



What is the Best Formulation of B12?

Vitamin B12, also called "cobalamin," is one of the eight water-soluble vitamins that play a key role in the metabolism of every cell in the human body, and is especially important in the normal functioning of the brain and nervous system, and the formation of red blood cells.

Only bacteria have the enzymes needed for their synthesis. No fungi, plants, or animals can make vitamin B12. However, animal tissues significantly store vitamin B12, which is made from bacteria that they have consumed. This is the reason that meat, poultry, eggs, fish, and dairy foods are recommended sources of B12 in people's diets. Those of us who follow a vegan diet (no animal foods) are often told we must eat animal foods or risk developing deficiency of this essential vitamin.

Featured Recipes

Recipes this month are from our [recipe collection](#) as well as the [Recipe App](#)

Garden Potato Medley

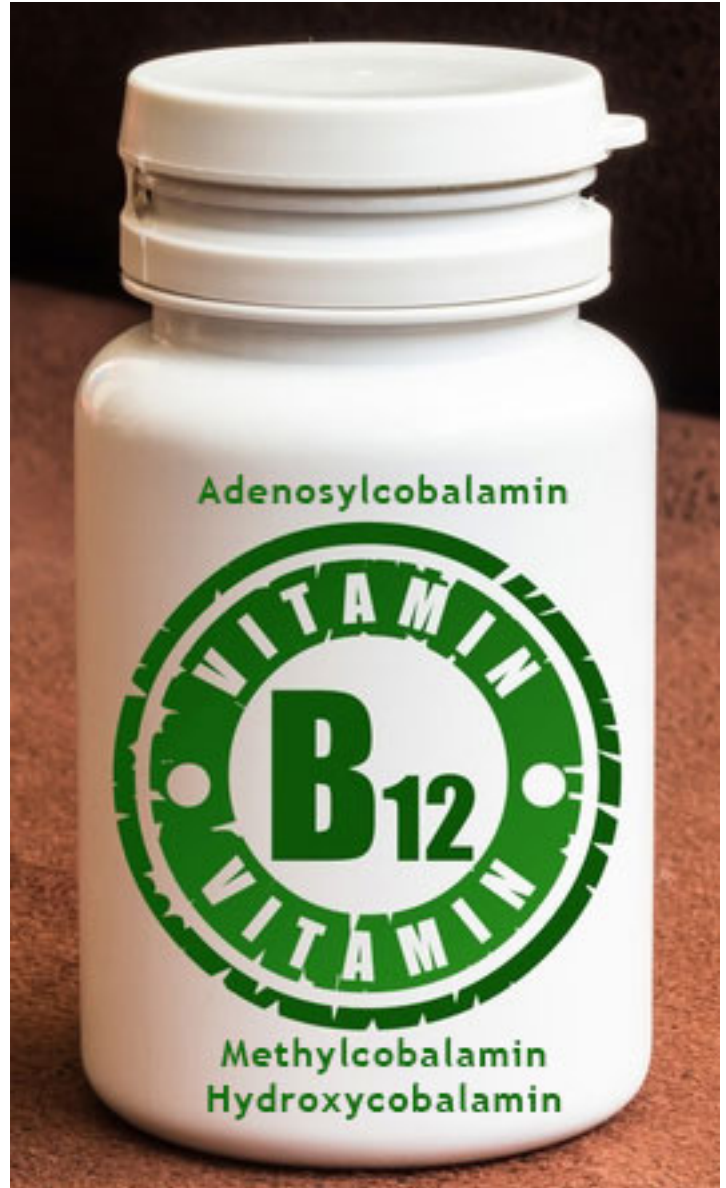
One Pot Pasta Jumble

Marsala Mushroom Sauce with Garlic Mashed Potatoes

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Only bacteria have the enzymes needed for the synthesis of various forms of Vitamin B12. No fungi, plants, or animals can make vitamin B12. However, animal tissues significantly store vitamin B12, which is made from bacteria that they have consumed. This is the reason that meat, poultry, eggs, fish, and dairy foods are recommended sources of B12 in people's diets. Those of us who follow a vegan diet (no animal foods) are often told we must eat animal foods or risk developing deficiency of this essential vitamin.



Fortunately, we live in a world naturally populated with trillions of B12-producing bacteria. Plus our mouth and large intestine are very large reservoirs of B12-synthesizing bacteria. The various sources of bacteria in our environments supply sufficient amounts for most people, and as a result, actual cases of vitamin B12 deficiency disease due to lack of sufficient oral intake are very rare.

There Are 4 Common Forms of B12

Three natural forms of vitamin B12 are commercially available: methylcobalamin (MeCbl), adenosylcobalamin (AdCbl), and hydroxycobalamin (OHCbl), all of which

have been shown in clinical studies to improve the vitamin B12 status of individuals. Because these three forms are biologically identical to those found in our tissues, they would seem to be [preferred](#).

The fourth form is cyanocobalamin (CNCbl). This is a synthetic B12 compound sold commonly as supplements and used for food fortification. All four forms (natural and synthetic) are converted in the body into the metabolically active molecule cobalamin. However, some people do not efficiently make this conversion with the "cyano" products. Plus the cyanide portion of the cyanocobalamin molecule accumulates in the body. Cyanide is a well-known poison that was once used as a chemical warfare agent that can cause death. In small doses, as taken in vitamin B12 supplements (cyanocobalamin), cyanide may have long-term toxicity. Early symptoms of mild cyanide toxicity include headache, dizziness, fast heart rate, shortness of breath, and vomiting.

Assimilation and metabolism of various forms of B12 (cobalamin) differ in people. The way to discover how you respond to a particular form is determined by an inexpensive vitamin B12 blood test. Normal vitamin B12 blood levels are above 150 pg/ml (picograms per milliliter). However, many laboratory references consider normal to be above 200 pg/ml, and some clinicians suggest levels, especially in older people, to be above 500 pg/ml.

My Recommendations for Vitamin B12 Supplementation

Over the past 40 years I have been recommending that people who follow my diet, which is based on starches, vegetables, and fruit, take a vitamin B12 supplement. The body efficiently stores and reutilizes B12, and as a result, people on the standard American diet accumulate at least a three-to-eight-year supply of this vitamin.

The daily requirement of B12 is [less than 1 microgram](#) (one-millionth of a gram). However, just to be on the safe side, my recommendation has been to take a supplement of 5 micrograms daily. When you look for B12 supplements in the store, the smallest doses available are 500 micrograms in liquids, capsules, and tablets. Fortunately, there is little known toxicity from an overdose of cobalamin. With amounts of a hundred times greater than needed, rather than taking daily, a safe

regime could also be 500 micrograms weekly. This dose can be swallowed or dissolved sublingually under the tongue.

My recommendation is to take the hydroxyl, methyl, and/or adenosyl forms (not the cyano form due to the toxicity from chronic cyanide accumulation). After taking any of the individual forms for three months you, should have your blood tested. A simpler and more certain approach would be to take a formulation that is already in a combination of the hydroxycobalamin, methylcobalamin, and adenosylcobalamin.

[From the November 2007 McDougall Newsletter](#)

Vitamin B12 Deficiency—the Meat-eaters' Last Stand

Defending eating habits seems to be a primal instinct for people. These days Westerners are running out of excuses for their gluttony. Well-read people no longer believe meat is necessary to meet our protein needs or that milk is the favored source of calcium. With the crumbling of these two time-honored battle fronts the vitamin B12 issue has become the trendy topic whenever a strict vegetarian (vegan) diet is discussed. Since the usual dietary source of vitamin B12 for omnivores is the flesh of other animals, the obvious conclusion is that those who choose to avoid eating meat are destined to become B12 deficient. There is a grain of truth in this concern, but in reality an otherwise healthy strict vegetarian's risk of developing a disease from B12 deficiency by following a sensible diet is extremely rare—less than one chance in a million.

I knew forty years ago that vitamin B12 would become the last bastion for meat- and dairy-lovers (and the industries that profit from them), because this is the only criticism with any merit that could be lodged against the McDougall Diet. In order to avoid that condemnation and the small risk of harming anyone, I have recommended and printed in the beginning of my books and DVDs the following advice:

If you follow the McDougall Diet for more than 3 years, or if you are pregnant or nursing, then take a minimum of 5 micrograms of supplemental vitamin B12 each day.

Avoid B12 Deficiency; Get Heart Disease and Cancer

Vitamin B12 is involved in the metabolism of all cells in the body; but the effects of deficiencies are first seen in the blood and then the nervous system. An anemia, called megaloblastic anemia, because it is characterized by large red blood cells, is a common manifestation of deficiency. The low red blood cell count is very well tolerated by the patient even when severe, and is always cured by the taking of small amounts of B12. Mild problems with the nervous system characterized by numbness and tingling in the hands and feet also develop. These sensations are reversible in early stages; however, damage to the nervous system can become much more severe and irreversible after prolonged deficiency.

Take a moment to compare the possible consequences of your dietary decisions. You could choose to eat lots of B12-rich animal foods and avoid the one-in-a-million chance of developing a reversible anemia and/or even less common, damage to your nervous system. However, this decision puts you at a one-in-two chance of dying prematurely from a heart attack or stroke; a one-in-seven chance of breast cancer or a one-in-six chance of prostate cancer. The same thinking results in obesity, diabetes, osteoporosis, constipation, indigestion, and arthritis. All these conditions caused by a B12-sufficient diet are found in the people you live and work with daily. How many vegans have you met with B12 deficiency anemia or nervous system damage? I bet not one! Furthermore, you have never even heard of such a problem unless you have read the attention-seeking headlines of newspapers or medical journals.

Sensationalism Surrounds B12-Deficient Vegetarians

Rare cases of B12 deficiency suspected to be caused by following a vegetarian diet make media-selling banners, because "people love to hear good news about their bad habits." However, in depth research reveals that many of these "vegetarians" also suffer from generalized malnutrition—not just isolated B12 deficiency from a diet based on plant foods. For example, the March 23, 2000 issue of the *New England Journal of Medicine* published a letter (not a scientific article) with the provocative title, "Blindness in a Strict Vegan."¹ The letter described a 33-year old man who was found to have severe loss of vision (bilateral optic neuropathy). He had started a strict vegetarian diet at age 20. Tests showed he suffered from deficiencies of

vitamins A, C, D, E, B1, B12 and folic acid, as well as zinc and selenium. All combined, these deficiencies clearly indicate severe malnutrition. B12 injections corrected his anemia, but not his visual loss.

Do you see the disconnection between the case history and the headlines? Starches, vegetables, and fruits are very rich sources of folic acid and vitamin C (as well as A, E, B1, zinc and selenium). His malnourished condition most likely was caused by an intestinal disease and/or an unhealthy "vegetarian" diet.² The headlines published worldwide that followed this letter reassured meat- and dairy-lovers that becoming a vegetarian was an unwise decision. Examination of many reported cases of B12 deficiency connected to a vegetarian diet in both children and adults reveals similar confounding factors.¹⁻⁶ The patients may have subtle malabsorption and often come from conditions of poverty and/or live an eccentric lifestyle—their health problems are not simply due to avoiding animal foods. However, I do believe there are very rare patients with diseases due to lack of B12 from following a strict vegetarian diet for years—while others have disagreed with me and believe that all cases have confounding factors.⁷

Germ for Good Health

Although vitamin B12 is found in animal foods it is not synthesized by plants or animals. Only bacteria make biologically active vitamin B12—animal tissues store "bacteria-synthesized B12," which can then be passed along the food chain by animals eating another animal's tissues. Ruminants (like cows, goats, sheep, giraffes, llamas, buffalo, and deer) are unique in that bacteria in their rumens (stomachs) synthesize vitamin B12, which is then passed down and absorbed by their small intestines. Lions and tigers get their B12 from eating these grazers.

The human gut also contains B12-synthesizing bacteria, living from the mouth to the anus.⁸ The presence of these bacteria is an important reason that disease from vitamin B12 deficiency occurs very rarely in people, even those who have been strict vegetarians (vegans) all of their lives. The colon contains the greatest number of bacteria (4 trillion/cc of feces), and here most of our intestinal B12 is produced. However, because B12 is absorbed in the ileum, which lies upstream of the colon, this plentiful source of B12 is not immediately available for absorption—unless people eat feces (don't gasp). Feces of cows, chickens, sheep and people contain large

amounts of active B12. Until recently most people lived in close contact with their farm animals, and all people consumed B12 left as residues by bacteria living on their un-sanitized vegetable foods.

Why would a plant-food-based diet, heralded as a preventative and cure for our most common chronic diseases be deficient in any way? Such a diet appears to be the proper, intended, diet for humans, except for this one blemish. The reason for this apparent inconsistency is we now live in unnatural conditions—our surroundings have been sanitized by fanatical washing, powerful cleansers, antiseptics, and antibiotics. Since the germ theory of disease was developed by Louis Pasteur in 1877 our society has waged an all-out war on these tiny creatures—most of them extremely beneficial with only a very few acting as pathogens. The rare case of B12 deficiency may be one important consequence of too much cleanliness.

Efficiency Is the Other Reason Deficiency Is Rare

The human body has evolved with highly efficient and unique mechanisms to absorb, utilize, and conserve this vitamin. Our daily requirement is less than 3 micrograms a day—one microgram is one-millionth of a gram (1/1,000,000 gram).⁹ Which means, by design, people are expected to be exposed to only miniscule amounts of this essential nutrient.

Vitamin B12 is the only nutrient that requires a cofactor for efficient absorption. The cells of the stomach produce a substance, called intrinsic factor, which combines—after the acidic digestion of the food in the stomach—with the B12 released from food. This "intrinsic factor-B12 complex" then travels to the end of the small intestine (the ileum) where it is actively absorbed.

There is a second, much less efficient process, called "the passive absorption of B12" which also occurs in the intestine. This mechanism does not use intrinsic factor and as a result it is 1/1000 as efficient. But by consuming very large doses of oral B12, passive absorption will correct B12 deficiency even for patients with diseases of the stomach and small intestine.

On average, for someone raised on the Western diet, about 2 to 5 milligrams of B12 are stored, mostly in the liver. This means most people have at least a three year reserve of this vital nutrient. Conservation of B12 by the body boosts the time this

supply lasts by 10-fold. After excretion through the bile into the intestines most of the B12 is reabsorbed by the ileum for future use. As a result of this recirculation it actually takes, on average, 20 to 30 years to become deficient after becoming a strict vegan. That is if no vitamin B12 were consumed—which is impossible, even on a strict vegan diet, because of bacterial sources of B12 from the person's bowel, contaminated vegetable foods, and the environment.

There is evidence that suggests that during pregnancy and nursing a mother is more dependent on B12 from her diet, because B12 stored in the woman's body is less available for the baby.¹⁰ Therefore, during these important times, B12 supplementation should be used by a vegan mother.

Biochemical Changes Occur with Low B12

Blood levels of B12 can be measured directly in the blood and are a means to help diagnose deficiency. Values above 150 pg/ml (picograms per milliliter) are considered normal, and levels below 80 pg/ml represent unequivocal B12 deficiency.¹¹

Within the body, biochemical reactions require B12. A deficiency can cause an interruption of normal metabolism and result in the accumulation of substances like methylmalonic acid and the amino acid, homocysteine. Tests showing increases in these metabolic products are used to diagnose "early B12 deficiency"—before any actual disease occurs.

Elevated homocysteine has been associated with an increased risk of common Western diseases (heart attacks, strokes, etc.). However, this amino acid itself does not cause disease—it serves as a marker for identifying people who consume large amounts of animal foods. Eating meat, poultry, fish, and cheese raises levels of homocysteine—as well as these same foods making people fat and sick. Efforts to lower homocysteine with supplements of folic acid and/or B12 have produced no reduction in heart disease or stroke¹²—and in fact the use of folic acid supplements increases the risk of cancer, heart disease, and overall death.¹³

The long-term consequences of B12 supplementation are unknown; so far this vitamin appears to be non-toxic and beneficial. As a result, I currently have no hesitation recommending supplements to strict vegetarians in order to prevent the rare chance of a deficiency occurring.

Intestinal Diseases, Not Dietary Deficiency, Cause Most B12 Problems

Almost all cases of vitamin B12 deficiency seen in patients today and in the past are due to diseases of the intestine, and are not due to a lack of B12 in their diet. Damage to the stomach (parietal cells) usually from an autoimmune disease or surgery halts the production of intrinsic factor. Damage to the ileum, preventing reabsorption and interrupting recirculation, causes the loss of B12. Over a period of 3 to 6 years the body's stores of vitamin B12 are depleted. The disease that results is called pernicious anemia. (The word pernicious refers to a tendency to cause death or serious injury.) Prior to the development of a treatment with liver extracts in 1926 this condition was fatal.¹⁴⁻¹⁵

Sources of Vitamin B12

As little as 0.3 to 0.65 micrograms per day of vitamin B12 has cured people of megaloblastic anemia;⁹ however, to add an extra margin of safety I have recommended a higher dosage of 5 micrograms per day. You may be surprised to discover that you cannot purchase these tiny dosages. Supplements sold contain 500 to 5000 micrograms per pill. These exaggerated concentrations will correct by passive absorption B12 deficiency caused by disease of the intestine.¹⁶⁻¹⁷ Everyone else is being overdosed by a factor of 1000. If you are an otherwise healthy vegan and are using typical dosages of B12 (500 micrograms or more per pill), a weekly dose of this vitamin will be more than sufficient.

You will often find B12 sold under its proper name. Because vitamin B12 contains one molecule of the mineral cobalt, the scientific name is Cobalamin. As a food additive and a supplement pill, vitamin B12 is usually found in the form cyanocobalamin. The effectiveness of this "cyanide complex" for treating neurologic problems has been questioned; therefore, other forms, such as methylcobalamin and hydroxycobalamin may be better choices for the prevention and treatment of B12-related conditions.¹⁸

Choosing a bioactive form of B12 is important. There are many B12-like substances called analogues found in food supplements, such as spirulina and other algae—these are ineffective and should not be relied upon.¹⁹ Foods fermented by bacteria, such as tempeh, and miso; as well as sea vegetables (nori), have been recommended as sources of B12. Miso and tempeh do not contain B12.²⁰ Nori—the dried green and

The History of B12 Deficiency from Pernicious Anemia (PA)¹⁴⁻¹⁵

1824—A fatal form of anemia associated with stomach degeneration was first described by J.S. Combe of Edinburgh.

1860—Austin Flint recognized the nutritional basis of this anemia and the degeneration of the stomach in this disease.

1872—Biermer, in Switzerland, coined the concept of pernicious anemia (PA) based on the inevitably fatal outcome of this disorder.

1880's—Ehrlich added that patients with this anemia had giant peripheral blood cells, so called megaloblasts.

1887—Lichtheim describes an association of PA and spinal cord lesions.

1921—Levine and Ladd reported that no stomach acid was found in patients with PA.

1925—William Castle fed cooked ground beef to healthy young men and one hour later, removed the gastric juice which contained partly digested beef, and placed it in the stomach of patients with pernicious anemia. As a control, he gave ground beef without gastric juice to another group of patients. The experimental group responded with the production of new blood cells, but the control group did not. He postulated that some unknown, but essential, interaction between beef muscle as an extrinsic factor and normal human gastric juice as an intrinsic factor was required.

1926—Two American physicians, Minot and Murphy, described a raw liver diet (liver therapy) that cured PA in the Journal of the American Medical Association. They received the Nobel Prize in Physiology and Medicine in 1934 for their work.

1941—Folic acid received its name following its isolation from spinach (from the Latin 'folium' meaning leaf). Folic acid deficiency causes megaloblastic anemia, but not nervous system damage.

1945—Folic acid was synthesized and found to be effective in treating all types of megaloblastic anemia, but especially those that proved refractory to liver preparations such as the megaloblastic anemia of sprue, celiac disease, pregnancy and malnutrition.

1948—Two independent teams in the United States and England isolated the mysterious extrinsic factor, vitamin B12, in crystalline form.

1955—Dorothy Crowfoot Hodgkin, a British chemist, elucidated the unique and complex chemical structure of this large molecule, in its cyanocobalamin form, using X-Ray crystallography. She was awarded the Nobel Prize for Chemistry in 1964.

purple lavers commonly used to make sushi—has been tested and found to have substantial amounts of active vitamin B12 and has been recommended a "most excellent source of vitamin B12 among edible seaweeds, especially for strict vegetarians."^{20,21} (Nori obtains its B12 from symbiotic bacteria that live on it.²²)

However, there is still some uncertainty about nori as a reliable B12 source; therefore, I suggest if you do choose this seaweed that you should monitor your B12 levels by blood tests now, and if adequate, every 3 years.

In order to minimize your risk of any health problems, I recommend you and your family follow a diet based on starches, vegetables, and fruits. To avoid the extremely rare chance of becoming a national headline, add a reliable B12 supplement. By making this addition to a healthy diet you can't go wrong, nor will you suffer from any justifiable criticism of your McDougall Diet delivered by well-meaning family and friends.

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Featured Recipes

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Garden Potato Medley

We grew potatoes in our garden the year we developed this recipe and there is nothing better tasting than freshly dug potatoes. That year we also had a huge crop of heirloom tomatoes and plenty of dinosaur kale (my favorite variety).

Preparation Time: 15 minutes

Cooking Time: 20 minutes

Servings: 4

4 cups chunked potatoes

1 tablespoon vegetable broth

1 onion, chopped



1 teaspoon minced fresh garlic
1 jalapeno pepper, seeded and minced
2 ½ cups chopped fresh tomatoes
several twists freshly ground black pepper
4 cups packed chopped dinosaur kale
1 15 ounce can red beans, drained and rinsed
1 tablespoon soy sauce
1 teaspoon chili paste (Sambal Oelek)
¼ cup chopped fresh cilantro

Place the potatoes in water to cover, bring to a boil, reduce heat and cook until fairly tender, about 6-8 minutes. Drain and set aside.

Place the vegetable broth in a large non-stick frying pan. Add the onion, garlic and jalapeno. Cook over medium heat, stirring frequently, until vegetables are very soft, about 3-4 minutes. Add tomatoes and black pepper. Cook, uncovered over low heat, stirring occasionally, for 3 minutes. Add the kale and stir gently to combine. Cover and continue to cook for about 2 minutes until kale turns bright green, then add the potatoes and beans. Cook, stirring occasionally for 5 minutes, then add the soy sauce, chili paste and cilantro. Cook an additional 5 minutes, until kale is tender.

Serve warm or cold.

Hint: Use a variety of tomatoes for an attractive, colorful dish. Use small, new potatoes cooked with the skins on for best flavor. Small red potatoes or a variety of fingerlings are delicious in this recipe. If you can't get dinosaur kale (also called Lacinato Blue), use regular kale, but remove the stems first.

One Pot Pasta Jumble

is a quick and easy dinner that the whole family will enjoy.

Preparation Time: 10 minutes

Cooking Time: 20 minutes



Servings: 4

8 ounces whole wheat or brown rice spaghetti
3 cups broccoli florets
1 cup red or orange bell pepper strips
1 14.5 ounce can chopped tomatoes, drained
1 15 ounce can cannellini beans, drained and rinsed
2 tablespoons chopped fresh flat-leafed parsley
2 tablespoons tomato paste
1 teaspoon minced garlic
Dash sea salt
Freshly ground black pepper to taste

Place a large pot of water on to boil. Cook spaghetti according to package directions adding the broccoli and peppers for the last 4 minutes of cooking time. Drain and return to pan. Add the remaining ingredients, mix well and cook, stirring frequently, until heated through, about 5 minutes.

Marsala Mushroom Sauce with Garlic Mashed Potatoes

Mushroom Sauce

Prep: 15 minutes Cook: 15 minutes

Serves: Makes 3 1/2 cups

2 leeks, sliced (white and light green part only)
3/4 pound fresh mushrooms, sliced
3 1/2 cups water
1/2 tsp leaf oregano
1/2 tsp leaf sage
1/4 cup soy sauce
1/8 cup Marsala wine
3 1/2 tablespoons cornstarch mixed in 1/4 cup cold water.



Place leeks and mushrooms in a pot with 1/2 cup of the water. Cook, stirring occasionally, for 5 minutes. Add the remaining water, the oregano, sage, soy sauce and wine. Bring to a boil, reduce heat and simmer uncovered for 8 minutes. Add the cornstarch mixture and cook and stir until thickened.

Hint: This delicious sauce may be used as a topping for grains, potatoes or vegetables.

Garlic Mashed Potatoes

Preparation Time: 10 minutes

Cooking Time: 20 minutes

Servings: makes 2 cups

4 large Yukon Gold potatoes

2 cloves garlic

¼ cup unsweetened soy milk

Several twists freshly ground white pepper

Dash sea salt

Peel potatoes and chop into chunks. Place in a stainless pan with water to cover. Add 2 whole cloves of peeled garlic. Bring to a boil, reduce heat, cover and cook for 15 minutes until potatoes are tender. Drain. Mash in pan using electric beaters or use a hand masher, adding the remaining ingredients as necessary to get a smooth consistency and delicious flavor.