The potential of spices and herbs to improve Public Health through improved diet quality and/or physiological outcomes

Anne-Marie Roussel, PharmD, PhD
Emeritus Professor of Biochemistry
Joseph Fourier University, Grenoble, France
Conflict of interest regarding this presentation:

I wish to declare a potential conflict of interest, and that I have received direct or indirect industry support in relation to part of the results presented here.
A reason to season …
part of hedonic liking of eating

- Over the centuries, herbs and spices have long been used to improve the colour, flavour, taste of food, and variety of meals.
An other reason to season ... 

diet quality and potential health benefits

Over the last decade, research into the role of spices and herbs as contributors of active phytochemicals has dramatically increased, demonstrating that they contribute to:

- preserve food quality.
- promote healthy dietary habits
- protect against the risk of developing chronic diseases.

Quality of food
Healthy eating attitudes

Potential health benefits
Reduced risk of chronic diseases
Spices, Herbs, Diet quality and Healthy eating attitude
Spices and culinary herbs are rich in bioactive phytochemicals

**Sulfur components**

*Allicin (garlic)*

**Polyphenols**

- capsaiacin et capsinoïds (*chilli pepper*)
- curcumin (*turmeric*)
- proanthocyanidins (*cinnamon*)
- rosmarinic acid (*rosemary, sage, thyme*)

**Alkaloïdes**

- piperine (*pepper*)

**Carotenoïds**

- capsanthine (*paprika*), crocetine (*saffron*)

**Terpenes**

- anethole (*fennel, star anise*)
- cinnamaldehyde (*cinnamon*)
- eugenol (*cloves*)
- carnosic acid (*sage, rosemary*)
- Cuminaldehyde (*cumin*)
Spices and herbs are rich in antioxidants

<table>
<thead>
<tr>
<th>Spice</th>
<th>Antioxidant content mmol/100 g(^a)</th>
<th>n</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allspice, dried ground</td>
<td>100.4</td>
<td>2</td>
<td>99.28</td>
<td>100.40</td>
</tr>
<tr>
<td>Basil, dried</td>
<td>19.9</td>
<td>5</td>
<td>9.86</td>
<td>30.86</td>
</tr>
<tr>
<td>Bay leaves, dried</td>
<td>27.8</td>
<td>2</td>
<td>24.29</td>
<td>31.29</td>
</tr>
<tr>
<td>Cinnamon sticks and whole bark</td>
<td>26.5</td>
<td>3</td>
<td>6.84</td>
<td>40.14</td>
</tr>
<tr>
<td>Cinnamon, dried ground</td>
<td>77.0</td>
<td>7</td>
<td>17.65</td>
<td>139.89</td>
</tr>
<tr>
<td>Clove, dried, whole and ground</td>
<td>277.3</td>
<td>6</td>
<td>175.31</td>
<td>465.32</td>
</tr>
<tr>
<td>Dill, dried ground</td>
<td>20.2</td>
<td>3</td>
<td>15.94</td>
<td>24.47</td>
</tr>
<tr>
<td>Estragon, dried ground</td>
<td>43.8</td>
<td>3</td>
<td>43.22</td>
<td>44.75</td>
</tr>
<tr>
<td>Ginger, dried</td>
<td>20.3</td>
<td>5</td>
<td>11.31</td>
<td>24.37</td>
</tr>
<tr>
<td>Mint leaves, dried</td>
<td>116.4</td>
<td>2</td>
<td>71.95</td>
<td>160.82</td>
</tr>
<tr>
<td>Nutmeg, dried ground</td>
<td>26.4</td>
<td>5</td>
<td>15.83</td>
<td>43.52</td>
</tr>
<tr>
<td>Oregano, dried ground</td>
<td>63.2</td>
<td>9</td>
<td>40.30</td>
<td>96.64</td>
</tr>
<tr>
<td>Rosemary, dried ground</td>
<td>44.8</td>
<td>5</td>
<td>24.34</td>
<td>66.92</td>
</tr>
<tr>
<td>Saffron, dried ground</td>
<td>44.5</td>
<td>3</td>
<td>23.83</td>
<td>61.72</td>
</tr>
<tr>
<td>Saffron, dried whole stigma</td>
<td>17.5</td>
<td>3</td>
<td>7.02</td>
<td>24.83</td>
</tr>
<tr>
<td>Sage, dried ground</td>
<td>44.3</td>
<td>3</td>
<td>34.88</td>
<td>58.80</td>
</tr>
<tr>
<td>Thyme, dried ground</td>
<td>56.3</td>
<td>3</td>
<td>42.00</td>
<td>63.75</td>
</tr>
</tbody>
</table>

\(^a\) mean value when n > 1

(Cho et al. Nutrition Journal 2010, 9:3)
Spices and herbs preserve antioxidant capacity of food

- Increased antioxidant power of salad

200 g of salad:
1) : lettuce + tomato.
2) : lettuce + tomato + lemon.
3) : lettuce + tomato + culinary herbs.


- Preservation of alpha-tocopherol in sunflower oil by herbs and spices


100 mg/kg : Rosemary, thyme, sage, oregano, curcumin.

- Antioxidant protection of edibles oils


- Increased β-carotene bioavailability in vegetables

(Veda et al., J Agric Food Chem, 2008, 56(18):8714-9)
Spices and herbs reduce fat oxidation during meat grilling

- 11 healthy volunteers,
- burger vs [burger + spice mixture] during cooking

Spice mixtures
(11.25 g/250g meat)
- cloves,
- cinnamon,
- oregano,
- rosemary,
- ginger,
- black pepper,
- paprika,
- garlic.

MDA (malondialdehyde) production in grilled spiced meat is reduced by 71%

Plasma MDA (% change)

Urinary MDA

Plasma MDA as % change from baseline.

Spice and herbs, a potential help for reducing sodium intake: the SPICE clinical trial

Multifactorial behavioural intervention with spices and herbs for facilitating adherence to the recommended sodium intake as 1500 mg/d (US Dietary Guidelines).

Intervention group vs self-directed control group after 4 weeks low Na diet

Intervention group: counseling sessions, cooking demonstrations, use of familiar and non-familiar spices and herbs, self monitoring of sodium intake, strategy for eating with family or outside....

24 hour urinary sodium excretion (mg/day)

<table>
<thead>
<tr>
<th></th>
<th>Screening</th>
<th>Random assignment</th>
<th>Week 14</th>
<th>Week 16</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>control</td>
<td>intervention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 2300 mg/d, %</td>
<td>20</td>
<td>35</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>1500 mg/d, %</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>25</td>
</tr>
</tbody>
</table>

Study participants meeting goals per 2000 kcal diet (Na values adjusted for the number of hours of urine collection)

Research report

Enhancing consumer liking of low salt tomato soup over repeated exposure by herb and spice seasonings

Sameer Khalil Ghawi, Ian Rowland, Lisa Methven

Department of Food and Nutritional Sciences, University of Reading, Whiteknights, Reading RG6 6AP, UK
Adding spices may increase vegetable consumption: a prospective randomized pilot study in healthy adults

*87 overweight healthy subjects (IMC 25-30), 30-60yrs, less than 3 servings/d vegetables, assigned in random order to eat broccoli, cauliflower or spinach with or without added spices

* High vs low restraint eaters (TFEQ)*

- High restraint eaters consumed 91% more spiced broccoli.
- Rate of eating spiced broccoli was 50% greater.

Li Z. et al, Food and Nutrition Sciences, 2015, 6, 437-444

* Three Factor Eating Questionary

Increasing the intake of healthy food such as broccoli among restraint eaters by adding spices to improve acceptability and taste is a useful strategy for consumption of vegetables containing phytochemicals with a bitter taste.
Adding herbs and spices to a reduced-fat dip increases intake of vegetable in preschoolers

Preschoolers 3 – 5 yrs

<table>
<thead>
<tr>
<th>Condition</th>
<th>Yummy</th>
<th>Just OK</th>
<th>Yucky</th>
<th>Refused</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Vegetable alone</td>
<td>11</td>
<td>31</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Vegetable plus plain dip</td>
<td>17</td>
<td>49</td>
<td>8</td>
<td>25</td>
</tr>
<tr>
<td>Vegetable plus herb dip</td>
<td>22</td>
<td>64</td>
<td>6</td>
<td>18</td>
</tr>
</tbody>
</table>

Herbs and spices improve liking of lower-fat foods

S: Sensory & Food Quality

The Influence of Herbs, Spices, and Regular Sausage and Chicken Consumption on Liking of Reduced Fat Breakfast and Lunch Items

Sarit Polsky\textsuperscript{1,2}, Jimikaye Beck\textsuperscript{3,*}, Rebecca A. Stark\textsuperscript{3}, Zhaoxing Pan\textsuperscript{4}, James O. Hill\textsuperscript{3} and John C. Peters\textsuperscript{1,2}

Article first published online: 12 SEP 2014
DOI: 10.1111/1750-3841.12643
© 2014 Institute of Food Technologists®

In summary:

- Improves acceptability of reduced salt foods
- Preserves antioxidant capacity of edible oils
- Helps adherence to recommended sodium intakes
- Reduces fat oxidation during meat grilling
- Increases liking of low fat foods
- Enhances vegetable consumption
Spices, Herbs and Human Health

- Neuroprotection
- Cardiovascular health
- Cancers
- Microbiote
- Energy expenditure
- Fat oxidation
- Weight management
- Insulin signaling
- Glucose homeostasis
- Inflammation
Red pepper at hedonically doses: effects on energy expenditure and thermogenesis

- Healthy lean individuals, BMI: 22.6 ± 0.3 kg.m²
- Test load with 1 g RP / meal *

Changes in energy expenditure (measured over the 270 min after test load) increase energy expenditure and thermogenesis.

Changes in mean core body temperature (measured over the 270 min after test load)

Red pepper consumption at hedonically acceptable doses increases energy expenditure and thermogenesis.

*) Mean acceptable dose: Europe, USA 1 g/d, Asia, South America 7 g/d.

Herbs and spices: from the weight management to the prevention of the metabolic syndrome....

Spices and herbs consumption
- Satiety and mood
- Energy expenditure
- Thermogenesis
- Body composition

Energy balance and weight management
- Dyslipidemia
- Hypertension
- Insulin resistance
- Oxidative stress
- Inflammation

Obesity related metabolic effects
Spices blend* decreases the magnitude of post-prandial increases in circulating insulin

- healthy overweight men, BMI 25 – 27

* spices blend = 14 g
- black pepper,
- cinnamon,
- cloves,
- garlic,
- ginger,
- oregano,
- paprika,
- rosemary,
- turmeric.

⇒ may help to normalize post-prandial glucose homeostasis.

Cinnamon regulates glycaemia and oxidative stress:

- 24 men; 18 – 40 yrs; 25 < BMI < 30
- 250 mg/d cinnamon extracts (1g cinnamon powder) 12 weeks

Positive correlation between MDA and fasting glucose: \( r = 0.74, p < 0.001 \)

Cinnamon decreases glycaemia in overweight or type 2 DM people: meta analysis

1. Tang, 2008
2. Khan, 2003
3. Vanschoonbeek, 2006
5. Ziegenfuss, 2006
6. Mang, 2006
7. Stoecker, 2010
8. Roussel, 2009
9. overall cinnamon
10. cinnamon extract

Standardized differences in fasting blood glucose (FBG) means

Potential cardiovascular benefits of spices on post-prandial endothelial dysfunction

- Randomized cross over study, DT2 patients, 35 – 70 yrs.
- 2 test meals:
  - ground beef seasoned with salt (10 % fat),
  - ground beef seasoned with spices (10 % fat):
    - 11.25 g / 250 g
    - cloves: 4 %
    - cinnamon: 4 %
    - oregano: 26 %
    - rosemary: 4 %
    - ginger: 11 %
    - black pepper: 7 %
    - paprika: 30 %
    - garlic powder: 13 %

Li Z et al., Diabet Med, 2013, 30(5):590-5
Several culinary herbs and spices with potential anti-inflammatory activity to alleviate the effects of inflammation

- Oregano  
  (Origanum vulgare)
- Red pepper  
  (Capsicum frutescens)
- Black pepper  
  (Piper nigrum)
- Thyme  
  (Thymus vulgaris)
- Rosemary  
  (Rosmarinus officinalis)
- Turmeric  
  (Curcuma longa)
- Ginger  
  (Zingiber officinale)
- Cardamom  
  (Elettaria cardamomum)
- Coriander  
  (Coriandrum sativum)
- Cloves  
  (Syzygium aromaticum)

Aggarwal BB et al. EBM 2009; 234:825-49.
Ginger reduces muscle pain induced by exercise

- 11 days of raw or eated-treated ginger supplementation (2g/d)
- Pain intensity 24H after eccentric actions on the elbow flexors is reduced in both supplemented groups vs placebo

*Black CD et al., Journal of Pain, 2010, 11(9): 894-903*
In summary,

Addition of herbs and spices to the diet are reported to

- act in preserving food quality
- improve healthy eating attitudes, especially in young people: salt reduction, higher acceptability of low fat food, increased vegetable consumption
- generate substantial health effects on
  Energy balance and Weight management, Insulin sensitivity, Cardiovascular health and Inflammation....

- **BUT**

This promising area of research needs further studies:
Clinical studies in more areas (cognition, microbiote..)
Determination of efficient hedonical intakes
Bioavailability,
Mechanisms of action
Should spices and herbs be part of nutritional recommendations??

Traditional Okinawan diet food pyramid


⇒ Interestingly, herbs and spices are already present in Okinawan diet food pyramid and part of Australian recommendations
Thanks for your attention!