Tofu and Tempeh

An Important Message About Tofu and Tempeh

We have placed soy foods (such as tofu and tempeh) on our "10 Most Controversial WHFoods List". This list was created to let you know that even though some foods (like tofu and tempeh) can make an outstanding contribution to your meal plan, they are definitely not for everyone. Soy foods can be difficult to find in high-quality form; can be more commonly associated with adverse reactions than other foods; and can present more challenges to our food supply in terms of sustainability.
What's New and Beneficial About Tofu and Tempeh

Even though soy foods in general are associated with decreased risk of cancer in several countries, a comprehensive analysis of 28 previously published studies on Chinese adults has now shown that intake of soy foods in the form of tofu (and soy miso) does a better job of reducing risk of at least one cancer type (stomach cancer) than intake of soy in general. A team of researchers at the School of Radiation Medicine and Public Health at Soochow University in Suzhou, Jiangsu Province, China arrived at this conclusion after statistical analysis of numerous studies conducted between 1998-2008. While we cannot be sure about the ability of tofu and soy miso to provide health benefits for U.S. adults in the same way that they provide health benefits for Chinese adults, we can be sure that there is something unique about tofu and miso among all varieties of soy foods, and that this uniqueness may extend to stomach cancer prevention under certain circumstances.

In the case of fermented tofu, we've recently learned that antioxidant and free radical-scavenging health benefits are directly related to the length of fermentation time. Tofus fermented for nine versus three days have recently been shown to provide up to double the free radical-scavenging activity. We suspect that there is no magic number with respect to fermentation time, and that a variety of factors was responsible for the increased free radical-scavenging activity of these tofus after nine days of fermentation. Nevertheless, this study underscores the potentially beneficial nutrient changes that can take place when a food is carefully fermented and when micro-organisms used in fermentation are provided with enough time to grow and transform the food's nutrient potential. In this particular study a variety of micro-organisms (fungi) were used to ferment the tofu, including Aspergillus oryzae, Aspergillus sojae, Aspergillus awamori, Actinomucor taiwanensis, and Rhizopus oligosporus.

A recent study from Kuala Lumpur, Malaysia has provided us with some fascinating results about the bioavailability of calcium from tempeh. In this study involving postmenopausal women, calcium from tempeh was determined to be as equally well absorbed as calcium from cow's milk. Due to the higher concentrations of calcium in cow's milk versus tempeh, however, four servings of tempeh were needed to bring the total amount of calcium absorbed from
tempeh up to the same level as the total amount of calcium absorbed from fresh cow's milk. Still, the excellent bioavailability of calcium from tempeh was an important research finding in this study, since many women (as well as men) would benefit from increased intake of calcium from non-dairy foods, and tempeh clearly performed very well as a calcium source in this study.

Tofu and tempeh are two widely-enjoyed foods made from soybeans, and they are great examples of how a simple food like soybeans can be woven into human food traditions in a way that is natural, inexpensive, and nourishing. Tofu is a surprisingly versatile form of soybeans that is made by curdling soymilk so that its proteins become coagulated and then pressed into a sliceable cake. Even though very little tofu sold in the U.S. has been fermented, it is also possible for tofu to be made not only through coagulation, but also through fermentation—i.e., through the addition of micro-organisms which can interact with the soy curds. (There are many health advantages to the fermentation of soy foods, and these advantages will be described in more detail throughout this food profile.)

In contrast to tofu, tempeh is a soy food sold in the U.S. that has always been fermented. In the case of tempeh, the fungus Rhizopus oligosporus is used to carry out the fermentation process. Following fermentation, the tempeh can be pressed into a sliceable cake and, like tofu, can be used in a wide variety of ways.

Both tofu and tempeh have been enjoyed for more than a thousand years in Asian countries (with tofu originating in China and tempeh on the Indonesian island of Java). Both are available year-round in many grocery stores across the U.S.

**Health Benefits**

In the Health Benefits section of our Soybeans food profile, we provide an in-depth look at many of the controversial issues surrounding soyfoods and their role in health. (You may want to visit that section of our website to learn more about these issues.) One of the most important things to remember about tofu and tempeh is their basic whole food nature. The vast majority of soy consumed in the U.S. comes from a highly processed form of soy. The soybeans we consume have usually been
genetically engineered, cracked, dehulled, crushed, and subjected to solvent extraction to separate their oils from the rest of the bean. What's left behind after oil extraction (defatted soy flour) is then further processed into animal feed, or processed to produce a protein concentrate or a protein isolate. The isolate can be used as an ingredient in low-fat soymilk, and the concentrate can be further processed (extruded) to form a textured soy protein for use in meat analog products (like soy burgers). Tofu and tempeh are each produced with far less processing than most low-fat soymilks and soy burgers, and they are soyfoods that are much closer to a "whole foods" category than soy protein isolates and concentrates.

While there is existing research that indicates the possibility of certain health risks from consumption of soy, we believe that a significant amount of these possible health risks involve consumption of soy in a highly processed form (like soy protein isolate or soy protein concentrate) rather than a whole food form. By contrast, we view tofu and tempeh as forms of soy that are closer to soy in its whole food form.

From a health benefits standpoint, we also like the fermented nature of tempeh, and we would point out that tofu is also available in fermented form. Fermentation increases the digestibility of soy (especially its proteins), nutrient absorption from soy (including absorption of phytonutrient isoflavones like genistein and daidzein), and the concentration of bioactive peptides (formed during the breakdown of soy proteins during fermentation).

**Overall Nutrient Benefits**

According to a recent research analysis of the U.S. population and dietary practices within this population, U.S. adults would increase their intake of folate, vitamin K, calcium, magnesium, iron and fiber if we replaced our meat and dairy intake with soy, including tofu and tempeh. Replacing meat and dairy with tofu, tempeh, and other soy products would also lower our total cholesterol intake by about 125 milligrams per day and our saturated fat by about 2.4 grams per day. These nutritional changes, in turn, would lower our risk of several chronic diseases, including cardiovascular diseases.

Soyfoods typically contain a wide variety of well-studied phytonutrients. In the case
of fermented soyfoods like tempeh (or tofu, provided that it has been fermented) these phytonutrients can become more concentrated and more bioavailable as well. Below is a list of some key phytonutrients that can be found in tofu, tempeh and other soyfoods.

- Flavonoids and Isoflavonoids: daidzein; genistein; malonylgenistin; malonyldaidzin

- Phenolic Acids: Caffeic acid; Coumaric acid; Ferulic acid; Gallic acid; Sinapic acid

- Phytoalexins: glyceollin I; glyceollin II; glyceollin III; Phytosterols; beta-sitosterol; beta-stigmasterol; campesterol

- Proteins and Peptides: defensins; glycinin; conglycinin; lunacin

- Saponins; soyasaponins (group A and group B); soyasapogenols

Before concluding this phytonutrient section, we think it's important to point out
one nutrient-related aspect of soy processing. Phytates are substances found in soybeans (and many other foods) that can lessen the absorption of certain nutrients, especially minerals. Soy products in general (including products that are minimally processed) contain 1.4-3.0% phytates. Soy isolates (commonly used production of low-fat soy milk) usually contain a minimum of 2.89% phytates, and soy concentrates can contain up to 4.8-4.9% phytates. Forms of soy that are more whole food-based like tofu and tempeh will do a better job of lowering your phytate exposure than highly processed forms of soy like soy protein concentrates or isolates.

**Cardiovascular Benefits of Tofu and Tempeh**

We've seen very few studies of soy and cardiovascular health that are specific to tofu or tempeh. However, we do know that whole food soy products provide better cardiovascular support than dietary supplements containing isolated soy components (like purified isoflavones). We also know that fermented soyfoods like tempeh and fermented tofu have more bioactive peptides than non-fermented soyfoods. (Peptides are smaller breakdown parts of proteins.) In the case of fermented soyfoods, two key storage proteins—glycinin and conglycinin—are broken down by molds, yeasts, and bacteria into peptide fragments that have antioxidant, anti-inflammatory, and blood pressure-lowering properties. For example, some of the peptides found in fermented tofu and tempeh inhibit angiotensin-converting-enzyme (ACE) and are therefore classified as "ACE inhibitors." When this enzyme is inhibited, it is often easier for the cardiovascular system to regulate blood pressure. The antioxidant and anti-inflammatory properties of soy peptides found in fermented soyfoods can help protect the blood vessels from oxidative and inflammatory damage.

Intake of soy foods (especially whole soy foods) has been associated with improved levels of blood fats in numerous research studies. However, even in the case of whole soyfoods, we would not describe this improvement of blood fat levels as being "strong." A better word would be "moderate." The most consistent effect of soybean intake on blood fats has been a moderate lowering of LDL cholesterol. Some studies show other positive impacts on blood fats, like the lowering of triglycerides and total cholesterol or the raising of HDL cholesterol (the "good" cholesterol). However, these additional blood fat results have not been confirmed in all studies.
Soyasaponins are soy phytonutrients that have been especially interesting to researchers with respect to their cardiovascular benefits. There is some evidence, mostly in animal studies, that soyasaponins can lessen the rate of lipid peroxidation in blood vessels, lessen absorption of cholesterol from the GI tract, and increase excretion of fecal bile acids. All of these events would be expected to contribute to a decreased risk of cardiovascular disease. Soyasaponins are provided in many forms of soy, but fermentation of soy has been shown to increase their concentration. Increased levels of soyasaponins in fermented soy foods like tempeh or fermented tofu are likely to play a role in the better track record of fermented (versus non-fermented) soyfoods in the area of cardiovascular benefits.

**Cancer Prevention Benefits**

The area of cancer prevention is a controversial area of health research on soybeans. Many studies provide us with evidence that supports the role of whole soy foods in a cancer-preventing diet. Genistein (an isoflavone phytonutrient in soy) is often a key focus in these cancer-prevention studies. This soy isoflavone can increase activity of a tumor suppressor protein called p53. When p53 becomes more active, it can help trigger programmed cell death (apoptosis) in cancer cells, and it also help trigger cell cycle arrest (helping stop ongoing cancer cell activity). Genistein has also been shown to block the activity of protein kinases in a way that can help slow tumor formation, especially in the case of breast and prostate cancer. Importantly, genistein is found in higher concentrations in fermented soyfoods like tempeh and fermented tofu (compared to non-fermented soyfoods like soymilk, isolate soy protein, concentrated soy protein, textured soy protein—also known as TVP—and non-fermented tofu).

Even in the case of fermented soyfoods and their higher concentration of isoflavones like genistein, however, the potential cancer-related benefits of soy are complicated by other real-life factors. For example, the lifecycle and metabolic status of an individual seems to make a potentially important difference in the anticancer benefits of soy (even fermented soy). In studies on soy intake and breast cancer involving women who are pre-menopausal and develop tumors that are neither estrogen receptor positive nor progesterone receptor positive, soy and genistein intake (even from fermented soy foods) does not appear to offer risk reduction. Overall dietary intake may also make an important difference in the anticancer benefits of soy. For example, without strong dietary intake of fresh fruits and vegetables, even fermented soy foods may not provide reliable anticancer benefits.
In several studies, large doses of purified soy isoflavones (obtained through dietary supplements) has been associated with increased risk of certain cancers, including breast cancer. This evidence should not be surprising. Under certain metabolic circumstances, most antioxidant, anti-inflammatory, and anti-tumor compounds can also act in a way that is pro-oxidant, pro-inflammatory, and pro-tumor (often called a "proliferative" effect that is promoting of tumor growth). We view intake of tempeh and tofu (especially fermented tofu) as very different from intake of highly processed forms of soy, or intake of dietary supplements containing purified soy components. And our recommendations to you based on all of this information is as follows:

First, if you have a family history of hormone-related cancers like breast cancer or prostate cancer, we recommend that you consult with your healthcare provider before consuming very large amounts of soy in your diet (for example, 3 or more servings per day). This recommendation holds true not only for non-fermented soyfoods like non-fermented tofu but also for fermented soy products like tempeh or fermented tofu. And while this recommendation is a conservative one on our part, we believe that it's justified based on the current level of controversy in the health research on soy.

Second, we recommend that you choose whole food soybeans whenever possible, rather than highly processed versions like soy protein isolates and soy protein concentrates. Especially good choices in this context would be whole food-type soy products that have also been fermented, like tempeh or fermented tofu. In general, it's worth remembering that fermented soyfoods have a better track record in cancer prevention than non-fermented soy products.

**Fermented Soy Foods and Vitamin K**

Fermentation of soy foods can often result in increased formation of vitamin K, especially when bacteria called Bacillus subtilis participate in the fermentation process. When Bacillus bacteria are used to help ferment tofu or tempeh, they are able to create a form of vitamin K2 called menaquinone-7 (MK-7). Studies have shown that higher levels of MK-7 in the blood correspond to lower risk of hip fracture in older Japanese women, and that higher MK-7 also correspond to increased intake of soy foods fermented with Bacillus bacteria.
Unfortunately, however, we have not found nationally marketed tofu or tempeh in the U.S. that appears to have been fermented with the help of Bacillus bacteria as reflected in significant vitamin K content. Nutrient databases that are widely used in the U.S. to document the nutritional content of food usually report tofu and tempeh as providing no measurable amount of vitamin K in a standard serving, and since we make use of those nutrient databases in our own ranking system, we also show no measurable vitamin K in our nutrient profiles for tofu and tempeh. It may be possible for you to find some tofu and tempeh products that have been traditionally fermented and that have been fermented with the help of Bacillus bacteria. If you are able to find these products, they may be able to make a valuable contribution to your vitamin K intake. However, as a general rule, it's best to assume that the tofu and tempeh you purchase at the grocery store will not be able to provide you with vitamin K.

**Other Areas of Potential Health Benefit**

There are several other areas of potential health benefit from tofu and tempeh that we believe deserve special mention. First is prevention and treatment of obesity. In this context, it is some of the unique peptides (protein breakdown products) in soy that have been associated with obesity prevention and treatment. Some of these peptides have shown the ability to decrease synthesis of SREBPs (sterol regulatory element binding proteins), thereby helping decrease synthesis of certain fatty acids as well as the depositing of these fatty acids in fat cells. Since fermented soy foods like tempeh and fermented tofu have increased concentrations of bioactive peptides (versus non-fermented soyfoods), tofu and tempeh may turn out to be premier forms of soy with respect to obesity management. However, it's important to remember that this fascinating research on soy and obesity is still in a very early stage.

A second area of potential health benefit is prevention of type 2 diabetes. In multiple animal studies, soy foods have been shown to lessen insulin resistance by increasing the synthesis of insulin receptors. However, this increased formation of insulin receptors only appears to occur in the presence of other dietary circumstances, like a moderate amount of polyunsaturated fat intake. High levels of total soy intake (approximately 200 grams per day) have also been associated with decreased risk of type 2 diabetes, but only in Asian populations thus far. We have yet to see specific studies on tofu or tempeh in this regard, but we look forward to more research in this area.
Other areas of active research on soy and health include chronic obstructive pulmonary disease (COPD), periodontal disease, and neurodegenerative disease. While we have yet to see studies on tofu or tempeh in these areas, we expect to learn more about potential benefits of tofu and tempeh in these areas.

**Description**

Tofu and tempeh are two widely-enjoyed soy foods, and each of these foods is very different from highly processed forms of soy like soy protein isolate or soy protein concentrate. We'd like to give you a closer look at each of these whole food-based forms of soy.

**Tofu**

Originating in China well over a thousand years ago, tofu is made by curdling soymilk so that soymilk proteins become coagulated. The resulting soy curds can then pressed into a sliceable cake. "Nigari" tofu typically refers to soymilk that has been coagulated with the addition of magnesium chloride. Gypsum (calcium sulfate) is another coagulant that is widely used to curdle soymilk. Both calcium sulfate and magnesium chloride are also referred to as "salt" coagulants. ("Salt" in this case doesn't mean table salt, i.e., sodium chloride. Salt is used in this context in a chemical way to refer to any ionic compound.) "Acid" coagulants like glucono delta-lactone (GDL) are also used to coagulate tofu in a way that produces a softer version of this soy food, often referred to as "silken" tofu. Because tofu is "curded" soymilk, tofu is also often called "bean curd." In Chinese, tofu would more accurately be spelled "doufu." Today there are over 200,000 manufacturers of tofu worldwide.

The vast majority of tofu sold in the United States has not been fermented. However, many forms of fermented tofu are widely enjoyed worldwide. You will read and hear about fermented tofu being described using a seemingly endless list of terms, including: pickled tofu, preserved tofu, tofu cheese, Chinese cheese, sufu, sufu cheese, stinky curd, stinky tofu, and stinky sufu. All of these terms refer to tofu that has been fermented. Fermentation of tofu can take place using a variety of methods, including the addition of bacteria and molds as well as special brines.
There's little question in the research about the added health benefits that can come from fermentation of tofu. To understand these health benefits, however, it can be helpful to think not only about fermentation of tofu, but about fermentation of foods in general.

**Fermentation of Soy and Other Foods**

Fermentation of food typically involves the breakdown of a food's carbohydrates into gasses, alcohols, and other molecules by micro-organisms. These micro-organisms include molds, yeasts, and bacteria. Common examples of fermented food include beer and wine, cider, leavened bread, yogurt, and sauerkraut. Interestingly, a relatively small number of micro-organisms account for a very large percent of commercially fermented foods, and an even smaller number account for most fermented soy foods. Fermented soy foods (including tempeh and fermented tofu) usually involve the activity of the molds Aspergillus, Rhizopus, Mucor, Actinomucor and Neurospora; several species of the yeast Saccharomyces; and numerous species of the bacteria Bacillus and Pediococcus.

While fermentation is usually defined in terms of the action of micro-organisms on a food's carbohydrates, many nutrients in food can be transformed during the process of fermentation. These nutrients can include the food's proteins, fats, vitamins, minerals, and phytonutrients. In fermented soy foods, for example, proteins are often made more digestible through fermentation. Minerals like calcium in soy foods can become more soluble and bioavailable through fermentation as can the bioavailability of many phytonutrients, including isoflavones like genistein and daidzein. In some cases, when fermentation changes the digestibility of protein in soy foods (and in other foods as well), smaller protein fragments are created (called peptides) that have unique health supportive properties of their own. For example, one of the important storage proteins in soybeans is called conglycinin. Conglycinin and its fellow storage protein, glycinin, account for as much as 80% of the total proteins in soybeans. During the process of fermentation, conglycinin in soy is often broken down into smaller peptides that serve as antioxidants, boost immune function, and prevent excessive inflammatory response.

In the overall picture, we believe that non-fermented soy foods like non-fermented tofu (or a non-fermented fresh green soybean food like edamame) can provide you with important health benefits. (To learn more about these overall soy benefits, please refer to our food profile for Soybeans.) We believe that these whole
food-based forms of soy stand in clear distinction to highly processed versions of soy like soy protein concentrate or soy protein isolate. So we recommend that you consider adding any whole-food form of soy to your diet. At the same time, we also believe that the research support for the health benefits of soy foods is even stronger for fermented versus non-fermented soyfoods. So we also encourage you to consider inclusion of fermented soyfoods among your whole soy choices. One great option here is tempeh.

**Tempeh**

Tempeh is fermented soyfood that originated on the island of Java in Indonesia and is fermented with the mold Rhizopus oligosporus. Fermentation of tempeh can involve a period of several days or longer, and fermentation is usually carried out at temperatures of 85-90°F/29-32°C. Tempeh is usually purchased in a cake-like form and can be sliced in a way that is similar to tofu. However, tempeh usually has a less watery texture than tofu, and in comparison to non-fermented tofu, a more distinct flavor as well. Steaming, baking, and frying are all popular ways of preparing tempeh in many countries. Tempeh is also commonly incorporated into stews, soups, and grilled kebabs.

**History**

**Tofu**

Along with miso, tofu was a favored food as early as the 12th century AD in Japan, regularly enjoyed by military rulers (Shoguns) and at Zen Buddhist temples throughout the country. In fact, tofu became one of the primary ingredients in "Zen Temple Cookery" (Shojin Ryori) during this time period. Tofu provided a common bond of sorts between common persons, monks, and other officials whose lives were more closely connected with the world of and monasteries. To this day, tofu is viewed as a common food that is both nourishing and inexpensive and can be enjoyed by all.
Tempeh is one of the few soyfoods not originating in China, Japan, or Korea. Instead, tempeh is believed to have first been prepared on the island of Java in Indonesia, at least hundreds of years ago. However, less is known about the exact origins of tempeh than other soyfoods. We do know that trade between Indonesia and China was well underway as early as 1000 AD and that soybeans may have been a part of those trading practices. We also know that a fermentation process used for coconut was already being practiced in China and that this process may have been adapted for use with soybeans. Whatever the exact origins of tempeh, it would not have been uncommon for individuals in Java, China, Japan, or Korea to think about food preparation in terms of fermentation. Fermented foods had become a well-established part of Asian cuisines for several thousand years, and it's probably most sensible to think about tempeh as a logical part of this fermented food tradition.

How to Select and Store

Tofu

Tofu is available refrigerated in individual packages or in bulk, or non-refrigerated in aseptically sealed containers. Packaged tofu should feature expiration dates, which you can use as a guideline for how long of a shelf-life it will have. Tofu varies in texture from soft to firm to extra-firm. Soft tofu has a smoother texture and is therefore better suited for salad dressings, sauces, and desserts. Firm and extra-firm tofu are best for baking, stir-frying and grilling.

While aseptically packaged tofu need not be refrigerated until it is opened, all other forms of tofu should be refrigerated in their container. Once their packages are open, all types should be rinsed well, kept in a container covered with water, and placed in the refrigerator. Changing the water daily will help keep the tofu fresh for up to one week.

Tofu can also be frozen in its original packaging and will keep this way for up to five months. This process will actually alter its texture and color, making it more spongy and absorbent, and more yellowish in color. This change in physical properties is actually very suitable for certain recipe preparations.
If you are selecting tofu on the basis of fat content, the firmer tofus are usually the highest in fat, and the softest tofus, often called silky or silken, are the lowest.

If you are looking for tofu with higher calcium content, look for products that specifically say "calcium-precipitated" on the label or that include calcium sulfate in their ingredient list. This method of tofu manufacturing uses calcium to help coagulate the soy milk. You'll also sometimes find the word "gypsum" being used to describe tofu coagulants, and this word refers to calcium sulfate as well.

If you are looking for tofu with higher magnesium content, look for products that say "nigari tofu" or "prepared from nigari flakes" on the label. In this context, "nigari" usually refers to a magnesium chloride coagulant that has been used to curdle the soymilk.

Finally, if you are looking for a tofu that is more easily digested and more likely to contain nutrients in forms that are better absorbed, look for fermented tofu. As described earlier, you will find a wide variety of terms being used to describe fermented tofu, including pickled tofu, preserved tofu, tofu cheese, Chinese cheese, sufu, sufu cheese, stinky curd, stinky tofu, and stinky sufu.

**Tempeh**

For many years it was only possible to find tempeh in natural foods and Asian stores. Yet, with the growing demand for soy foods, tempeh is now becoming more and more available in supermarkets throughout the country. Depending upon the store, tempeh may either be kept in the refrigerated or freezer section.

In a well-stocked natural foods supermarket, you'll find tempeh in a variety of forms. Some of these forms are pre-cooked and ready-to eat, indicating so on the package. Other forms are not yet cooked and should be cooked before eating. You'll find plain soy tempeh that has been made from soy and Rhizopus mold but without the addition of any grains, and you will also find tempeh made from soy-grain combinations, especially soy-rice. The tempeh you find in the supermarket may also have been flavored with soy sauce or other seasonings.
Look for tempeh that is covered with a thin whitish bloom. While it may have a few black or grayish spots, it should have no evidence of pink, yellow, or blue coloration as this indicates that it has become overly fermented. In general, choose tempeh in which the soybeans and grains appear tightly bound. Also choose tempeh that tends to have a drier outside surface. High-quality, plain soy tempeh often has an aroma that would best be described as mushroom-like.

Uncooked, refrigerated tempeh can keep in the refrigerator for up to ten days. If you do not prepare the whole package of uncooked tempeh at one time, wrap it well and place it back in the refrigerator. Uncooked tempeh will also keep fresh for several months in the freezer. If you freeze tempeh and then unthaw it, you can keep the thawed tempeh in your refrigerator for about 10 days. Also, if you are purchasing tempeh from a refrigerated display in the supermarket, check the package for a "sell by" date. It should have one, and you should make sure that it's up ahead in the calendar.

Tips for Preparing and Cooking

Tips for Preparing Tofu

If you would decide that you would like to have your tofu available at a later date, or if you decide that you would like to remove some of the moisture from your tofu to help it soak in sauces and flavors, you can freeze it. Freezing tofu is also called "pressing" it. First, take the tofu out of its package and place it on a cutting board to allow the packaging fluids to drain off. This step will help keep too much ice from forming around your tofu when you freeze it.

Next, place the tofu on some paper towels, and cover the top of the tofu with some paper towels as well. Then find some slightly heavy object (like a small book) that can be placed on the tofu's top paper towel layer. The goal here is to find an object that is heavy enough to press down on the tofu and cause its fluid to be pushed out without actually crushing or collapsing the tofu. Leave the object on top of the tofu for 15 minutes.
After 15 minutes, remove the object and all paper towels from the tofu, and place the drained tofu in a freezer bag. Make sure you run your hand over the tofu and bag to remove all the air pockets before sealing the bag. Then just place it in the freezer.

Your tofu should be fine for at least 2-3 months when frozen in this way. When you are ready to use it, just remove and thaw. Some tofus will change color slightly after being frozen (usually to a slightly more yellowish color) and most will also have a slightly different texture (usually a little more "chewy").

Tips For Preparing Tempeh

In the grocery store you will often find tempeh that says "pre-cooked" and "ready to eat" on the package. Even though it's fine to eat this tempeh "as is," you might still want to steam this tempeh for several minutes if you enjoy a tempeh that is a little softer. Pre-cooked tempeh that is steamed just before its addition to a recipe can sometimes do a better job soaking up recipe flavors as well.

Since tempeh can be cut into slices or crumbled, you can control the degree to which you would like your tempeh to be "recognized" in whatever dish you are preparing. Crumbled tempeh will usually be much less "evident" as similar to ground meat it will shift into the background of the dish and feel much more like a texture-only component. Sliced tempeh will usually be much more "evident" and will feel like a more "featured" ingredient of the dish. Both sliced and crushed tempeh can still do a great job soaking in flavors and sauces.

How to Enjoy

A Few Quick Serving Ideas for Tofu

Blend together soft tofu, olive oil, garlic and lemon juice to make a tofu aoli
Scramble soft tofu together with your favorite vegetables and the spice turmeric to give it a yellow "egg-like" coloring. This delicious dish can be served as is or can be used as the basis for "tofu rancheros" by being wrapped in a tortilla and served with black beans and salsa.

Healthy Stir-Fry firm tofu with your favorite vegetables and seasonings.

Blend soft tofu with your favorite fruits (and honey or other natural sweeteners to taste) in a blender or food processor and serve for breakfast or dessert.

Add cubes of tofu to miso soup.

A Few Quick Serving Ideas for Tempeh

For a twist on the traditional reuben sandwich, place broiled tempeh on a slice of whole grain bread, layer with sauerkraut, top with cheese or non-dairy "cheese" and then broil in oven for a few minutes until the sandwich is hot and toasty. Top with Russian dressing made by combining ketchup and mayonnaise, and enjoy.

A vegetarian option to spaghetti and meat sauce is spaghetti and tempeh sauce. Just substitute tempeh for ground beef in your favorite recipe.
Add extra flavor, texture and nutrition to chili by adding some tempeh.

**Individual Concerns**

**Allergic Reactions to Tofu and Tempeh**

Although allergic reactions can occur to virtually any food, research studies on food allergy consistently report more problems with some foods than with others. It's important to realize that the frequency of problems varies from country to country and can change significantly along with changes in the food supply or with other manufacturing practices. For example, in several part of the world, including Canada, Japan, and Israel, sesame seed allergy has risen to a level of major concern over the past 10 years.

In the United States, beginning in 2004 with the passage of the Food Allergen Labeling and Consumer Protection Act (FALCPA), food labels have been required to identify the presence of any major food allergens. Since 90% of food allergies in the U.S. have been associated with 8 food types as reported by the U.S. Centers for Disease Control, it is these 8 food types that are considered to be major food allergens in the U.S. and require identification on food labels. The 8 food types classified as major allergens are as follows: (1) wheat, (2) cow's milk, (3) hen's eggs, (4) fish, (5) crustacean shellfish (including shrimp, prawns, lobster and crab); (6) tree nuts (including cashews, almonds, walnuts, pecans, pistachios, Brazil nuts, hazelnuts and chestnuts); (7) peanuts; and (8) soy foods.

These foods do not need to be eaten in their pure, isolated form in order to trigger an adverse reaction. For example, yogurt made from cow's milk is also a common allergenic food, even though the cow's milk has been processed and fermented in order to make the yogurt. Ice cream made from cow's milk would be an equally good example.
Food allergy symptoms may sometimes be immediate and specific, and can include skin rash, hives, itching, and eczema; swelling of the lips, tongue, or throat; tingling in the mouth; wheezing or nasal congestion; trouble breathing; and dizziness or lightheadedness. But food allergy symptoms may also be much more general and delayed, and can include fatigue, depression, chronic headache, chronic bowel problems (such as diarrhea or constipation), and insomnia. Because most food allergy symptoms can be caused by a variety of other health problems, it is good practice to seek the help of a healthcare provider when evaluating the role of food allergies in your health.

**Tofu, Tempeh, and Thyroid Health**

Along with the increasing presence of soy foods (such as tofu and tempeh) in grocery stores and on restaurant menus has come increasing controversy over soybeans and thyroid health. We're not surprised to find strong conflicting opinions in this area because scientific research on thyroid and soy is both complicated and inconclusive. We have written an extensive review of what we know—and what we don't know—about this important issue at this point.

**Tofu, Tempeh and Oxalates**

Soybeans, and foods made from them like tofu, are among a small number of foods that contain measurable amounts of oxalates, naturally-occurring substances found in plants, animals, and human beings. When oxalates become too concentrated in body fluids, they can crystallize and cause health problems. For this reason, individuals with already existing and untreated kidney or gallbladder problems may want to avoid eating soybean-based products like tofu or tempeh. Laboratory studies have shown that oxalates may also interfere with absorption of calcium from the body. Yet, in every peer-reviewed research study we've seen, the ability of oxalates to lower calcium absorption is relatively small and definitely does not outweigh the ability of oxalate-containing foods to contribute calcium to the meal plan. If your digestive tract is healthy, and you do a good job of chewing and relaxing while you enjoy your meals, you will get significant benefits—including absorption of calcium—from calcium-rich foods plant foods that also contain oxalic acid. Ordinarily, a healthcare practitioner would not discourage a person focused on ensuring that they are meeting their calcium requirements from eating these nutrient-rich foods because of their oxalate content.
Genetically modified (GM) soybeans have reached 90% market penetration in the United States, and if you are purchasing non-organic soy products, including tofu or tempeh, you are likely to be consuming soy that has come from a genetically modified plant. Since 1998, nearly a dozen patents have been approved for genetic modification of soybeans, mostly to increase their resistance to herbicides and pesticides that growers expect to spray on the plants during cultivation. If you are wanting to decrease your exposure to GM foods, choose certified organic tempeh and tofu, since the current USDA (U.S. Department of Agriculture) organic regulations prohibit any use of genetic modification. You may find some versions of tofu and tempeh in the marketplace that are not certified organic, but contain the words "GMO free" on the packaging. This labeling information would also indicate the absence of genetic modification in the soybeans used to prepare the tempeh or tofu.

**Nutritional Profile**

A wide range of unique proteins, peptides, and phytonutrients contained in soyfoods, including tofu and tempeh. Examples are flavonoids and isoflavonoids (daidzein, genistein, malonylgenistin, and malonyldaidzin); phenolic acids (caffeic, coumaric, ferulic, gallic and sinapic acids); phytoalexins (glyceollin I, glyceollin II, and glyceollin III); phytosterols (beta-sitosterol, beta-stigmasterol, campestrol); unique proteins and peptides (defensins, glycinin, conglycinin, and lunacin); and saponins (soyasaponins from group A and group B, and soyasapogenols).

Tofu is an excellent source of calcium and a very good source of manganese, iron and protein. In addition, tofu is a good source of selenium, omega-3 fatty acids, phosphorus, copper, and magnesium.

Tempeh is a very good source of manganese and a good source of protein, copper, phosphorus, vitamin B2 and magnesium. In addition, tempeh is a good source of monounsaturated fats.

In addition to providing the above nutrients, tempeh will provide many nutrients (including proteins) in a more digestible and absorbable form due to the process of fermentation. If tofu is purchased in a fermented form, it will also provide better digestibility and absorbability of many nutrients for this reason.
In-Depth Nutritional Profile

In addition to the nutrients highlighted in our ratings charts, in-depth nutritional profiles for Tofu and Tempeh are also available. Each profile includes information on a full array of nutrients, including carbohydrates, sugar, soluble and insoluble fiber, sodium, vitamins, minerals, fatty acids, amino acids and more.

In order to better help you identify foods that feature a high concentration of nutrients for the calories they contain, we created a Food Rating System. This system allows us to highlight the foods that are especially rich in particular nutrients. The following chart shows the nutrients for which this food is either an excellent, very good, or good source (below the chart you will find a table that explains these qualifications). If a nutrient is not listed in the chart, it does not necessarily mean that the food doesn't contain it. It simply means that the nutrient is not provided in a sufficient amount or concentration to meet our rating criteria. (To view this food's in-depth nutritional profile that includes values for dozens of nutrients - not just the ones rated as excellent, very good, or good - please use the link below the chart.) To read this chart accurately, you'll need to glance up in the top left corner where you will find the name of the food and the serving size we used to calculate the food's nutrient composition. This serving size will tell you how much of the food you need to eat to obtain the amount of nutrients found in the chart. Now, returning to the chart itself, you can look next to the nutrient name in order to find the nutrient amount it offers, the percent Daily Value (DV%) that this amount represents, the nutrient density that we calculated for this food and nutrient, and the rating we established in our rating system.

[WHFoods_Tofu and Tempeh.pdf]

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