



# Biogenic Amines in Foods & MAOI Drugs

A Crossroads Where Medicine,  
Nutrition, Pharmacy, and Food  
Industry Converge



# Authors

- Beverly J. McCabe-Sellers, PhD, RD, LD
- Cathleen Staggs, MS
- Margaret L. Bogle, PhD, RD, LD
  
- Lower Mississippi Delta Nutrition Intervention Research Initiative
- Little Rock, AR 72211





# Biogenic Amines in Foods

- What are Biogenic Amines (BAs)?
- What are MAOI drugs?
- Why be concerned?
- What are the problems in establishing BA content of foods?
- Why is interdisciplinary collaboration essential?





# Biogenic Amines

- Organic bases usually produced by decarboxylation of amino acids or by amination and transamination of aldehydes and ketones.
- Vasoactive or psychoactive amines.





# Decarboxylation Reactions: Free Amino Acid to Biogenic Amine

- |                 |   |                                      |
|-----------------|---|--------------------------------------|
| ■ Histidine     | ⇒ | ■ Histamine                          |
| ■ Arginine      | ⇒ | ■ Putrescine                         |
| ■ Phenylalanine | ⇒ | ■ 1-phenylethylamine &<br>■ Tyramine |
| ■ Tyrosine      | ⇒ | ■ Tyramine                           |
| ■ Tryptophan    | ⇒ | ■ Tryptamine                         |





# Vasoactive Pressor Amines

- Tyramine
- Tryptamine
- $\beta$ -phenylethylamine





# Tyramine: Physiological Effects

- Peripheral vasoconstriction
- Increased cardiac output
- Increased respiration
- Elevated blood sugar
- Release of norepinephrine





# Tyramine Detoxification

- Healthy gut normally detoxifies tyramine in food by enzyme monoamine oxidase.
- MAO-A : Deaminates serotonin, in CNS and dietary monoamines in GI system
- MAO-B: Predominantly in liver, muscle deaminates dopamine, phenylethylamine







# MAOI Drugs

- Used to inhibit the actions of Monoamine Oxidase, especially in CNS as antidepressant
- More effective than other antidepressants in some subgroups, e.g. anxiety depressions, older adults





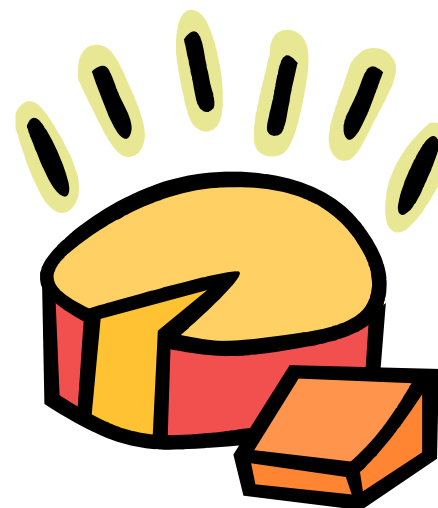
# MAOI Drugs

- First generation: nonspecific, inhibited both A & B, irreversible inhibition
- Second generation: Selective inhibition but less effective in depression. Given in larger doses to be effective, became nonselective.





# Tyramine and the Cheese Reaction





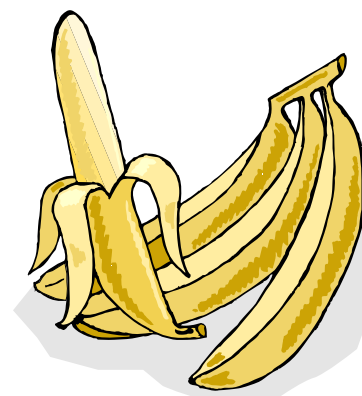
# Foods with Tyramine

- Analysis failed to distinguish among various amines.
- Wide variation of tyramine content from one part of a food to another, e.g. cheese wheel.
- Only one or two samples of a food analyzed at a time.
- Poor quality of original food
- Temperature abuse





# Banana pulp or Banana Peel





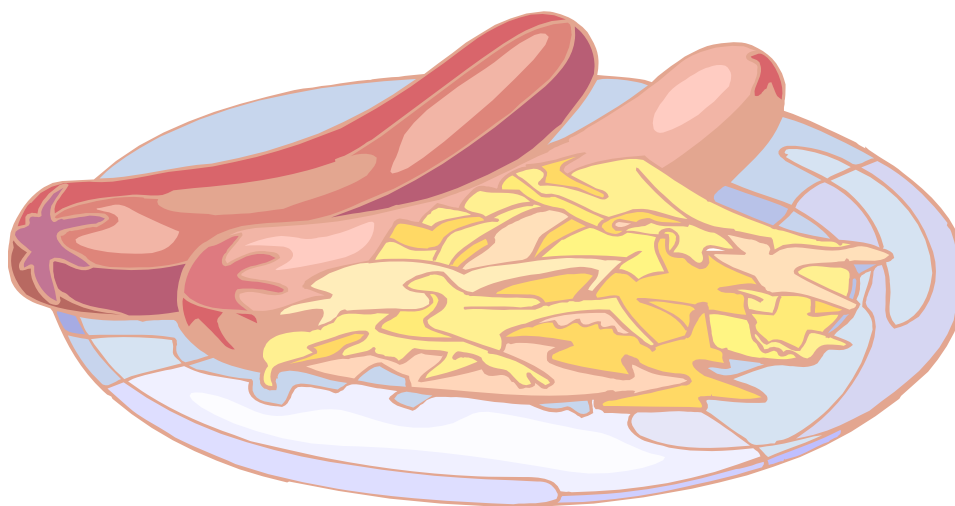
# Potential for Tyramine Formation

- Any protein-containing food not properly cleaned, stored, and prepared.
- Aged foods, especially aged cheeses
- Fermented foods more recently recognized
- Newer foods from many cultures



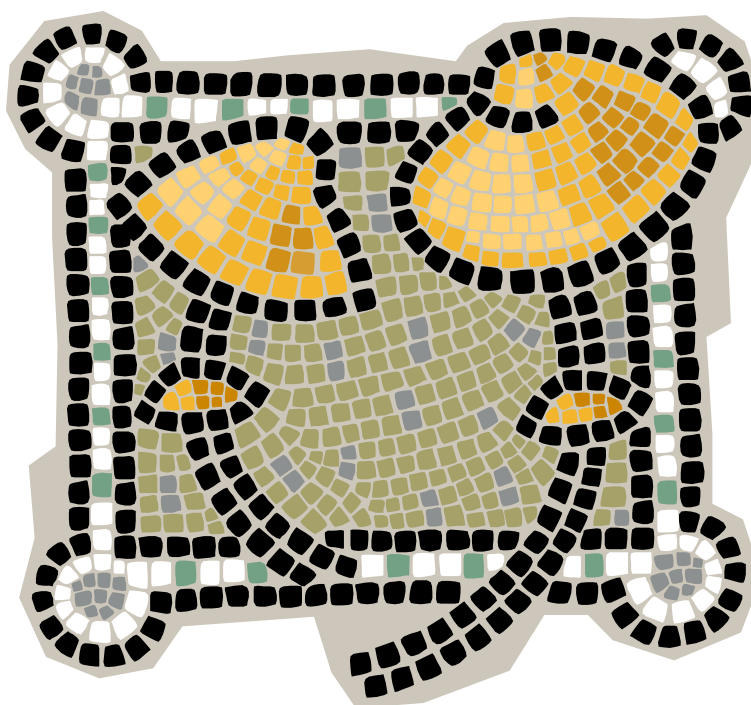


# Fermented: Sauerkraut





# Mushrooms: Long storage, temperature abuse.



Delta Nutrition Intervention Research Initiative





# Questions about Early Analyses

- Improved sensitivity and specificity for tyramine identification
- Improved processing of foods, e.g. rapid chilling, freezing of foods such as fish
- Food packaging that prolongs shelf life
- Recognition of critical points in the prevention of BA formation:HCAAP





# Questions about Early Analyses

- More use of “Best use by” or “Sell dates” aid in identifying freshness.
- Improved manufacturing practices
- Substitution of cultures less likely to produce decarboxylation.





Delta Nutrition Intervention Research Initiative



# Review of Published Values

- 289 food values and 108 alcoholic beverage values since 1981
- 15 (6%) foods were deliberately aged
- 65 (22%) contained sufficient tyramine to induce clinical reaction if 1-2 servings were consumed.
- 18/69 (26%) of cheeses had clinical levels.





# Review of Published Values

- 12/33 (36%) of Asian dishes were of clinical significance level (fermented)
- 9/28 (32%) of fermented veggies and straw mushrooms had significant levels.
- 1/1 (100%) of Marmite yeast had significant levels.





# Review of Published Values

- Food groups without clinically significant levels:
- Major Chain store pizzas (n=6)
- Fish (n=32)
- Fruit (n=11)
- Pate (n=3)





# Review of Published Values

- Food groups without clinically significant levels:
- Yogurt (n=1)
- Brewer's yeast (n=4)
- Chocolate/Chocolate dishes (n=6)





# Review of Published Values

- Food groups without clinically significant levels:
- Bottled/canned beers (n=43)
- Distilled spirits (n=5)
- Dealcoholized beers (n=7)
- Wine (n=12 reds, 4 whites, 3 ports)







# Review of Published Values

- Clinically significant levels were found in:
- 4/34 (12%) tap beers
- 5/21 (42%) sauces (shrimp, fish, soya)





# Food Science has brought us.....

- Better technology to detect BA
- Food handling processes = improves food
- Over 100 articles addressing methods/processes of detecting or preventing tyramine development.





# Pharmaceutical Science has brought us.....

Newer generations and new modes of administration that lower the risks for food-drug interaction.

- Selective reversible MAOIs allow treatment of Parkinson Disease with little risk of hypertensive crisis.





# Pharmaceutical Advances

- Transdermal patch allows a more effective dosage of MAOIs to be delivered for the treatment of depression with less risk of inhibiting gut monoamines. First tested with tyramine-restricted diet.
- Now in clinical trials without special diet.





# Science promises....

- Packaging disk that will change to signal the presence of biogenic amines as a biosensor of change in the freshness of meat.





# Nutritionists bring....

- Better ability to assess clinical significance of laboratory analysis of specific foods.
- Design of realistic, workable guidelines for prevention of food-drug interactions
- Skills in counseling patients on the prevention of food-drug interactions.
- Team approach to food-drug interactions.





# Best Dietary Advice with MAOIs

- Buy fresh.
- Cook fresh
- Eat fresh

