Prevalence of Phosphorus Containing Food Additives in Grocery Stores

Cathy Sullivan, MS RD, LD
Cleveland OH
Outline

• What are phosphorus containing food additives and how are they used?
• How do phosphorus containing food additives affect the accuracy of nutrient databases?
• Are phosphorus enhanced foods common and how much phosphorus do they add to foods?
• Why are these additives harmful for kidney disease patients?
• Is this a problem for the general population?
Common Phosphorus Additives

- Dicalcium Phosphate
- Hexametaphosphate
- Monocalcium Phosphate
- Phosphoric Acid
- Pyrophosphate
- Sodium Acid Pyrophosphate
- Sodium Aluminum Phosphate
- Sodium Phosphate
- Sodium Tripolyphosphate
- Tricalcium Phosphate
Common Uses Of Food Additives

- Leavening
- Acid
- Suspension/dispersion agent
- Anti caking
- Decrease cooking time
- Emulsifier
- Stabilizer
- Moisture binding
- Improve texture
- Maintain color or firmness
- Flavor enhancer
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Actual minus USDA database phosphorus content of 38 chicken products

Sullivan 2007 Journal of Renal Nutrition
### Actual and Expected Phosphorus Contents of a Variety of Chicken Products

<table>
<thead>
<tr>
<th>Category</th>
<th>Product</th>
<th>Phosphorus containing additives*</th>
<th>Serving size (g)</th>
<th>Actual phosphorus (mg/100g)</th>
<th>Expected phosphorus (mg/100g)</th>
<th>Difference (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boneless breast</td>
<td>Giant Eagle fresh chicken breast</td>
<td>None</td>
<td>112</td>
<td>205</td>
<td>228</td>
<td>-23</td>
</tr>
<tr>
<td></td>
<td>Townsend quick frozen chicken breast</td>
<td>1</td>
<td>113</td>
<td>250</td>
<td>228</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Tyson quick frozen chicken breast</td>
<td>1</td>
<td>112</td>
<td>317</td>
<td>228</td>
<td>89</td>
</tr>
<tr>
<td>Breast patties</td>
<td>Tyson breast patties</td>
<td>1,3</td>
<td>73</td>
<td>185</td>
<td>126</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>Banquet chicken breast patties</td>
<td>2,4,5</td>
<td>76</td>
<td>291</td>
<td>126</td>
<td>165</td>
</tr>
</tbody>
</table>

Sullivan 2007 JRN
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Prevalence of Phosphate Additives in Top Selling Groceries

- Nielsen grocery sales data for NE Ohio
  - 52 weeks ending February 1, 2010

- Top 20 Total Departments by unit sales

- Deleted 5 categories
  - total fresh produce, milk, pet food, candy, paper products

- Reviewed 200 top selling food items/category
  - Eliminated store brands
### Department Sales (millions)

<table>
<thead>
<tr>
<th>Department</th>
<th>Total Unit Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbonated beverages</td>
<td>61.4</td>
</tr>
<tr>
<td>Yogurt</td>
<td>51.6</td>
</tr>
<tr>
<td>Bread and baked goods</td>
<td>39.3</td>
</tr>
<tr>
<td>Snacks</td>
<td>34.1</td>
</tr>
<tr>
<td>Soup</td>
<td>31.4</td>
</tr>
<tr>
<td>Prepared foods - frozen</td>
<td>27.1</td>
</tr>
<tr>
<td>Juice drinks shelf stable</td>
<td>26.8</td>
</tr>
<tr>
<td>Packaged meat</td>
<td>26.5</td>
</tr>
<tr>
<td>Cereal</td>
<td>26.5</td>
</tr>
<tr>
<td>Condiments/gravies/sauces</td>
<td>26.3</td>
</tr>
<tr>
<td>Prepared foods – dry mixes</td>
<td>22.0</td>
</tr>
<tr>
<td>Vegetables – canned</td>
<td>21.7</td>
</tr>
<tr>
<td>Cheese</td>
<td>20.3</td>
</tr>
<tr>
<td>Vegetables – frozen</td>
<td>17.9</td>
</tr>
<tr>
<td>Prepared foods – ready serve</td>
<td>17.4</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>450.3</strong></td>
</tr>
</tbody>
</table>

15 departments represent 45% of total grocery sales in NE Ohio.
# Labels Reviewed

<table>
<thead>
<tr>
<th>Department</th>
<th># Items reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepared foods – frozen</td>
<td>195</td>
</tr>
<tr>
<td>Prepared foods – dry mixes</td>
<td>171</td>
</tr>
<tr>
<td>Packaged meat</td>
<td>168</td>
</tr>
<tr>
<td>Bread and baked goods</td>
<td>145</td>
</tr>
<tr>
<td>Soup</td>
<td>172</td>
</tr>
<tr>
<td>Yogurt</td>
<td>164</td>
</tr>
<tr>
<td>Carbonated beverages</td>
<td>170</td>
</tr>
<tr>
<td>Vegetables – frozen</td>
<td>195</td>
</tr>
<tr>
<td>Juice drinks shelf stable</td>
<td>176</td>
</tr>
<tr>
<td>Cereal</td>
<td>167</td>
</tr>
<tr>
<td>Prepared foods – ready serve</td>
<td>165</td>
</tr>
<tr>
<td>Snacks</td>
<td>169</td>
</tr>
<tr>
<td>Cheese</td>
<td>116</td>
</tr>
<tr>
<td>Condiments/gravies/sauces</td>
<td>160</td>
</tr>
<tr>
<td>Vegetables – canned</td>
<td>122</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>2394</strong></td>
</tr>
</tbody>
</table>
Percent Grocery Department Sales Containing Phosphate Additives
2394 food labels reviewed

- Prepared foods - frozen
- Prepared foods dry mixes
- Packaged meat
- Carbonated beverages
- Juices drinks shelf stable
- Bread and baked goods
- Soup
- Yogurt
- Vegetables - frozen
- Cereal
- Snacks
- Cheese
- Prepared foods ready serve
- Condiments/gravies/sauces
- Vegetables - canned

Graph showing percentage of total unit sales and total dollar sales with additives.
Mean Phosphorus Content (mg/100g)

- Top 5 items/category
  - with additives: 169
  - without additives: 101
  - N = 70

- Additive/non additive match
  - with additives: 173
  - without additives: 107
  - N = 58

p = .02
p = .03
Difference in Phosphorus Content Additive and Non-additive by Category

Mean = 65
Difference in Phosphorus Content Between Matched Items

Mean = 65 mg/100g

Number of matched product pairs

mg/100g phosphorus difference

<0: 6, 0.1 - 25: 23, 25.1 - 50: 9, 50.1 - 100: 7, 100.1 - 200: 9, >200: 4
Comparison Examples

• Velveeta shells and cheese = 456 mg
• Kraft mac and cheese = 280 mg
• Kraft mac and cheese organic = 200 mg

• Kraft singles deluxe American = 148 mg
• Horizon organic American = 79 mg

• Yoplait strawberry (regular) = 311 mg
• Yoplait light strawberry = 137 mg
• Breyer strawberry (regular) = 119 mg
Comparison Examples

• Spaghettios with meatballs = 194 mg
• Chef Boyardee shells & meatballs = 101 mg

• Cheerios = 132 mg
• Nature’s Path organic whole o’s = 55 mg

• Sugardale bacon = 445 mg/100g
• Hormel black label bacon = 263 mg/100g

• Ragu roasted garlic parmesan = 67 mg
• Classico roasted garlic alfredo = 37 mg
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• **Why are these additives harmful for kidney disease patients?**
• Is this a problem for the general population?
Why is this important in CKD?

• Significant cause of CVD morbidity/mortality
  – 45% of HD patients have persistently high Phosphorus
  – Exceeds limits of medication

• Difficult for patients and clinicians to determine which foods are high in phosphorus
  – Increased reliance on convenience foods
  – Many people are not learning cooking skills

• Additives are almost entirely absorbed, natural only ~60%
  – Most restaurants use enhanced meats

• Depending on food choices, additives add as much as 1000 mg/day of phosphorus to diet. (Calvo MS, 1996)
  – Based on intake data from 1989-90
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General Population Concerns

• Numerous studies in the non CKD population have found associations with serum phosphorus and:

  – Vascular Calcification and stiffness
  – Cardiovascular Events
  – All cause mortality
  – Bone metabolism
Public health approach:
Is it relevant to enough people?

• 400,000 dialysis patients in the US

• 10 million Americans with moderate kidney disease

<table>
<thead>
<tr>
<th>prevalence (age ≥20 years), percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>CKD all stages</td>
</tr>
<tr>
<td>Stage 3</td>
</tr>
<tr>
<td>Stage 4/5</td>
</tr>
</tbody>
</table>
Conclusions

• Phosphorus additives are commonly used in the most frequently purchased grocery items.
• Phosphorus additives contribute a significant amount of phosphorus to grocery items.
• Large variation in content in like foods found on analysis.
• Patients and clinicians unable to determine quantity of phosphorus if foods.
Thoughts

• Epidemiological and clinical trials require accurate databases

• Manufacturers must analyze products for phosphorus content to populate databases

• Current databases are unable to show the wide variability in products due to additive phosphorus