (HCl)* is the form that has been used most often in studies where glucosamine is combined with chondroitin. Glucosamine *sulfate* (more correctly called glucosamine sulfate 2-KCl -- the KCl stands for potassium chloride) or glucosamine *sulfate 2-NaCl* (the NaCl stands for sodium chloride) are the forms that have been used most often when glucosamine alone has been studied. There appears to be no conclusive evidence that one form is better than another. However, the amount of true (or "free") glucosamine per gram of each compound varies greatly. In fact, 1,500 mg of glucosamine hydrochloride actually yields 1,246 mg of free glucosamine while 1,500 mg of glucosamine sulfate with 2-NaCl or 2-KCl yield, respectively, only 938 mg or 888 mg of free glucosamine. Although the hydrochloride form provides more free glucosamine than the sulfate forms, 1,500 mg per day of either form appears to be effective. People watching their salt intake may, however, want to avoid products made with the form that includes NaCl (sodium chloride) -- if a label states only glucosamine sulfate, it could be either form, so look specifically for products stating glucosamine sulfate 2-KCl.

Chondroitin is typically sold as chondroitin sulfate, which is also the form that's been used in most studies. About 1,200 mg of chondroitin sulfate is recommended per day. Chondroitin sulfate is usually in a salt form to help stabilize it, so don't be concerned if you see "sodium chondroitin sulfate" (or "chondroitin sulfate sodium) on the label. These are the complete chemical names — although not all manufacturers use them — and the active ingredient, chondroitin sulfate, is the same. Supplement labels typically list the amount of chondroitin sulfate in the product, but some may include the relatively small weight of the attached sodium, representing about 5% of the total weight. For example, a label indicating 1,200 mg of chondroitin sulfate (as sodium chondroitin sulfate) should provide 1,200 mg of chondroitin sulfate, while a label indicating 1,200 mg of sodium chondroitin sulfate should provide about 1,140 mg of chondroitin sulfate.

Be aware that 1,200 mg of chondroitin sulfate from the *sodium* salt form will contribute about 60 mg per day of sodium. To reduce your sodium intake, consider products made with the *calcium* salt form. With that form you'll add about 191 mg of calcium per day to your diet instead of sodium.

Chondroitin can vary in terms of its purity, which tends to range from about 80% to 90%. The GAIT study sponsored by the NIH used chondroitin sulfate made by Bioberica which is believed to be 95% pure. The manufacturer of CosaminDS (a glucosamine/chondroitin combination product which is Approved in this Review) claims to be the exclusive licensee for this form of chondroitin. Chondroitin can also vary in terms of the chain length (and molecular weight) of its components — although the clinical significance of this is not well known. Results of laboratory studies with cell cultures indicate that shorter length molecules are better absorbed, but it is possible that longer length molecules are also digested to shorter length units. It is, therefore, difficult to say whether either form works better than the other.

Some products mention in their labeling that they contain chondroitin A, which is a subcomponent of the larger chondroitin polysaccharide. This is probably of little importance. All chondroitin from cow or pig sources contains combinations of chondroitin A (or chondroitin 4 sulfate), chondroitin C (or chondroitin 6 sulfate) and a non-sulfated component.

Both glucosamine and chondroitin are typically taken in divided doses throughout the day (that is, 500 mg of glucosamine HCl or sulfate and 400 mg of chondroitin sulfate three times per day or 750 mg glucosamine HCl or sulfate and 600 mg chondroitin sulfate two times per day). Because the amount of glucosamine or chondroitin per pill varies across products, the number of pills needed daily varies and this should be considered when comparing the costs of products. One large, successful study used a single daily dose of 1,500 mg of glucosamine sulfate and 800 mg of chondroitin sulfate (LEGS study).

For treating symptoms of osteoarthritis of the hand, 800 mg once daily of a highly purified (95% pure) chondroitin sulfate has been used (Gabay, Arth & Rheum 2011).

Some glucosamine-chondroitin products may contain manganese (which may potentially aid bone formation). The manganese levels in such products typically exceed the recommended intake, which is 2.3 mg per day for men and 1.8 mg per day for women — an amount similar to that consumed in the typical American diet. Too much manganese (over 11 mg per day) for an extended period of time carries a risk of neurological side effects. While this amount of manganese is not dangerous if taken just during a few weeks of initial therapy, it should not be exceeded for an extended period of time.

Beneficial effects from these products may take anywhere from several weeks to 3 months, and the products aren't likely to help those with severe osteoarthritis — where cartilage has worn down so much that bones rub against bones. Losing weight and switching from high-impact to low-impact sports are also advised for people with osteoarthritis.

If a positive response is not experienced within 3 months, continuing with the supplement or increasing the dose is not indicated. If the supplements are having a beneficial effect, it may be possible to reduce the dose after the first few months. A person under 200 lbs. with a positive response to the full dose (1,500 mg glucosamine and 1,200 mg chondroitin per day) could try reducing the dose to 1,000 glucosamine and 800 of chondroitin. Those under 115 lbs. could try going to 500 glucosamine and 400 chondroitin. If symptoms return, they should return to the full dosage. Those over 200 lbs. should stay on the full dosage.

MSM

There are few well-controlled published clinical studies for MSM, so it's difficult to determine the optimal dose. The most commonly suggested daily dose is 2 grams. However, recommendations can range from 500 mg to 3 grams (1,000 mg = 1 gram). Occasionally, recommendations go as high as 8 grams/day.

High-quality MSM is an odorless white crystalline powder. When improperly manufactured, it can be contaminated with DMSO, which has a faint sulfur-like or garlic smell. Some products claim as little as 167 mg of MSM per pill; others, as much as 1,500 mg. When buying an MSM product, consider this variation.

Boswellia

Boswellia resin should consist of at least 1% boswellic acids, while extracts of the resin are expected to contain at least 6%. Proprietary extracts are often standardized to much greater concentrations of boswellic acids or specific ones such as AKBA, e.g., 5-Loxin (30% AKBA) and AprèsFlex (20% AKBA enriched with non-volatile resin oils — also sold as Aflapin by PLT Health/ Laila Nutraceuticals). 5-Loxin is found in *Swanson Boswellia Serrata Extract* in this review. AprèsFlex is found in two products tested in this review, *Life Extension ArthroMax Advanced NT2 Collagen* and *Instaflex Advanced* -- both of which contained their expected amount of boswellic extract. These proprietary extracts may, therefore, be more potent than less concentrated extracts -- so be sure to carefully check ingredient descriptions in the Supplement Facts panels on labels. [**UPDATE (6/20/25)**: ConsumerLab was informed today that, despite its name, 5-

Loxin "Advanced" is only 20% AKBA. We had incorrectly assumed that it was, like, 5-Loxin, 30% AKBA. Apparently, it is the same as AprèsFlex. 5-Loxin "Advanced" is found in *Osteo Bi-Flex Joint Health Triple Strength*, tested in this Review. This information was provided in a conversation with representatives of Nestlè USA which owns Rexall Sundown, the manufacturer of *Osteo B-Flex*.]

Boswellic acids such as AKBA are fat soluble and, therefore, not well absorbed if taken with only water. *Absorption may be enhanced (potentially doubled or more) if taken along with a fatty meal* (Sterk, Planta Med 2004;Skarke, J Clin Pharmacol 2012). Formulations that include oils (such as Alfapin) or that encapsulate AKBA in liposomes or phytosomes may also enhance absorption of AKBA, as shown in animal experiments (Sengupta, Mol Cell Biochem 2011; Husch, Fitoterapia 2013). It has been suggested that the addition to supplements of piperine (a compound in black pepper sold as Bioperine) may increase the bioavailability of boswellic acids, but there do not appear to be published studies demonstrating this.

For treating symptoms of osteoarthritis, 100 mg or 250 mg of the 5-Loxin brand of Boswellia extract (which is 30% AKBA) has been shown to provide benefit after 90 days of treatment, with initial benefit seen in the 250 mg dose group within 7 days of treatment (Sengupta, Arth Res Ther 2008 ; Sengupta Int J Med Sci 2010). 100 mg daily of the Aflapin brand has shown similar, if not somewhat greater, benefit. The dose is typically divided in half and taken twice daily.

An extract consisting of 40% boswellic acids (but just 2% AKBA), given for 8 weeks at a dose of 333 mg three times daily has also been shown to reduce symptoms of osteoarthritis of the knee. All patients receiving drug treatment reported a decrease in knee pain, increased knee flexion, and increased walking distance. There was also a decrease in the frequency of swelling in the knee joint (Kimmatkar, Phytomedicine 2003).

For treating symptoms of ulcerative colitis, 300 mg or 350 mg of Boswellia resin taken three times daily for 6 weeks, have been shown to be as, if not more, effective as the drug sulfasalazine (1,000 mg three times a day) (Gupta, Eur J Res 1997; Gupta, Planta Med 2001).

Hyaluronic acid

Hyaluronic acid, a natural component of cartilage and synovial fluid (the fluid around joints), is sometimes used for joint health, particularly osteoarthritis. While the FDA has approved hyaluronic acid *injections* for osteoarthritis treatment, and approximately 1 in 7 people with newly diagnosed knee osteoarthritis in the U.S. are prescribed such injections (Dysart, Am Health Drug Benefits 2021), an analysis of 169 clinical trials involving more than 21,000 people showed that hyaluronic acid injections do *not* reduce pain intensity or improve knee function by clinically meaningful amounts. Moreover, hyaluronic injections increased the risk of serious adverse events (e.g., hospitalization, disability, life-threatening adverse events, or death) by about 50% compared to placebo (Pereira, BMJ 2022).

Hyaluronic acid is also sometimes added to supplements for joint health, but the evidence is mixed as to whether it works when used orally. Two small studies of a branded hyaluronic acid formula (*Hyabest®(J)*, Kewpie Co.) suggest that 200 mg taken daily for up to two months may improve pain and stiffness in people with severe knee osteoarthritis pain, but appears to be no more effective than placebo for those with mild to moderate pain, or when taken for longer periods of time (Sato, J New Rem & Clin 2009; Tashiro, Sci World J 2012). A study among 31 healthy adults with knee pain but *without* osteoarthritis found that taking 111 mg of a similar hyaluronic acid formula (*Hyabest®(S) LF-P* by Kewpie Co., which conducted the study) once daily for 12 weeks did *not* significantly improve physical function (i.e., ability to stand from a sitting position or the how long they could stand on one leg with their eyes open) but seemed to lessen the *self-reported* knee pain, stiffness, and discomfort (such as when descending stairs or walking long distances) compared to placebo (Sugiyama, Exp Ther Med 2023). In a clinical study of men and women with knee osteoarthritis, a branded formula containing a combination of hyaluronic acid and collagen, (*Hyal-Joint®*, Bioiberica) failed to show any significant benefit compared to placebo (Kalman, Nutr J 2008). However, another study found that 80 mg of a hyaluronic acid formula (without collagen) (*Oralvisc®*, Bioiberica) taken daily for 3 months significantly reduced pain and stiffness and blood markers of inflammation in overweight and obese men and women with knee osteoarthritis compared to placebo (Nelson, Rheumatol Int 2015). Interestingly, those taking the hyaluronic acid also had a significant decrease in levels of leptin, a hormone which tends to be elevated in people who are obese.

If you want to try hyaluronic acid, it's best to take amounts used in clinical studies (between 80 mg and 200 mg hyaluronic acid per daily serving), which are typically found in supplements that only contain hyaluronic acid. Be aware that hyaluronic acid is sometimes added on its own or part of a "formula" or "blend" in joint health supplements containing other ingredients, such as some glucosamine and chondroitin supplements in this review, (see the last column of the results table above for "Other Notable Ingredients"), but typically not in clinically meaningful amounts — just a few milligrams per serving. Some joint supplements contain a "propriety blend" containing hyaluronic acid, however, there is no way to know how much hyaluronic acid the blend contains. When taken as a supplement, hyaluronic acid appears to be generally safe, although one person in a clinical study stopped taking it after developing a rash. Rarely, anaphylaxis has been reported when it is injected. The hyaluronic acid in supplements is extracted from roosters' combs (the red flesh on top and below the head) or produced from bacteria.

Turmeric

The typical daily dose ranges from 500 mg to 2,000 mg of curcuminoids (most of which is curcumin) from turmeric extracts, which can often be as much as 95% curcuminoids. Turmeric powder in some supplements is similar to turmeric spice, which is only about 3% curcuminoids, i.e., one teaspoon of turmeric powder (about 5,000 mg) provides only about 150 mg of curcuminoids. For more details, see the Dosage section of the Turmeric and Curcumin Supplements Review.

Collagen

When using undenatured collagen which is made of cartilage (such as UC-II or, another branded collagen, NT2) for joint pain, the dose is 40 mg per day (providing 10 mg of collagen), taken on an empty stomach at bedtime.

Exercise

Proper muscle strengthening exercises and physical activity can reduce joint pain and improve function associated with osteoarthritis. A study in Australia among 206 adults with knee osteoarthritis showed that following a 24-week, self-administered program of exercise and activity (developed by physiotherapists at the University of Melbourne) resulted in clinically important reductions in knee pain in 72.1% of those who followed the program, which included automated reminder messages. In addition, 68% had clinically important improvements in knee function (Nelligan, JAMA 2021). The researchers have made the program free on the internet at https://mykneeexercise.org.au/. The program consists of three phases of exercise, each lasting about 2 months. The website explains and demonstrates the exercises. Also free is an online app that sends tailored, weekly motivational messages.

Concerns and Cautions:

Glucosamine and chondroitin

Glucosamine and chondroitin, taken in appropriate amounts, are generally considered safe for healthy people not taking other medications, but be aware that, in some individuals, glucosamine can cause **gastrointestinal discomfort, drowsiness, skin reactions, and headache** and chondroitin can occasionally cause **stomach upset** (Clegg, N Engl J Med 2006).

Glucosamine is an amino sugar, so it may theoretically affect **blood sugar levels**. However, studies in people have not found evidence of such an increase (Scroggie, Arch Intern Med 2003; Anderson, Food Chem Toxicol 2005). In fact, one study found that 1,500 mg of glucosamine sulfate taken for 3 years *slightly lowered* fasting blood sugar levels in older adults with knee osteoarthritis (Reginster, Lancet 2001). In addition, a study of nearly half a million adults in the UK found that, over a period of about 7 years, self-reported use of glucosamine was associated with a decreased risk of developing type 2 diabetes (Ma, Diabetes Care 2020 — see the What It Does section for more details).

Because the glucosamine in supplements is commonly derived from shrimp or crab shells, **people allergic to shellfish may experience an allergic reaction** to these products. A vegetable-based glucosamine is available, sold under the trademarks Regenasure and GreenGrown.

Glucosamine may increase eye pressure in people with **open-angle glaucoma or ocular hypertension**: A small analysis in people with open-angle glaucoma or ocular hypertension (IOP >21 mm Hg) found that eye pressure measurements were significantly higher, by about 18%, while taking glucosamine supplements compared to measurements before taking it. Most patients were taking 1,500 mg daily of glucosamine (the form of glucosamine, e.g., sulfate or HCl, was not listed in the study). When glucosamine was discontinued, eye pressure measurements returned to pre-supplement levels (Murphy, JAMA Ophthalmol 2013). For people *without* these conditions (and particularly in younger people without these conditions) glucosamine may have little to no ocular effect. For example, an increase in intraocular pressure of 9% was recorded in a study in which people without glaucoma or ocular hypertension who took 750 mg of glucosamine sulfate, three times daily, for three months for osteoarthritis. The risk of a clinically significant rise in pressure of ≥ 2 mm Hg was 2.7 times greater in the glucosamine group compared to placebo, and the average age of those who experienced this increase was 66, compared to 58 for those who didn't (Esfandiari, Eye (Lond) 2017). On the other hand, a study in Thailand among 88 men and women who did not have glaucoma or ocular hypertension found taking glucosamine sulfate (1,500 mg daily) for knee osteoarthritis for six months did *not* increase in ocular eye pressure compared to placebo (Yuenyongviwat, J Fr Ophtalmol 2019).

Rare case reports have linked glucosamine use to elevations in **liver enzymes**, suggesting possible liver toxicity. For example, in 2011, cases of possible toxicity were described in two older women in Spain, both of whom had chronic liver disease due to chronic hepatitis C, whose liver enzymes were elevated when taking glucosamine but decreased when glucosamine was discontinued (Cerda, World J Gastro 2013). Due to the possibility of liver toxicity, it would seem prudent to discontinue use of glucosamine if alterations in liver transaminase enzymes occur, and people with chronic hepatitis C may want to avoid use of glucosamine.

Chondroitin is similar in structure to the **blood-thinning** drug heparin, so use of chondroitin with blood-thinning drugs or daily aspirin therapy may cause bleeding in some people. There are also reports of glucosamine and glucosamine/chondroitin affecting coagulation, increasing the INR (international normalized ratio) and the risk of bruising or bleeding in people using warfarin (Coumadin). If you use blood-thinning drugs, be sure to let your healthcare provider know if you take glucosamine or chondroitin, the dosage, and if you change the dosage.

Chondroitin sulfate may aggravate **asthma**. A worsening of asthma symptoms that persisted for three weeks even with increased asthma medication was reported in a 52-year-old woman taking a product containing 500 mg of glucosamine and 400 mg of chondroitin sulfate three times daily; her symptoms resolved within 24 hours of stopping supplementation (Tallia, J Am Board Fam Pract 2002). People with asthma have been found to have elevated levels of antibodies to chondroitin sulfate in their airways.

Chondroitin sulfate is a component of a substance called versican that appears to support the spread of **prostate cancer** (Sakko, Cancer Res 2003). However, chondroitin sulfate itself has not been shown to have this effect (Braksy, Nutr Cancer 2011).

If you need to watch your **sodium** intake, consider choosing a product that does not use the sodium forms of glucosamine and chondroitin, as discussed above.

Before starting on any supplement for joint pain, consult a physician to be sure of your diagnosis. This is particularly important with **hip pain**, which may be caused by rheumatoid arthritis, infection, damaged blood supply, gout or other diseases for which treatment with glucosamine, chondroitin, or MSM would be inappropriate.

MSM

MSM is generally safe when taken at recommended dosage levels, but be aware that MSM occasionally causes **nausea, diarrhea, or headache**. MSM may also have an aspirin-like effect and shouldn't be used by patients already taking **blood-thinning drugs**, unless medically supervised. The safety of MSM hasn't been evaluated for children or for women who are pregnant or breast-feeding, so individuals in these groups should avoid using MSM.

Boswellia

At the dosage used in the clinical studies referenced above, boswellia resin and extracts have been well tolerated. Some patients have reported gastrointestinal side effects, such as **diarrhea, heartburn, nausea, and abdominal pain** but this has generally not caused them to discontinue treatment. **Headache, itching, and swelling of the foot** have also been reported (Sengupta, Arthritis Res Ther 2008). There is one report of an **allergic reaction** (confirmed with an allergen patch test) to boswellia when applied topically that resulted in a blistering rash (Acebo, Contact Dermatitis 2004).

Turmeric

Turmeric/curcumin supplements are generally safe, but gastrointestinal side effects may occur with higher doses and they can cause problems for people with **gallbladder disease**, **kidney stones**, or those taking **blood-thinning** or **blood-sugar-lowering medications**. Rarely, **liver injury** has been reported. One of the bioavailability enhancers commonly added can potentially affect a number of drugs. For more details, see the Concerns and Cautions section of the Turmeric and Curcumin Supplements Review.

Collagen

Collagen supplements are generally well-tolerated, but mild side effects including **gastrointestinal symptoms**, **headache**, **dizziness** and **rash** can occur. People with **allergies** to specific sources of collagen (such as fish) should avoid collagen products derived from these sources. For more details, see the Concerns and Cautions section of the Collagen Supplements Review.

White willow bark

White willow bark extract is added to some joint health formulas. It naturally contains salicin, a precursor to salicylic acid (the active metabolite of aspirin), which works as both a COX-1 and COX-2 inhibitor (Wu, Circulation 2000). Be aware, however, that white willow bark extract may cause **headache** and **dizziness** (Chrubasik, Rheumatology (Oxford) 2001) and it should not be used by **people sensitive or allergic to salicylates such as aspirin.** Allergic reactions such as rash, itchiness, and asthma have been reported, and in rare cases, anaphylaxis have occurred in sensitive individuals (Boullata, Annals of Pharmacotherapy 2003; Narat, N Am J Med Sci 2013).

+ 74 sources

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