Soy (Glycine max)
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While some complementary and alternative techniques have been studied scientifically, high-quality data regarding safety, effectiveness, and mechanism of action are limited or controversial for most therapies. Whenever possible, it is recommended that practitioners be licensed by a recognized professional organization that adheres to clearly published standards. In addition, before starting a new technique or engaging a practitioner, it is recommended that patients speak with their primary healthcare provider(s). Potential benefits, risks (including financial costs), and alternatives should be carefully considered. The below monograph is designed to provide historical background and an overview of clinically-oriented research, and neither advocates for or against the use of a particular therapy.

Related Terms:
- Abalone®, beta-conglycinin, bioactive peptides, bowman-birk inhibitor, coumestrol, daidzein, daizuga-cha (Japanese), dark soy sauce, dietary soy protein, edamame, equol, Fabaceae (family), flavonoids, fortified soy milk, frijol de soya, functional proteins, genistein, genistin, Glycine max, greater bean, haba soya, hydrolyzed soy protein, isoflavone, isoflavones, isoflavonoid, Isomil®, kuromame-cha (Japanese), kuromame-cha Gold (Japanese), kuromame-soy milk drink (Japanese), lecithin, legume, lignans, margarine, miso, Mull-Soy®, natto, Nursoy®, okara, phosphatidylserine, phytate, phytoestrogen, plant estrogen, PtdSer, S-PtdSer, shoyu, shoyu polysaccharides, soja, sojabohne, soya, soya-based food, soya protein, soya sauce, soybean, soybean-barley paste, soybean oil, soy milk, soy fiber, soy flour, soy food, soy isoflavones, soy lecithin, soy milk, soy nuts, soy oil, soy phosphatidylcholine complex (IdB 1016), soy phosphatidylinositol (PI), soy product, soy protein, soy protein isolate, soy sauce, Supro®, Ta-tou, tempeh, texturized vegetable protein, tofu, yuba.

BACKGROUND

- Soy is a subtropical plant, native to southeastern Asia. This member of the pea family (Fabaceae) grows from one to five-feet tall and forms clusters of three to five pods, each containing two to four beans per pod. Soy has been a dietary staple in Asian countries for at least 5,000 years, and during the Chou dynasty in China (1134-246 B.C.), fermentation techniques were discovered that allowed soy to be prepared in more easily digestible forms such as tempeh, miso, and tamari soy sauce. Tofu was invented in 2nd-Century China.

- Soy was introduced to Europe in the 1700s and to the United States in the 1800s. Large-scale soybean cultivation began in the United States during World War II. Currently, Midwestern U.S. states produce approximately half of the world's supply of soybeans.

- Soy contains protein, isoflavones, and fiber, all thought to provide health benefits. Soy is an excellent source of dietary protein, including all essential amino acids. Soy is also a source of lecithin or phospholipid. Soy isoflavones and lecithin have been studied scientifically for numerous health conditions. Isoflavones such as genistein are believed to have estrogen-like effects in the body, and as a result are sometimes called "phytoestrogens."

- Common sources of soy isoflavones include roasted soybean, green soybean, soy flour, tempeh, tofu, tofu yogurt, soy hot dogs, miso, soy butter, soy nut butter, soy ice cream, soy milk, soy yogurt, tofu pups®, soy cheese, bean curd, seitan, and soy noodles. Soybean flour is found in Spanish sausage products (chorizo, salchichon, mortadella, and boiled ham),
doughnuts, and soup stock cubes. Although processed soy foods (e.g., veggie burgers, tofu pups®, meatless dinner entrees, chicken-free nuggets, soy "ice creams" and energy bars) are usually high in protein, they typically contain lower levels of isoflavones.

Soy protein has also been investigated for benefit in terms of other cardiovascular disease risk factors, reducing menopausal symptoms, weight loss, arthritis, brain function, and exercise performance enhancement. Dietary soy may decrease the risk of breast cancer in women and prostate cancer in men, as well as other types of cancers. In general, the supportive evidence for use of phytoestrogens as treatments for menopause, cardiovascular disease, osteoporosis (weak bone mass), and cancer is limited. The use of soy formula has been investigated in the treatment of diarrhea in infants and is an effective and safe alternative to cow's milk formula in most infants. Due to limited human study, there is currently not enough evidence to recommend for or against the use of soy for weight reduction.

### SCIENTIFIC EVIDENCE

<table>
<thead>
<tr>
<th>Uses</th>
<th>Grade</th>
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<tbody>
<tr>
<td><strong>Dietary source of protein</strong>  &lt;br&gt;Soy products, such as tofu, are high in protein and are an acceptable source of dietary protein.</td>
<td>A</td>
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<tr>
<td><strong>High cholesterol</strong>  &lt;br&gt;Numerous human studies report that adding soy protein to the diet can moderately decrease blood levels of total cholesterol and low-density lipoprotein (&quot;bad&quot; cholesterol). Small reductions in triglycerides may also occur, while high-density lipoprotein (&quot;good&quot; cholesterol) is altered in some, but not all, studies.  &lt;br&gt;Some scientists have proposed that specific components of soybean, such as the isoflavones genistein and daidzein, may be responsible for the cholesterol-lowering properties of soy. However, this has not been clearly demonstrated in research and remains controversial. It is not known if products containing isolated soy isoflavones have the same effects as regular dietary intake of soy protein.  &lt;br&gt;Dietary soy protein has not been proven to affect long-term cardiovascular outcomes, such as heart attack or stroke.</td>
<td>A</td>
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<tr>
<td><strong>Diarrhea (acute) in infants and young children</strong>  &lt;br&gt;Numerous studies report that infants and young children (2-36 months old) with diarrhea who are fed soy formulas experience fewer daily bowel movements and fewer days of diarrhea. This research suggests that soy has benefits over other types of formula, including cow milk-based solutions. The addition of soy fiber to soy formula may increase the effectiveness. Better quality research is needed before a strong recommendation can be made.</td>
<td>B</td>
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Parents are advised to speak with qualified healthcare providers if their infants experience prolonged diarrhea, become dehydrated, develop signs of infections (such as fever), or have blood in the stool. A healthcare provider should be consulted for current breastfeeding recommendations and to suggest long-term formulas that provide enough nutrition.

### Allergies (prevention of food allergies)

Soy formulas are commonly used by infants with sensitivities to milk-based formulas. There is currently little evidence to support the use of soy formulas for preventing food allergies. Further research is needed in this field.

### Antioxidant

There is some evidence in support of soy increasing antioxidant status in humans. In general, diets high in plant foods may offer antioxidant benefits. Further research is required in this field before recommendations can be made.

### Bowel/intestinal disorders

The effect of soy on erosive-ulcer lesions of the alimentary tract has been examined in limited study. Overall, the effects of soy products appear beneficial. Further study is required before recommendations can be made.

### Cancer (prevention and treatment)

Several large population studies have asked people about their eating habits and reported that higher soy intake (such as dietary tofu) is associated with a decreased risk of developing various types of cancers, including breast, prostate, and colon cancer. However, other research suggests that soy does not have this effect.

Until better research is available, it remains unclear if dietary soy or soy isoflavone supplements increase or decrease the risk of these cancers.

### Cardiovascular disease

Dietary soy protein has not been shown to affect long-term cardiovascular outcomes, such as heart attack or stroke. Research does suggest cholesterol-lowering effects of dietary soy, which in theory, may reduce the risk of heart problems. Soy has also been studied for blood pressure-lowering and blood sugar-reducing properties in people with type 2 diabetes, although the evidence is not definitive in these areas. In women with suspected cardiac ischemia, high levels of the soy isoflavone genistein have been associated with blood vessel problems. Further investigation is needed before a strong recommendation can be made.
<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
<th>Recommendation</th>
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</thead>
<tbody>
<tr>
<td>Cognitive function</td>
<td>It is unclear if soy isoflavone supplementation in postmenopausal women can improve cognitive function. Results from studies are mixed.</td>
<td>C</td>
</tr>
<tr>
<td>Crohn's disease</td>
<td>Due to limited human research, there is not enough evidence to recommend for or against the use of soy as a way to prevent Crohn's disease. Further research is needed before a recommendation can be made.</td>
<td>C</td>
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<tr>
<td>Cyclical breast pain</td>
<td>It has been theorized that the &quot;phytoestrogens&quot; (plant-based compounds with weak estrogen-like properties) in soy may be beneficial to premenopausal women with cyclical breast pain. However, due to limited human research, there is not enough evidence to recommend for or against the use of dietary soy protein as a therapy for this condition.</td>
<td>C</td>
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<tr>
<td>Diabetes</td>
<td>Several small studies have examined the effects of soy products on blood sugar levels in people with type 2 (&quot;adult-onset&quot;) diabetes. Results are mixed, with some research reporting decreased blood glucose levels and other trials noting no effects. Overall, research in this area is not well designed or reported and better information is needed.</td>
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<tr>
<td>Exercise performance enhancement</td>
<td>Soy protein has been investigated as a source of protein with potential for benefit in exercise performance. In general, research findings suggest soy protein is better than no protein but is unlikely to be superior to other sources of protein. Further research is required in this field.</td>
<td>C</td>
</tr>
<tr>
<td>Gallstones (cholelithiasis)</td>
<td>Due to limited human research, there is not enough evidence to recommend for or against the use of soy as a therapy in cholelithiasis. Further research is needed before a strong recommendation can be made.</td>
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<tr>
<td>Gastrointestinal motility</td>
<td>In limited available studies, the addition of soy polysaccharide to non-regular diets increased the moisture content of stool and decreased the number of liquid stools. It is not clear if soy polysaccharide would be superior to other fiber sources in this regard.</td>
<td>C</td>
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**High blood pressure**

There is limited human research on the effects of dietary soy on blood pressure. Some research suggests that substituting soy nuts for non-soy protein may help improve blood pressure. Further research is needed before a firm recommendation can be made.

**Infantile colic**

There is currently a lack of scientific evidence to recommend for or against the use of soy formula for fussiness and gas in infants with cow’s milk allergy over a partially hydrolyzed cow's milk protein formula.

**Inflammation**

There is currently a lack of scientific evidence to recommend for or against the use of soy protein on inflammation associated with hemodialysis (removal of waste products from the blood).

**Iron deficiency anemia**

There is currently a lack of sufficient evidence to recommend for or against the use of soy-based formula in the treatment of iron deficiency anemia in children.

**Kidney disease (chronic renal failure, nephrotic syndrome, proteinuria)**

Due to limited human study, there is not enough evidence to recommend for or against the use of soy in the treatment of kidney diseases, such as nephrotic syndrome. People with kidney disease should speak with their healthcare providers about the recommended amounts of dietary protein because soy is a high-protein food.

**Menopausal symptoms**

Overall, evidence suggests that soy products containing isoflavones may help reduce menopausal symptoms, such as hot flashes. More study is needed to confirm this use.

**Menstrual migraine**

A phytoestrogen combination may help prevent menstrual migraine attacks. Further research is needed before a strong recommendation can be made.
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**Metabolic syndrome**

Treatment with soy protein and soy nuts was evaluated in patients with metabolic syndrome and benefits were found in terms of plasma lipids in patients consuming soy nuts as part of the DASH (Dietary Approaches to Stop Hypertension) diet. Further research is required in this field in terms of soy protein supplementation.

**Obesity/weight reduction**

Some research suggests that soy might be as effective as skim milk and more effective than a low-calorie diet alone in reducing weight. Other research has reported conflicting results. Further research is needed before a strong recommendation can be made.

**Osteoarthritis**

Osteoarthritis is a form of arthritis caused by the breakdown of cartilage. Early research suggests that intake of soy protein may be associated with reduced symptoms of osteoarthritis.

**Osteoporosis**

It has been theorized that "phytoestrogens in soy" (such as isoflavones) may increase bone mineral density in post-menopausal women and reduce the risk of fractures. However, more research is needed before a conclusion can be made.

**Quality of life**

The effect of soy on quality of life has been investigated in limited study. Further study is required before recommendations can be made.

**Rheumatoid arthritis**

There is currently insufficient evidence to recommend for or against the use of soy as a treatment for rheumatoid arthritis.

**Skin aging**

It is unclear if aglycones, a form of soy isoflavone, can improve aged skin in middle-aged women when it is taken by mouth. More research is needed.
### Skin damage caused by the sun

A soy moisturizing cream may help improve signs of sun damage, including discoloration, blotchiness, dullness, fine lines, and overall texture. Because the cream contained other ingredients besides soy, more research with soy alone is needed.  

**C**

### Spinal cord injury

Whey protein has traditionally been used as a protein source to increase body strength. Limited available study investigated whether soy protein could be used to increase ambulation performance in patients with incomplete spinal cord injury. There is currently not enough evidence to recommend for or against the use of soy as a treatment for increased endurance in individuals with spinal cord injury.  

**C**

### Thyroid disorders

Early research suggests that soy supplements do not affect thyroid function. More research is needed.  

**C**

### Tuberculosis

It has been suggested that soy may be beneficial for tuberculosis when taken with standard medications. According to early research, soy may improve the process of detoxification, have positive effects on the liver, reduce cell damage, and decrease inflammation. Therefore, soy supplements may allow patients to safely take higher doses of antimicrobial drugs that are used to treat tuberculosis.  

**C**

### Weight gain (infants)

In limited study, weaning infants with cow's milk allergy to soy based formula resulted in reduced weight for age as compared with formulas containing hydrolyzed proteins (broken down). Further research is required in this field.  

**C**

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**Key to grades:** A: Strong scientific evidence for this use; B: Good scientific evidence for this use; C: Unclear scientific evidence for this use; D: Fair scientific evidence against this use (it may not work); F: Strong scientific evidence against this use (it likely does not work).

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**TRADITION/THEORY**

*The below uses are based on tradition, scientific theories, or limited research. They often have not been thoroughly tested in humans, and safety and effectiveness have not always been proven. Some of these conditions are potentially serious, and should be evaluated by a qualified healthcare provider. There may be other proposed uses that are not listed below.*

- Alzheimer's disease
- Anorexia
- Anti-aging
- Antifungal
- Arthritis
- Atherosclerosis (hardening of
the arteries), attention deficit hyperactivity disorder (ADHD), benign prostate hyperplasia, bone density, bone fractures, breast enlargement, colitis, constipation, cystic fibrosis, diabetic neuropathy, fall prevention, fever, growth, headache, hepatitis (chronic), immune function, improving health outcomes (general), infertility, insect repellant, kwashiorkor, malnutrition, melasma (skin discoloration), memory enhancement, nosebleed (chronic), osteosarcoma, polycystic ovary syndrome, respiratory problems (cough, phlegm), skin conditions, thrombosis (blood clotting), vaginitis, vasoregulator, wound healing.

**DOING**

The below doses are based on scientific research, publications, traditional use, or expert opinion. Many herbs and supplements have not been thoroughly tested, and safety and effectiveness may not be proven. Brands may be made differently, with variable ingredients, even within the same brand. The below doses may not apply to all products. You should read product labels, and discuss doses with a qualified healthcare provider before starting therapy.

**Adults (over 18 years old)**

- Soy is typically consumed as a protein drink, soy flour, isolated soy protein (e.g. Supro®), extract, fiber/cereal, or milk beverage. Studies have examined the effects of 10-106 grams of soy with an isoflavone content of about 40-120 milligrams taken daily for up to 12 months by mouth.
- A dose of 20-106 grams of soy protein taken daily by mouth has been studied in people with high cholesterol. Isoflavone content has ranged from 60 to over 100 milligrams daily. Cholesterol and low-density lipoprotein levels have been reduced in people using these doses of soy protein. There is limited study of soymilk (400 milliliters daily) in pre-menopausal women, with reported benefits on cholesterol levels. Additional doses have been studied but are not recommended due to a lack of available scientific evidence.

**Children (under 18 years old)**

- Due to potential safety concerns, a qualified healthcare provider should be consulted regarding the choice of infant formula.

**SAFETY**

The U.S. Food and Drug Administration does not strictly regulate herbs and supplements. There is no guarantee of strength, purity or safety of products, and effects may vary. You should always read product labels. If you have a medical condition, or are taking other drugs, herbs, or supplements, you should speak with a qualified healthcare provider before starting a new therapy. Consult a healthcare provider immediately if you experience side effects.

**Allergies**

- Soy may act as a food allergen similar to milk, eggs, peanuts, fish, and wheat. Symptoms of an allergic reaction range from a runny nose to a sudden drop in blood pressure.

**Side Effects and Warnings**

- Soy has been a dietary staple in many countries for more than 5,000 years and it does not appear to cause long-term toxicity. Aside from allergic reactions, limited side effects have been reported in infants, children, and adults.
- Soy protein taken by mouth has been associated with stomach and intestinal difficulties, such as bloating, nausea, and constipation. Changes in stool quality have been reported. More
serious intestinal side effects have been uncommonly reported in infants fed soy protein formula, including vomiting, diarrhea, growth failure, and damage/bleeding of the intestine walls. People who experience intestinal irritation (colitis) from cow’s milk may also react to soy formula.

- Based on human case reports and animal research, soy may affect thyroid hormone levels in infants. There have been rare reports of goiters (enlarged neck due to increased thyroid size). Hormone levels became normal again after stopping soy. Infants fed soy or cow’s milk formula may also have higher rates of atopic eczema than infants who are breastfed.
- Acute migraine headache has been reported with the use of a soy isoflavone product. Based on animal research, damage to the pancreas may theoretically occur from regularly eating raw soybeans or soy flour/protein powder made from raw, unroasted, or unfermented beans.
- The use of soy is often discouraged in patients with hormone-sensitive cancers, such as breast, ovarian, or uterine cancer, due to concerns about possible estrogen-like effects (which theoretically may stimulate tumor growth). Other hormone-sensitive conditions, such as endometriosis, may also theoretically be worsened. In laboratory studies, it is not clear if isoflavones stimulate or block the effects of estrogen or both (acting as a "receptor agonist/antagonist"). Until additional research is available, patients with these conditions should be cautious and speak with a qualified healthcare practitioner before starting use.
- It is not known if soy or soy isoflavones share the same side effects as estrogens, such as increased risk of blood clots. Early studies suggest that soy isoflavones, unlike estrogens, do not cause the lining of the uterus (endometrium) to build up.
- There has been a case report of vitamin D deficiency rickets in an infant nursed with soybean milk (not specifically designed for infants). Patients should consult their qualified healthcare practitioners for current breastfeeding recommendations and use formulas with adequate nutritional value.

Pregnancy and Breastfeeding

- Soy as a part of the regular diet is traditionally considered to be safe during pregnancy and breastfeeding, although scientific research is limited in these areas. The effects of high doses of soy or soy isoflavones in humans are not clear, and therefore are not recommended.
- Recent study demonstrates that isoflavones, which may have estrogen-like properties, are transferred through breast milk from mothers to infants. High doses of isoflavones given to pregnant animals have resulted in tumors and reproductive changes in offspring, although this has not been tested in humans.
- In one human study, male infants born to women who ingested soymilk or soy products during pregnancy experienced more frequent hypospadias (a birth defect in which the urethral meatus, the opening from which urine passes, is abnormally positioned on the underside of the penis). However, other human and animal studies have examined males or females fed soy formula as infants, and have not found abnormalities in infant growth, head circumference, height, weight, occurrence of puberty, menstruation, or reproductive ability.
- Research in children during the first year of life has found that the substitution of soy formula for cow’s milk may be associated with significantly lower bone mineral density. Parents considering the use of soy formula should speak with qualified healthcare practitioners to make sure the appropriate vitamins and minerals are provided in the formula.
Most herbs and supplements have not been thoroughly tested for interactions with other herbs, supplements, drugs, or foods. The interactions listed below are based on reports in scientific publications, laboratory experiments, or traditional use. You should always read product labels. If you have a medical condition, or are taking other drugs, herbs, or supplements, you should speak with a qualified healthcare provider before starting a new therapy.

Interactions with Drugs

- Soy contains "phytoestrogens" (plant-based compounds with weak estrogen-like properties), such as isoflavones. It is not clear if isoflavones stimulate or block the effects of estrogen or both (acting as a "receptor agonist/antagonist"). It is not known if taking soy or soy isoflavone supplements increases or decreases the effects of estrogen on the body, such as the risk of blood clots. It is unclear if taking soy alters the effectiveness of birth control pills containing estrogen.

- It is not known what the effects of soy phytoestrogens are on the anti-tumor effects of selective estrogen receptor modulators (SERMs) such as tamoxifen. The effects of aromatase inhibitors such as anastrozole (Arimidex®), exemestane (Aromasin®), or letrozole (Femara®) may be reduced. Because of the potential estrogen-like properties of soy, people receiving these drugs should speak with their oncologists before taking soy in amounts greater than normally found in the diet.

- Soy protein may interact with warfarin (Coumadin®), although this potential interaction is not well characterized. Patients taking warfarin should check with a doctor and pharmacist before taking soy supplementation.

- Genistein, a major component of soy, may alter the way some drugs are broken down in the liver.

- Soy may also potentially interact with agents taken for diabetes, diarrhea, high blood pressure, high cholesterol, obesity, or cardiovascular disorders. In theory, various types of soy may interact with antibiotics, diuretics (water pills), iron salts, immunosuppressants or thyroid hormones. Conclusive human data is lacking for these interactions. Patients are advised to check with a qualified healthcare professional, including a pharmacist.

Interactions with Herbs and Dietary Supplements

- The effects of soy protein or flour on iron absorption are not clear. Studies in the 1980s reported decreases in iron absorption, although more recent research has noted no effects or increased iron absorption in people taking soy. People using iron supplements as well as soy products should consult their qualified healthcare practitioners to follow blood iron levels. Calcium and phosphate levels may be altered.

- Some experts believe that there may be a potential interaction between soy extract and *Panax ginseng*, although this possible interaction is not well understood.

- Prebiotics (complex sugars) do not appear to affect how the body absorbs soy. It is unclear if probiotics (commonly found in cultured milk products like yogurt) affect the absorption of soy.

- Soy may also potentially interact with herbs or supplements taken for cancer, diabetes, diarrhea, high blood pressure, high cholesterol, obesity, or cardiovascular disorders. In theory, various types of soy may interact with antibacterials, antioxidants, blood thinners, diuretics (water pills), immunomodulators, phytoestrogens, or thyroid hormones. Conclusive human data is lacking for these interactions. Patients are advised to check with a qualified healthcare professional, including a pharmacist.

- Soy has been studied along with various foods, herbs and supplements, such as avocado, beta-sitosterol, black cohosh, branched chain amino acids, green tea, lecithin, lycopene, magnesium, magnolia bark extract, oats, seaweed, spirulina, and tomatoes. There is not
enough scientific evidence to make a firm conclusion about the effects when taken together.

- Theoretically, soy protein may inhibit phosphate and calcium absorption and increase the absorption of manganese. Soy may also lower zinc and selenium levels in the blood. Soy nuts may be able to reduce sugar levels in the blood, but the magnitude of this effect is unclear. Genistein, a major component of soy, may alter the way some herbs and supplements are broken down in the liver.

**AUTHOR INFORMATION**

This information is based on a systematic review of scientific literature edited and peer-reviewed by contributors to the Natural Standard Research Collaboration (www.naturalstandard.com).

**REFERENCES**

Natural Standard developed the above evidence-based information based on a thorough systematic review of the available scientific articles. For comprehensive information about alternative and complementary therapies on the professional level, go to www.naturalstandard.com. Selected references are listed below.

The information in this monograph is intended for informational purposes only, and is meant to help users better understand health concerns. Information is based on review of scientific research data, historical practice patterns, and clinical experience. This information should not be interpreted as specific medical advice. Users should consult with a qualified healthcare provider for specific questions regarding therapies, diagnosis and/or health conditions, prior to making therapeutic decisions.