

Managing
Tyramine
in your diet

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Your MAO-B inhibitor, mealtime, and you

Staying healthy is important to everyone. The quality of our lives depends in great part on our good health, especially when managing the effects of Parkinson's disease (PD). A nourishing diet, regular exercise, and the right medications are key to a healthy, active life for people with PD.¹

In some cases, foods and beverages—even healthful foods and beverages—can have unfavorable interactions with certain medications. One such class of medications is *monoamine oxidase inhibitors* (MAOI) and *monoamine oxidase type B inhibitors* (MAO-BI). These can interact with a substance called *tyramine* to potentially cause serious problems.² To best understand the nature of the interaction between tyramine and medications, it may be helpful to define and discuss several important terms.

What is tyramine?

Tyramine is a *monoamine compound*—a substance that is found naturally in some foods, plants, and animals.

It can also be produced in foods and beverages as a result of fermentation, aging, or spoilage. Tyramine is important because it can affect blood pressure. Examples of foods that contain high amounts of tyramine include aged cheese, soy sauce, aged meats, pickled fish, tofu (soy curd), sauerkraut, and tap beer.²

What is monoamine oxidase (MAO)?

Monoamine oxidase (MAO) is an enzyme found in nerve endings, the liver, gastrointestinal tract, and brain. In the gut, it guards against the buildup of substances that could be dangerous. There are 2 types of MAO—MAO type A (MAO-A), which is found primarily in the liver and gastrointestinal tract, and MAO type B (MAO-B), which is found primarily in the nervous system, including the brain.³

MAO changes tyramine and other amine-containing compounds into a harmless substance that is then excreted from the body. It also breaks down several messengers for the nervous system including the brain, known as *monoamine neurotransmitters*. Two examples are norepinephrine (also known as noradrenaline), which helps regulate blood pressure, and serotonin, which influences mood.³

MAO also breaks down dopamine, another neurotransmitter. In PD, this can be a problem, because the brain already has decreased production of dopamine due to loss of specific nerve cells. Lack of dopamine is the cause of PD symptoms such as tremor and slowed movement. Further breakdown of dopamine by MAO can contribute to these PD symptoms.³

What is a monoamine oxidase inhibitor?

Monoamine oxidase inhibitors (MAOIs) are medications that slow the enzyme monoamine oxidase (MAO) in its breakdown of amine compounds including neurotransmitters, such as norepinephrine, serotonin, and dopamine. MAOIs also slow the breakdown of tyramine, another monoamine compound.³

There are 3 types of MAOIs, those that inhibit both MAO-A and MAO-B and those that preferentially or selectively inhibit MAO-B or MAO-A at the doses used.

The type of MAO inhibitor used to treat symptoms of PD is the MAO-B inhibitor (MAO-BI). It is important to note that even those MAO inhibitors that are selective for MAO-B can at high doses also begin to inhibit MAO-A.³

MAO-BIs slow the destruction of dopamine by monoamine oxidase type B, which is the main type in the brain. So, although the brain is producing less dopamine, the MAO-BIs make the dopamine last longer. By slowing the breakdown, MAO-BI medications help to prolong the useful activity of the dopamine, and this helps in managing PD symptoms.³

What happens when a person taking MAOIs and MAO-BIs eats foods high in tyramine?

Normally, tyramine in foods is inactivated by the MAO-A enzyme in the gut. But if a person is taking a medication that inhibits MAO-A (a nonselective MAOI or MAO-BI at too high a dose) and eats foods or meals high in tyramine, the tyramine may not be broken down and can build up in the blood.³ Increased amounts of tyramine in the blood are not desirable. Large amounts of tyramine can cause the release of excess norepinephrine, which can constrict the blood vessels, causing blood pressure to rise, sometimes to a severe level. If blood pressure increases to a dangerous level, this condition is called a *hypertensive urgency, emergency, or crisis*. When this is caused by too much tyramine in food, it is sometimes called a “cheese reaction” or the “cheese effect.”^{2,3}

This is because in the early days of MAOI use, it was noticed that some people experienced headaches after eating cheese. Even today, this is known as the “cheese reaction,” but other foods and beverages high in tyramine can also cause the symptoms within a few hours of eating.²

What is a hypertensive crisis?

A hypertensive crisis means that blood pressure has risen to dangerously high levels—systolic pressure (the top number) rising to 180 mm Hg or more and diastolic pressure (the bottom number) increased to more than 120 mm Hg. In extreme cases, it can lead to organ damage or even a stroke.⁴

What are the possible symptoms of hypertensive crisis?

Possible symptoms of hypertensive crisis include:

- Severe headache
- Blurred vision
- Difficulty thinking
- Seizure
- Chest pain
- Nausea/vomiting
- Signs or symptoms of a stroke

People taking an MAOI including MAO-AI and MAO-BI at too high a dose should be careful about what they eat or drink to make sure they avoid a possible hypertensive crisis or cheese reaction.²

How do I choose, store, and prepare safe foods?

Tyramine is produced in some plants and also can be a product of aging, curing, fermentation, and spoilage of produce, dairy products, and meats.

However, the tyramine content of foods and beverages can vary a great deal. Produce ripening time may vary, different fermentation and processing methods may have been used, and degree of spoilage may vary from overripe to actual decay.

The following guidelines will help in choosing foods and beverages⁵:

Storing foods at room temperature can increase tyramine levels. All fresh foods should be stored in the refrigerator or freezer. However, even refrigerated fresh produce can have an increase in tyramine content if stored for several days, so it is important to consume fresh produce within 48 hours of purchase.

- Eat fresh-canned or fresh-frozen foods, including produce, meats, poultry, and fish. In the case of canned or frozen foods, use immediately after opening
- Purchase fresh meats, poultry, and fish, and eat them the same day or freeze right away
- Thaw foods in the refrigerator or microwave; thawing out on the counter at room temperature could allow formation of tyramine
- Avoid any food that has been spoiled (including overripe produce, or cottage cheese with mold, for example). Avoid foods that have been aged, fermented, or pickled
- Aged, fermented, cured, smoked, and pickled foods include most nonprocessed cheeses, dry sausage, sauerkraut, pickled herring, soy sauce, miso soup, and concentrated yeast extracts (Marmite[®], Vegemite[®]). Plant foods to avoid include fava beans, broad beans (Italian green beans), snowpeas, and banana peels
- Heat does not destroy tyramine; therefore, cooking produce or other foods will not lower tyramine content
- Use caution when eating in restaurants or at other times when storage conditions cannot be determined
- More than three-fourths of all hypertensive crises and nearly all fatal cases of hypertensive crisis have been due to aged (but not processed) cheeses, so it will be especially important to avoid these food items
- If you stop taking your MAO-B inhibitor, continue to follow these guidelines for 2 weeks

How much is too much tyramine?

150 mg or more of tyramine in a single meal is considered to be a high amount of tyramine. Individual response to tyramine varies, but foods and beverages totaling 150 mg or more of tyramine content per meal should be avoided. This amount was deemed to be high by the Food and Drug Administration after their review of study data that looked at the effects of tyramine on blood pressure in healthy older volunteers taking an MAOI. It does not mean that taking this amount of tyramine will lead to a “cheese reaction” or elevated blood pressure in all patients, but since some patients may have increased sensitivity to tyramine, it is wise to avoid this amount in a meal.⁶

What is the tyramine content of certain foods?

The following tables should help in choosing foods and beverages based on their tyramine content. The tyramine content of foods may vary. For instance, Stilton cheese from one producer may differ in tyramine content from Stilton from another producer, based on method of preparation and age.

Thus, these tables are to be used as a guideline only.

CHEESES, DAIRY, DAIRY ALTERNATIVES	PORTION SIZE	TYRAMINE CONTENT (if known)
American cheese, pasteurized processed American cheese (such as Schwan's, Kroger, or Borden's American processed cheese; Kraft Velveeta®, Cheez Whiz®)	1 oz (28 g)	0.2-1.6 mg
Bleu/blue, Gorgonzola	1 oz (28 g)	28 mg and 1.6 mg, respectively
Camembert	1 oz (28 g)	38 mg
Canadian cheddar	1 oz (28 g)	43 mg
Casseroles or other products made with aged cheeses	1 cup (8 oz, 227 g)	Unknown, but considered to be high
Cottage cheese	4 oz (113 g)	0
Cream cheese	2 oz (57 g)	0
Farmers cheese, havarti, brie, Boursin® cheese	1 oz (28 g)	Considered to be low
Fresh milk	8 oz (237 mL)	Considered to be low or nonexistent
Ice cream	4 oz (118 mL)	Considered to be low or nonexistent
New York cheddar	1 oz (28 g)	42 mg
Parmesan cheese	½ oz (14 g)	0.05-4.1 mg
Ricotta cheese	2-4 oz (57-113 g)	0
Romano cheese	1 oz (28 g)	0.1 mg
Sour cream	1 oz (28 g)	0.03 mg
Soy milk alternative	8 oz (227 g)	Considered to be low or nonexistent
Stilton	1 oz (28 g)	33-61 mg
Swiss	1 oz (28 g)	28 mg
Yogurt	8 oz (227 g)	Considered to be low
ALCOHOLIC BEVERAGES	PORTION SIZE	TYRAMINE CONTENT (if known)
Beer, bottled, alcohol free	12 oz (355 mL)	Considered to be low
Beers, canned/bottled	12 oz (355 mL)	1.5 mg
Bourbon	2 oz (59 mL)	0
Gin	2 oz (59 mL)	0
Korean beer	12 oz (355 mL)	Unknown, but considered to be high
Red or white wine	4 oz (118 mL)	0-0.6 mg
Rum	2 oz (59 mL)	0

ALCOHOLIC BEVERAGES (cont'd)	PORTION SIZE	TYRAMINE CONTENT (if known)
Tap beer	12 oz (355 mL)	38 mg
Vermouth	1 oz (30 mL)	Unknown, but considered to be high
Vodka	2 oz (59 mL)	0
MEAT, POULTRY, FISH	PORTION SIZE	TYRAMINE CONTENT (if known)
All canned meats, poultry, and fish; should be eaten immediately after opening	2-4 oz (57-113 g)	Considered to be low or nonexistent
All fresh meats, poultry, and fish, including fresh chicken livers; should be cooked and eaten on day of purchase or frozen/canned	2-4 oz (57-113 g)	Considered to be low or nonexistent
Anchovies	1 tablespoon (14 g)	Considered to be low
Caviar	1 tablespoon (14 g)	Unknown, but considered to be high
Chicken livers, aged	1 oz (28 g)	60 mg
Chinese dried duck	4 oz (113 g)	Unknown, but considered to be high
Cooked dried beans, peas, and lentils except for fava beans	1-2 cups daily	Considered to be low or nonexistent
Dry sausages (such as mortadella)	1 oz (28 g)	3-43 mg
Fresh eggs, eaten immediately after cooking	1 daily	Considered to be low or nonexistent
Fresh sausage, such as breakfast sausage patties	2-4 oz (57-113 g)	Considered to be low or nonexistent
Gravies or sauces containing meat extracts (such as bouillon, beef broth), soy products, or cheese	Varies	Varies
Luncheon meats (eg, cooked sliced ham, hot dogs) except dry sausages (listed above) and salami (listed below)	2-4 oz (57-113 g)	Considered to be low or nonexistent
Pepperoni	1 oz (28 g)	1.75 mg
Pickled herring (in brine)	1 oz (28 g)	0-86 mg
Pizza (homemade or gourmet pizzas may have higher tyramine content)	2 slices	Pizzas from large-chain commercial outlets are safe for consumption with MAOIs. However, caution must be exercised if ordering pizzas from smaller outlets or gourmet pizzas known to contain aged cheeses.
Salami, including Genoa salami, hard salami, cacciatore	1 oz (28 g)	1.2-5.4 mg
Smoked or pickled fish (lox, caviar)	1 oz (28 g)	Unknown, but considered to be high
Snails	¼ cup (57 g)	Considered to be low
Soups or casseroles containing meat extracts (such as bouillon, beef broth), soy products, or cheese	Varies	Varies
Wild game meat	4 oz (113 g)	Considered to be low

PRODUCE	PORTION SIZE	TYRAMINE CONTENT (if known)
All fresh, canned, or frozen vegetables and fruits except banana peel, fava beans and broad beans, kim chee, miso soup, and sauerkraut (listed below)	½ to 1 cup (aim for at least 5 servings per day)	Considered to be low or nonexistent
Banana peel	1 peel or 1 oz	1.4 mg/peel to 1.8 mg per 1 oz
Fava beans and broad beans (Italian green beans) and their pods	—	These beans contain dopa, which is converted to dopamine and can act to raise blood pressure, as with tyramine
Kim chee	4 oz (113 g)	Unknown, but considered to be high
Miso soup, fermented soy bean/bean curd, tofu	2 oz (57 g)	Unknown, but considered to be high
Raisins	2 tablespoons (1 oz, 28 g)	Considered to be low
Raspberries and canned figs	½ cup (113 g)	Considered to be low
Sauerkraut	4 oz (113 g)	3.5-14 mg
CONDIMENTS	PORTION SIZE	TYRAMINE CONTENT (if known)
Concentrated yeast extract (Marmite®, Vegemite®)	1 US tablespoon (14 g)	1.5-34 mg
Ketchup, mustard, Worcestershire sauce	1 tablespoon (14 g)	Considered to be low or nonexistent
Salad dressings	1 tablespoon (14 g)	Varies
Soy sauce	1 US teaspoon (5 mL)	0.05-4.7 mg
Thai or Vietnamese fish sauce	1 US teaspoon (5 mL)	0-3.7 mg
MISCELLANEOUS	PORTION SIZE	TYRAMINE CONTENT (if known)
Chocolate	1 oz (28 g)	Considered to be low or nonexistent
Coffee, tea, and soft drinks	4-12 oz (118-355 mL)	Considered to be low or nonexistent
Yeast bread	2 slices	Considered to be low or nonexistent

Sample meal plan

Plan each meal so that the tyramine content remains less than 150 mg.

Example: If you plan to eat more than one portion of a food, the amount of tyramine will increase, too. One ounce of Camembert may contain 38 mg of tyramine; if you choose 2 ounces, the tyramine increases to 76 mg. If you then add an ounce of mortadella (43 mg) and a tap beer (38 mg), your total will be 157 mg of tyramine. This amount is too high and should be reduced by omitting one of the food items.

SAMPLE MENU

Tyramine content below 150 mg per meal

Morning

*Omelet with 1 oz of cheddar cheese
2 oz breakfast sausage patty
Toast, preferably whole grain; butter, jam, jelly, or preserves
Coffee or tea; milk cream, sugar as desired
Orange juice or other fresh, frozen reconstituted, or
canned fruit juice (consume product within 48 hours)*

Midday

*Tuna salad sandwich
Banana
Carrot and celery sticks
Tomato juice (consume fresh, frozen, or canned product within 48 hours)*

Evening

*4 oz of red or white wine or 12-oz can or bottle of beer (no Korean beer)
Steak or pork chop (fresh, not aged)
Baked potato with 2 tablespoons sour cream
Steamed carrots or summer squash with butter
Bread or dinner roll with butter
Ice cream*

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