

## **New Zealand ferns as a source of polyunsaturated fatty acids**

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# Arachidonic acid in ferns

- “Arachidonic and related fatty acids which normally are found in animals or microorganisms have been isolated and identified from several mosses and ferns” – the first reference: H.Schlenk & J.L.Gellerman (1965) JAOCS 42:504-11
  - 5 species, 2-11% AA (of total fatty acids), EPA
- W.G.Haigh et al. (1969) BBA 176:647-50
  - 3 species, 4-12% AA, acids up to C28:0
- G.R.Jamieson & E.H.Reid (1975) Phytochemistry 14: 2229-2232
  - 4 species, 4-13% AA, in “more polar” lipids, seasonal variations



# Arachidonic acid in ferns

- A limited number of publications
- Metabolism of AA in plants discussed by R.L.Wolff, W.W.Christie et al. (1999) Lipids 34: 1083-1097
- It is possible that some ferns may serve as a source of valuable polyunsaturated fatty acids
- New Zealand possesses over 160 species of ferns, but lipids of only few of these species were studied.
- We investigated lipid content and fatty acid composition in leaves of 6 common New Zealand ferns.



# Lipid content of fresh fronds

- Lipid content in leaves varied from 0.6% of wet weight in *Pyrrosia eleagnifolia* to 2.3% in *Cyathea dealbata*:
  - Asplenium oblongifolium 1.0%
  - Blechnum novae-zelandiae 0.9%
  - Cyathea dealbata 2.7%
  - Phymatosorus pustulatum 1.3%
  - Pteridium esculentum 2.0%
  - Pyrrosia eleagnifolia 0.6%

# AA in *C.dealbata*: extraction/derivatization vs. direct transesterification



- Conventional (Folch extraction, FAME after Carreau & Dubacq, 1978): 7.7%
- Method 1 (Lepage & Roy, 1986): 5.5%
- Method 2 (Browse et al., 1986): 4.7%
- Method 3 (Garces & Mancha, 1993): 5.7%
- Method 4 (Alves et al. 2008): 4.8%



# Fatty acid composition

- Major fatty acids found in all samples studied were palmitic (17.1-36.7% of total fatty acids), oleic (5.2-49.0%), linoleic (0.2-26.6%), arachidic (1.2-15.3%), behenic (1.5-8.4%), and lignoceric (1.4-22.7%).
- A number of samples contained linolenic (up to 27.1%), arachidonic acid (AA, up to 8.8%), and/or eicosapentaenoic acid (EPA, up to 2.9%).
- Polyunsaturated fatty acids comprised from 0.8 to 54.6% of total fatty acids.

# *Phymatosorus pustulatum*, hounds tongue fern



- The lowest level of polyunsaturated fatty acids was observed in *Phymatosorus pustulatum*, 0.8%.
- This fern was the most abundant in saturated fatty acids - 90.6% of total fatty acids (mostly palmitic 36.7%, lignoceric 22.7%, arachidic 15.3%, and behenic 8.4%).
- No AA or EPA was observed in this fern.



# *Pyrrosia eleagnifolia*, leather-leaf fern

- Saturated acids - 45.9%
- Monoenoic acids – 42.4%
- Dienoic acids – 10.6%
- Only 0.3% of arachidonic acid, no eicosapentaenoic acid





## AA and EPA

- When (AA) was present in the fern leaf sample, its content was always higher than that of EPA.
- The highest content of AA found was in *Asplenium oblongifolium*, shining spleenwort - 8.8% of total fatty acids, while the level of EPA in this fern was low (0.2%).

# *Blechnum novae-zelandiae*, Kiokio



- Major fatty acid – 18:3n-3, 27.1%
- Saturated acids - 41.4%
- Monoenoic acids – 7.0%
- Dienoic acids – 10.3%
- Trienoic acids – 31.9%
- Elevated AA content, also possessed also a significant proportion of EPA:
  - 7.6% AA
  - 1.8% EPA

# *Pteridium esculentum*, Bracken



- The lowest level of saturated fatty acids was found in *Pteridium esculentum* (total saturated 25.8%, palmitic 17.1%).
- This fern had the highest oleic acid level of the samples studied, 49% of total fatty acids.
- AA – 2.9%, EPA – 0.3% of total fatty acids



## *Cyathea dealbata*, silver fern

- A common silver tree fern, *Cyathea dealbata*, had the highest lipid content of the samples studied, 2.7% of wet weight.
- Readily available at large quantities.
- Arachidonic acids – 7.7%,  
eicosapentaenoic acid – 2.9%



## Next steps

- Studies of seasonal changes in fatty acid composition of fern leaves are in progress
- Non-chromatographic isolation of AA from silver fern supercritical fluid extracts.



# Thank you!

