Refining the MAOI Diet: Tyramine Content of Pizzas and Soy Products

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Background: Continuous refinement of the monoamine oxidase inhibitor (MAOI) diet has resulted in much reduced and simplified recommendations that attempt to balance safety and practicality. In the spirit of evidence-based practice, dietary restrictions should be based on carefully documented case reports and valid tyramine analyses. Residual concerns have focused on combination foods such as pizza and a variety of soy products. We determined the tyramine content of pizzas and a variety of soy products in order to refine dietary recommendations for use with MAOIs.

Method: High-pressure liquid chromatography analysis of tyramine content was performed on a variety of pizzas, soy sauces, and other soybean products. A tyramine level of 6 mg or less was considered safe.

Results: No significant tyramine levels were found in any of the pizzas, including those with double pepperoni and double cheese. Marked variability was found in soy products, including clinically significant tyramine levels in tofu when stored for a week and high tyramine content in one of the soy sauces.

Conclusion: 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. All soybean products should be avoided, especially soy sauce and tofu. Individualized counseling and continuous surveillance of compliance are still essential.

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Monoamine oxidase inhibitors (MAOIs) remain an important part of the pharmacologic armamentarium for a variety of psychiatric disorders.[1–4] In an ongoing attempt to refine MAOI diets, our group has conducted a series of tyramine analyses and critical literature reviews. Our recommendations aim to combine safety from hypertensive crises with practicality that incorporates issues of compliance and quality of life.[5–7] The initial situation was one in which an overinclusive and excessively restrictive diet was based on limited scientific evidence[8]; the diet has evolved to be more focused and less restrictive.[6] Nonetheless, as we have refined the diet, questions have arisen from patients and clinicians struggling with practical and important clinical issues. In particular, unresolved concerns have remained regarding the tyramine content of pizzas that combine cheeses and pepperoni, as well as other combination foods that contain soy products such as veggie burgers, Worcestershire sauce, and other sauces.

Feinberg and Holzer[9] recently reflected on their clinical experience with kosher pizzas in New York City. They recommend that their patients consume only pizzas made with part-skim mozzarella or other fresh cheeses and emphasize the need for freshness as has been reported elsewhere.[6] This approach was considered to be a safe practice.[10]

With regard to Chinese foods, Wing and Chen[11] report marked variability in levels of tyramine found in a number of soy sauce brands. High tyramine levels were found in fermented soybean and bean curd (fermented tofu) and chili soybean paste. No significant tyramine levels were found in monosodium glutamate (MSG).

In an effort to evaluate the safety of pizza and other soy products, including combination foods, we analyzed the tyramine content of a variety of such foods obtained in local stores and large chain pizza outlets.

METHOD

Using the high-pressure liquid chromatography (HPLC) method previously reported,[7] we measured the tyramine content in a variety of pizzas and soy products. Thirty-three samples were evaluated for tyramine content. This included a selection of cheeses, tofu and tofu-

Table 1. Tyramine Content

Product	Serving Size	Tyramine Content per Serving (mg)
Cheese		
Sargento light Italian cheese	30 g	0.2462
Aged Romano cheese	30 g	0.1232
No name medium cheddar cheese	30 g	6.5419
No name medium cheddar cheese (7 days in refrigerator)	30 g	10.1228
No name medium cheddar cheese (8 days in refrigerator)	30 g	10.7909
Ziggy's feta cheese with sundried tomatoes and oregano	30 g	0.1734
Mozzarella cheese	30 g	0.5121
Soybean curd		
Veggie (just like) ground beef (7 days in refrigerator)	100 g	0.0628
Veggie (just like) ground beef (9 days in refrigerator)	100 g	0.5983
Solution stored with Vita tofu	15 mL	0.1276
Vita tofu	300 g	0.2268
Vita tofu (7 days in refrigerator)	300 g	4.7914
Soybean oil (identifies soybean oil on label)		
Entenmann's sour cream chip and nut loaf	30 g	0.1215
Golden Dipt ginger teriyaki marinade for seafood and chicken (236-mL bottle)	15 mL	0.0000
Golden Dipt ginger teriyaki marinade for seafood (341-mL bottle)	15 mL	0.0000
Golden Dipt low-fat honey soy marinade for seafood	15 mL	0.0471
Tamari garlic marinade (Memories of Kobe)	15 mL	0.2299
Diana sauce (barbecue sauce)	15 mL	0.0000
Soy sauce (hydrolyzed soy protein or soy protein extract)		
Wing's soy sauce	15 mL	0.1483
Kimlan soy sauce	15 mL	0.5496
Ozeki Sashimi soy sauce	15 mL	1.2488
Pearl River Bridge soy sauce	15 mL	3.3652
Kikkoman soy sauce	15 mL	0.4351
Worcestershire sauce		
Lea & Perrins Worcestershire sauce	15 mL	0.1243
Sharwood's Worcestershire sauce	15 mL	0.0073
No name Worcestershire sauce	15 mL	0.0648
Pizza		
1/2 medium double cheese Pizza Pizza	132.6 g[a]	0.1731
1/2 medium double cheese, double pepperoni Pizza Pizza	314.0 g[a]	0.0000
1/2 medium double cheese, double pepperoni Pizza Hut	136.5 g[a]	0.0628
1 McDonald's deluxe pizza	83.2 g[a]	0.0444
1 McDonald's pepperoni pizza	76.0 g[a]	0.0445
1/2 medium double cheese, double pepperoni Domino's pizza	104.2 g[a]	0.3785

[a]Weight of toppings not including crust.

containing products, products that contained soya (sauces), and 6 different selections of pizza from large chain outlets. As representative portions, we used one half of a medium-size double cheese and double pepperoni pizza from each of 4 popular chain outlets, namely: Pizza Pizza, Pizza Hut, Domino's, and McDonald's (single slices). On the basis of previous studies of tyramine and hypertension,[12,13] we considered 6 mg of tyramine to be the cutoff for safe consumption.

RESULTS

Table 1 shows that most of the tested foods contained less than 6 mg of tyramine in a serving (one-half medium pizza, 15 mL of sauce, 100-gram burgers). However, storage of tofu for 1 week at 4° centigrade increased the tyramine content from 0.2 mg to 4.8 mg per 300-gram serving. One brand of soy sauce (Pearl River Bridge) contained 3.37 mg/15 mL. Consistent with earlier findings, cheddar cheese had significant tyramine levels that rose to 10 mg per serving with storage.

DISCUSSION

Our findings suggest that commercially available pizzas from large chain outlets are safe for consumption with MAOIs. While we cannot guarantee that aged cheeses were not used in these pizzas, the most commonly made pizzas that were analyzed appear to be safe even when made with double orders of cheese and pepperoni. Special caution must be paid if ordering gourmet pizzas from smaller outlets. Clearly, patients must continue to avoid pizzas that specifically have aged cheeses added.

While there is still considerable variability in tyramine among soy products, the literature review and our own testing[7] confirm that there are isolated examples of high tyramine levels appearing in soy products including soy sauce and soybean curd (tofu) when stored. The variability of volumes of soy sauce consumed is also an important consideration. While the Pearl River Bridge soy sauce (15 mL) contained only 3.37 mg of tyramine, it is easy to conceive of an individual consuming double or triple that amount of soy sauce, thereby raising tyramine levels well above the 6-mg threshold. We conclude that all soy sauces and indeed all soybean products should be avoided.

Guidelines for MAOI diets are based on a risk-benefit analysis for a population of patients. While these guidelines are based on critical reviews of the literature and careful analyses of tyramine content, individualized counseling is still essential. Sweet et al.[14] cogently argued for this approach as well as continuous review of compliance taking into account the phenomenon of interindividual as well as intraindividual variability. We hope that this additional information on pizzas and soy products will help to refine MAOI diets so that they are practical and safe and based on the best available evidence including tyramine analyses and case reports. Further studies of tyramine content in pizzas from smaller outlets may help to reassure patients that standard cheese and pepperoni pizzas are safe in these settings as well. We refer readers to the recent review of diet and MAOIs[6] and suggest that those guidelines be supplemented with these additional data.

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