Mangos: Socializing a Globally Popular Fruit with Americans
Unpacking the Science and Exploring New Research Opportunities

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Disclosures

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  • Illinois Institute of Technology

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  • California Strawberry Commission
  • Hass Avocado Board
  • National Mango Board
  • California Fig Advisory Board
  • University of Indiana / Foundation
  • Pepsico, Ingredion

• Advisory Boards
  • Nutrient Institute
  • McCormick Science Institute
Outline

- Practical Implications and the Fruit Gap
- Mango Basics
- Unique Attributes of Mangos
- Health Benefits: Published Research
- Key Takeaways
Implications – Why is this Research so Important?

• Global Burden of Disease (GBD) study tells us a **diet low in fruit** is among the **top 3** dietary risk factors for CVD & Diabetes

• Need evidence for **specific foods to eat and why?**
  • AACE/ACE Medical guidelines for Diabetes and Pre-diabetes

• **Need evidence** for devising **fruit recommendations: amount and variety** to reduce disease risk and promote health
  • Dietary Guidelines for Americans

• **People want to know** – **what** foods/fruits and **how** much to eat to optimize health
Number of Deaths Due to Individual Dietary Risks

1. Diet HIGH in SODIUM
2. Diet LOW in WH GRAINS
3. Diet LOW in FRUITS

>50% of deaths and 66% DALYs accounted for by non-optimal intake of top dietary factors
Importance of Eating a Variety of Fruit

Diabetes Risk

C
Hazard ratio (95% CI) of type 2 diabetes

Fruit and vegetable variety (items/week)

More variety

Cooper et al Diabetes Care, 2012.
Addressing the Fruit Gap

Increase AMOUNT of total fruit consumed

Increase DIVERSITY of nutrients and “bioactives” phytochemicals in the diet
Mango Facts

What you may already know

- Great tasting
- Available year-round
- Versatile & Convenient
- Low-calorie / Low-energy density
- Contain a variety of nutrients

Nutrient Content Claims:
- Excellent source of vitamin C, 50% DV
- Good source of folate, 15% DV
- Good source of copper, 15% DV

Mangos and Vitamin C

45 mg / NLEA serving
50% DV → Excellent source
Mangos and Folate

53 ug / NLEA serving
15% DV → Good source
Mangos and Fiber

Source: What We Eat in America, NHANES 2011-2012
## Carbohydrate: Sugar Stats

<table>
<thead>
<tr>
<th>Fruit</th>
<th>Calories</th>
<th>SUGAR (g)</th>
<th>Sucrose (g)</th>
<th>Glucose (g)</th>
<th>Fructose (g)</th>
<th>G:F Ratio</th>
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</thead>
<tbody>
<tr>
<td>Mangos</td>
<td>60</td>
<td>13.7</td>
<td>7</td>
<td>2.0</td>
<td>4.7</td>
<td>0.43</td>
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<tr>
<td>Grapes</td>
<td>69</td>
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<td>7.2</td>
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<tr>
<td>Apple</td>
<td>52</td>
<td>10.4</td>
<td>2.1</td>
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<td>Banana</td>
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<td>2.4</td>
<td>5.0</td>
<td>4.9</td>
<td>1.02</td>
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<td>Orange</td>
<td>50</td>
<td>8.6</td>
<td>4.3</td>
<td>2.0</td>
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<td>0.87</td>
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<tr>
<td>Strawberry</td>
<td>32</td>
<td>4.9</td>
<td>0.5</td>
<td>2.0</td>
<td>2.4</td>
<td>0.83</td>
</tr>
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</table>
Phytochemical “Bioactives”

- Carbohydrates
- Vitamins
- Minerals
- Fibers
- Phenolic acids
- Flavonoid derivatives
- Mangiferin (Xanthonoid)
- Carotenoids
- Tannins
Fruit Polyphenols, Metabolites, Health

Blood

Bio- Health

ENDPOINT

??
Are These “Bioactives” Bioavailable?

Absorbed from small intestine
Peak in blood in ~ 2 h
While others are absorbed later
YES – Mango Phyto-Bioactives are Bioavailable

Fan et al. Molecules 2020
Eating Mangos Daily for 2 Weeks Increases Select Metabolites Measured in Urine
Eating Mangos Daily for 6 Weeks Increases Select Metabolites Measured in Urine

A

B

C

D

E

F

Barnes et al 2018
Carotenoid Bioavailability

Lutein
α carotene
β carotene
What Health Benefits Have Been Documented About Mangos?

Broad look at the literature
Evidence...

Whole Fruit

Fruit Product

Fruit/ Peel Extract

Isolated Fruit Compounds
### Table 1: Database Summary: Biological models

<table>
<thead>
<tr>
<th>Model</th>
<th>Bioavail</th>
<th>Body Weight</th>
<th>Brain</th>
<th>Cancer</th>
<th>CVD</th>
<th>DM</th>
<th>GI</th>
<th>Skin</th>
<th>Anti-Inflam Ox</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=</td>
<td>11</td>
<td>9</td>
<td>17</td>
<td>60</td>
<td>22</td>
<td>39</td>
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<td>59</td>
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<tr>
<td>Human</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<td>9</td>
<td>0</td>
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<td>4</td>
<td>7</td>
<td>6</td>
<td>3</td>
<td>37</td>
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<tr>
<td>Assays</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

*Source: Mango Summary of Research Database, Up to July 2016*

1 Reflects models used in research studies; more than 1 model may have been used in a study

2 Number of published articles (shown in bold)
Phytochemical Compounds

Directly or Indirectly

• Anti-oxidant
  • Scavenge free radicals
  • Alter oxidative production
  • Enhance endogenous defenses against free radicals

• Anti- inflammation

• Alter cell signaling
  • Enhance cell-to-cell communication
  • Repair DNA or other tissue damage
  • Detoxify carcinogens
**Health Benefits of Mangoes**

- **Vascular and Heart Health** (Enhanced blood flow)
- **Metabolic Health** (Glucose and lipids control; insulin action)
- **Brain Health** (Better memory)
- **Intestinal Health** (Mucosal integrity)
- **Skin Health** (Wrinkle control)

**Evidence and Opportunities**

*Burton-Freeman BM, Sandhu AK, Edirisinghe I. Food Funct. 2017 Sep 20;8(9):3010-3032. PMID: 28612853.*
Nutritional Benefits Associated with Mango Intake
Mango Consumer vs Non-Consumers

Higher total and whole fruit intake
Higher dairy (children)
Higher seafood and plant protein (adults)
Higher fiber intake
Higher folate
Higher potassium
Less sodium

OVERALL—Higher Healthy Eating Index
Adults and Children
Mango Consumer vs Non-Consumers

- Lower BMI
- Smaller waist circumference
- Lower body weight

Males and Mangos
Mango and Body Weight

*Primary outcome in response to eating mangos — none in humans*

*Secondary outcomes — humans*

No data to support weight gain or weight loss when eating mangos
-generally neutral effect on body weight when monitored as secondary outcome

Satiety effects suggested compared to isocaloric cookie snack

Evidence from animal studies suggest weight loss
Cardio-Metabolic Effects of Mango Intake
Effects of Fresh Mango Consumption on Glucose and Insulin in Overweight and Obese Adults: Mango Intake Reduces Glucose Concentrations

N=27
100 kcal: Mango or Cookie
Effects of Fresh Mango Consumption on Glucose and Insulin in Overweight and Obese Adults: Mango Intake Reduces CRP, a Marker of Inflammation

Other outcomes:
BW – no change, mango
BW – increase, cookie
TG – no change mango
TG – increase cookie
Cholesterol – no change both
Effects of Fresh Mango Consumption for 8 Weeks in Overweight and Obese Adults: **Blood Pressure**

<table>
<thead>
<tr>
<th>Blood pressure (mm Hg)</th>
<th>Week 0</th>
<th>Week 4</th>
<th>Week 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>All participants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBP</td>
<td>117±1</td>
<td>116±2</td>
<td>113±2(^a,b)</td>
</tr>
<tr>
<td>DBP</td>
<td>75±1</td>
<td>74±1</td>
<td>72±1(^#)</td>
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<tr>
<td>Males</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBP</td>
<td>123±2</td>
<td>123±1</td>
<td>119±2</td>
</tr>
<tr>
<td>DBP</td>
<td>76±3</td>
<td>74±2</td>
<td>71±3</td>
</tr>
<tr>
<td>Females</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBP</td>
<td>114±1</td>
<td>113±2</td>
<td>110±2(^c)</td>
</tr>
<tr>
<td>DBP</td>
<td>75±1</td>
<td>74±2</td>
<td>73±1</td>
</tr>
</tbody>
</table>

Note: Values are presented as means ± standard deviation. Data were analyzed using general mixed linear models. DBP, diastolic blood pressure; SBP, systolic blood pressure.

\(^#\) p = 0.061 compared with week 0.
\(^a\) Significantly different from week 0 (p = 0.01).
\(^b\) Significantly different from week 4 (p = 0.03).
\(^c\) Significantly different from week 0 (p = 0.01).

Keathley et al 2022
Effects of Fresh Mango Consumption for 8 Weeks in Overweight and Obese Adults: *Insulin* and *Glucose*

All participants

N=27

280 g a day for 8 weeks

Keathley et al 2022
Effects of Fresh Mango Consumption for 8 Weeks in Overweight and Obese Adults: Microbiota Composition

Keathley et al 2022
Additional Work on Microbiota Showing Promising Effects Influencing Health

Kim et al Molecules 2021, Review

Kim et al Pilot study in IBD
Kim et al OW/OB
Mango Research Summary

- Glucose
- Inflammation Markers
- Blood Pressure
- No impact on body weight
- Diet Quality
- Microbial Diversity
- Microbial Metabolites
Mango and Future Directions

Brain
Brain health
Cognition, appetite regulation

Cardio-Metabolic health
Dietary patterns research
Across life cycle
Improving bioavailability, exposure to metabolites

Gut health
Integrity and function
Small and Large intestine
IBS, IBD, other
Addressing Fruit and Fiber Gaps with Mango

To promote health and reduce chronic disease risk
How to include more mango in the diet
THANK YOU

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