FRP-043-01-01-15
April 29, 2014

How balsam fir helps liver cells balance their sugar-making and storage activities*

Purpose

Our earlier studies suggested that balsam fir (*inaast*) could affect how much sugar the liver makes and stores. This study tried to identify the active ingredients in balsam fir that produce this effect, and figure out exactly how they do it.

Background

We know that, in diabetes, a person's muscle cells do not respond to insulin properly. But diabetes also affects how much sugar our livers make, and how much of it gets stored instead of being put into the bloodstream. In our earlier lab tests, balsam fir stood out for its ability to help with sugar balance in the liver. It decreased how much sugar got made, and increased how much of it was stored. Both of these things could help with diabetes. In this study, Abir took a closer look at which ingredients in balsam fir produce these effects, and how they produce them.

Methods

Our livers use a multi-step process to make sugar—one that involves many different chemical actors. The same thing is true of the process for storing sugar. Abir did not measure all these steps. Instead, she chose one crucial step from each process (sugar production and sugar storage), and looked at how balsam fir affects that step. She also looked at three of the chemical "actors" that we know are involved in these steps. These were lab tests, using cells that resemble the ones in human livers.

Which ingredients in balsam fir produce the effects?

Abir broke balsam fir's ingredients into groups, and tested each group for its impact on sugar production and storage. The results led her to conclude that three main ingredients are responsible for most of balsam fir's effects. These ingredients are dehydroabietic acid (DAA), squalene, and abietic acid. Of the three, DAA had by far the largest effects. Other scientists have already looked at these three ingredients, and found them to have properties that could help with diabetes.

From there, Abir took a closer look at each of these ingredients, to find out

- Exactly *how* they help reduce how much sugar a liver cells makes; and
- How they help liver cells to put more sugar into storage.

How do these ingredients act on sugar production?

How do these three ingredients work inside the cells to decrease sugar production? Abir found that they use two paths—the same path that insulin uses, plus another one that does not involve insulin. Specifically, all three ingredients act on an agent called Akt (the insulin pathway) and another agent called AMPK (the other pathway). Both paths influence the sugar-production process.

How do these ingredients work to increase sugar storage?

All three of the ingredients affected sugar storage. The first two ingredients had about as much effect as insulin does. The third ingredient (and the plant tea as a whole) had even stronger effects than insulin. Abir's tests suggest that the ingredients work by acting on an agent called GSK-3, which helps set off a crucial step in the cycle by which sugar gets stored.

In sum, Abir re-confirmed that balsam fir affects the way liver cells make and store sugar (at least in the lab). And she found that those effects are produced by three ingredients, especially one called DAA. Knowing the active ingredients may help in future, if the Cree need to test different batches of balsam fir tea for potency. The ingredients might also serve as the basis for new anti-diabetic medicines, if the effects we see in lab tests prove to hold true in live animals.

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[*] This is a plain-language version of an article by Abir Nachar, Ammar Saleem, John Arnason, and Pierre Haddad, called "Regulation of hepatic glucose homeostasis by dehydroabietic acid, abietic acid and squalene isolated from balsam fir (*Abies balsamea* (L.) Mill.) a plant of the Eastern James Bay Cree traditional pharmacopeia."

This summary is presented to the Research Committee and Elders for information only, since it follows from previous studies that have already been formally approved, and makes no new disclosures of traditional knowledge.