Cinnamon-Vanilla Granola:
The Potential Health Benefits of Coumarin and Cinnamon

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Nutrition 201: Advanced Food Science
December 12, 2011
Purpose
To address the studies and considerations for phytonutrients and functional foods as means of improving the health conditions of individuals. Coumarin is considered a phytonutrient and it is valuable to examine its potential to positively contribute to overall health and wellness. Additionally, foods that contain coumarin will be researched in order to design a recipe that works as a functional food.

Abstract
Phytonutrients are naturally occurring compounds found in plants and are thought to promote human health. Phytonutrients are found in fruits, vegetables, grains, legumes, nuts, and tea. Traditional 'essential' nutrients include protein, fat, vitamins, minerals are thought to be essential for life whereas phytonutrients are still under examination. Phytonutrients are believed to improve health in many ways including any following: serve as antioxidants, enhance immune response, enhance cell-to-cell communication, alter estrogen metabolism, convert to vitamin A, cause cancer cells to die (apoptosis), and repair DNA damage caused by smoking and other toxic exposures. (www.webmed.com)

In the last 30 years, many hundreds of phytonutrients have been identified and it is predicted that as nutrition science research continues to develop over 40,000 phytonutrients will be fully catalogued and understood. Currently, phytonutrients are classified by their chemical structure. The main classes of phytonutrients include carotenoids, flavonoids, isoflavones, lignans, monoterpenes, phenolic acids, phytosterols, and hydroxycinnamin acids. (www.whfoods.com)

“Obtaining adequate nutrients from various foods plays a vital role in maintain normal function of the human body,” explains Jian Zhao author of Nutraceuticals, Nutritional Therapy, Phytonutrients, and Phytotherapy for Improvement of Human Health: A Perspective on Plant Biotechnology Application. “These functional or medicinal foods and phytonutrients or phytomedicines play positive roles in maintain well being, enhancing health, and modulating immune function to specific diseases.”
Additionally, Zhao points out that Hippocrates, the well-recognized father of modern medicine once stated, “Let food be they medicine and medicine be they food.” This statement sheds light on the current research being done to examine the relationship between foods, its function, the phytonutrients it contains, and their therapeutic benefits.

The Institute of Medicine’s Food and Nutrition Board defines functional foods as “any food or food ingredient that many provide a health benefit beyond the traditional nutrients it contains.” (Nutriwatch) Functional foods and nutraceuticals are terms often used interchangeably however; a functional food is a more broad term used to describe foods that have been designed or intended with specific purpose. On the other hand, a nutraceutical is used in nutritional therapy and has been scientifically researched and emphasizes an expected result, such as preventing or treating a disease.

One example of a functional food is cinnamon. Cinnamon has been shown to have beneficial importance in controlling blood sugar when using it to season a high carbohydrate food. In a study completed in 2007, cinnamon was shown to slow the rate in which one’s stomach emptied after meals by reducing the rise in blood sugar after eating. The study included 14 healthy individuals who ate 300 grams of rice pudding either along (plain) or seasoned with 6 grams of cinnamon. Those who ate the rice pudding with the added cinnamon lowered their gastric emptying rate from 37% to 34.5% and their rise in blood sugar levels after eating with significantly less than those who ate the plain rice pudding. (Hiebowicz) Additionally research indicates the cinnamon has a positive effect on blood platelets and helps prevent the unwanted clotting of blood platelets. The mechanism for this action is by means of inhibiting the release of the fatty acid, arachidonic acid from the platelet membranes which reduces the formation of inflammatory messaging molecules. Therefore, cinnamon falls in an anti-inflammatory category.

Research has provided science with the proof that cinnamon contains high levels of coumarin. Coumarin is a phytonutrient that belongs to the hydroxycinnamin acids class. It is found in many plants including tonka beans, vanilla grass, sweet woodruff, melluein, sweet grass, cassia cinnamon, and sweet clover. Coumarin has a bitter-taste which may explain why it is often considered an appetite suppressant and historically reduced the impact of animals grazing on the farmlands. As a phytonutrient, coumarin
has been reported to have anti-hypertension, anti-tumor, anti HIV, anti-inflammatory, antiseptic, and pain relief characteristics.

In particular, Ceylon cinnamon contains low levels of coumarin whereas cassia cinnamon contains high levels of coumarin. It is impossible for consumers to distinguish between Ceylon cinnamon and cassia cinnamon in cinnamon powders bought in many grocery and supermarkets. However, it is imperative to note that the FDA recommended the isolated coumarin cannot be added to foods because of its toxicity levels. (Woehrlin) Coumarin is contained in parts of plants and added to flavor foods, such as cinnamon but must be limited to 2 milligrams per kilogram of food.

Research and studies provided by Irena Kostava at the Medical University Bulgaria explains that coumarin have important effects in biochemistry and physiology and may act as antioxidants, enzyme inhibitors, and precursors of toxic substances. Kostava explains that hydrocoumarins are phenolic compounds and act as free radical scavengers that have powerful chain-breaking antioxidants.

Among the coumarins there is a wide range all of which vary in chemical structures, and many different substitutions can be made at the base level. This explains why it may be possible for coumarin to be beneficial in so many different human disorders. The simplest coumarin, a parent molecule, has been reported to prevent the proliferation of a number of human malignant cell lines and has demonstrated activity against different types of animal tumors, explains Kostava. Additionally, this coumarin structure has been reported in clinical trials to demonstrate activity against prostate cancer, malignant melanoma, and metastatic renal cell growth.

Coumarin has anticoagulant properties. In 1878, a connection was made between the clotting mechanism of coumarin and the development of metastases. Research has not confirmed but Kostava presents studies that coumarin has the potential function as an anticoagulant which would inhibit the growth of small-cell lung cancer, and some day may be used in treatment.

Other research includes C. Konstantina’s studies on the anti-inflammatory and antioxidant properties of coumarin. Coumarin has been shown to be able to reduce tissue swelling due to several different stimuli, explains Konstantina in her article *Natural and Syntheic Coumarin Derivatives with Anti-Inflammatory/Antioxidant Activities*. Coumarin
aids in bringing about vasodilatation and enhances blood flow to an affected area, which then permits and enhances the permeability of the capillaries. Coumarin has been used in well-known drugs including warfarin and the name brand, Coumadin. The inflammatory response in coumarin is designed to provide a rapid mechanism by which the host can respond to the invasion of the foreign materials (such as, clotting factors) and return the capillaries and blood flow to equilibrium.

By studying phytonutrients, such as coumarin, and examining the foods that they are found in it is possible to design functional food recipes. Since cinnamon has been reported to have high levels of coumarin it is an advantageous ingredient to add to recipes in order to increase the coumarin levels. Cloves contain coumarin as well, and have similar properties as cinnamon and can be easily included in the same recipes that cinnamon is incorporated into. By increasing the coumarin levels in certain foods such as granola, it may be possible to improve its health benefits while providing anti-hypertension, anti-inflammatory, antiseptic, and pain relief characteristics to these foods.

Materials & Methods:

- Equipment List: 1 large bowl, oven, wooden spoon, saucepan, stovetop, cool rack, storage container
- 4 ½ cups of old fashioned oats
- 1 cup of sliced almonds (optional)
- ½ cup packed light brown sugar
- ½ teaspoon salt
- 1 teaspoon of cinnamon
- 1 teaspoon of cloves
- ½ cup canola oil
- ¼ honey
- 1 teaspoon vanilla extract
- 1 ½ cups raisins

The original recipes only included ¼ teaspoon of cinnamon however, in order to increase the coumarin levels and benefits of the recipe was altered to include 1 teaspoon of cinnamon. For similar purposes, cloves were added to the recipe. By means of improving the health quality of the granola, canola oil was substituted for vegetable oil. The first step in the process of making the granola was to preheat the oven to 300 degrees
and then mix the oats, almonds, brown sugar, salt, cloves, and cinnamon in a large bowl. At this point, the oil and honey were heated in a small saucepan and the vanilla was whisked. As the liquid became evenly blended throughout, it was poured over the dry ingredients and stirred until evenly spread throughout. The next step was to spread the granola on a large (12-by-17-inch) baking pan, and toast the granola in the oven for 40 minutes. In order to make sure it was toasted equally, it was important to remove it from the oven and stir every 10 minutes. Finally, once the granola was removed from the oven the raisins were added. In the cooling process, the granola was transferred to a rack and cooled completely.

Results:

<table>
<thead>
<tr>
<th>Sensory Evaluation</th>
<th>Homemade Cinnamon - Vanilla Granola</th>
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<tbody>
<tr>
<td>Color &amp; Appearance</td>
<td>Even shades of brown, heterogeneous consistency (some clumped oats) woody fragrance</td>
</tr>
<tr>
<td>Texture &amp; Tenderness</td>
<td>Firm, brittle</td>
</tr>
<tr>
<td>Flavor</td>
<td>Cinnamon, spicy yet sweet, bold</td>
</tr>
<tr>
<td>Mouthfeel</td>
<td>Crunchy, dry</td>
</tr>
</tbody>
</table>

Figure I: Tasting and Sensory Observations

Above, Figure I, displays the outcome of the tasting evaluation and observation of the coumarin rich granola. The granola appeared to have consistent shades of brown indicating that it was cooked evenly through. The texture was heterogeneous as some of the oats clumped together and others stood on their own. For some chunky pieces of granola are preferred while other enjoy it more in a breakfast cereal consistency. The granola had a woody fragrance, which was likely due to the cinnamon and cloves. The texture was firm and brittle with a crunchy yet dry mouth feel. The flavor was bold and unique. The cinnamon flavor was quite powerful and it seemed to be spicy yet sweet and bitter.

Discussion:

Overall, the granola with added cinnamon and cloves was approved and enjoyed by the panelists. It is unclear whether the coumarin levels in the granola made in the lab would be sufficient enough for humans to absorb its researched potential health benefits. However, granola is a food that for some is eaten more regularly than others but if consumed in moderate portioned levels can be incorporated into diets of healthy
individuals. Granola is high in fat, and sugar, which is why many might be considered it an unhealthy food and should be consumed in moderation. However, if the recipe is altered to include cinnamon and cloves so that the individual can benefit from the coumarin it may serve as a functional food. Granola is also a useful food to add cinnamon to because many eat it for breakfast and it paired well with fruit and yogurt, as are cinnamon and clove flavorings. It is valuable to recognize that in a study cinnamon reduced the speed of gastric emptying therefore foods such as granola could include cinnamon and therefore provide further health benefits. (Hiebowicz).

While using cinnamon to flavor the granola it is worth noting its connection with metabolic syndrome. Metabolic syndrome is seen when an individual has insulin resistance, elevated glucose and lipid, inflammation, decreased antioxidant activity, increased weight gain and increased glycation of proteins. “Cinnamon has been shown to improve all these variables in vitro, animal, and/or human studies,” explains Dr. Boil Qin author of *Cinnamon: Potential Role in the Prevention of Insulin Resistance, Metabolic Syndrome, and Type 2 Diabetes*. “However, not all studies have shown positive effects of cinnamon, and type and amount of cinnamon, as well as the type of subjects and drugs subjects are taking, are likely to affect the response to cinnamon.”

Conclusion:

Dr. Qin’s point speaks directly to the need for further research on whole foods and phytonutrients, and their health benefits. While light has begun to be shed on phytonutrients such as coumarin and functional foods such as cinnamon and the benefits when incorporated into a regular diet the verdict is still out there. While cinnamon and coumarin both have impressive health promoting characteristics and qualities there is still room for research to confirm the big picture. It is imperative to further understand how these nutrients work by means of preventative care and their interaction with other foods, varying individuals, as well as medications and drugs.

References:


