Sources of 5,11,14-20:3 (sciadonic) Acid, a Structural Analog of Arachidonic Acid

Sir:

It has been shown (1) that dietary 5,11,14-20:3 (sciadonic) acid extensively replaced arachidonic (5,8,11,14-20:4) acid in mice hepatic phosphatidylinositol, indicating that the Δ8-ethylenic bond is not necessary for the acylation of this phospholipid. More generally, this acid, along with juniperonic (5,11,14,17-20:4) acid, affects lipid metabolism in the rat (2); this peculiar fatty acid may provide a unique nutritional tool for determining the metabolic consequences of acyl alteration *in vivo* (1). In these experiments, sciadonic acid was fed to rats as a component of *Biota orientalis* (also known as *Thuja orientalis*, *Platycladus orientalis*, or oriental arbor vitae) seed oil, in which it is a minor constituent (*ca*. 3% of total fatty acids). Otherwise, this oil is rich in α-linolenic acid (approximately 40%), and it contains in appreciable amounts (*ca*. 9%) another Δ5-olefinic acid of the n-3 series, the 5,11,14,17-20:4 acid. Qualitatively, these characteristics are typical for seeds of the family Cupressaceae, to which *B. orientalis* belongs. Owing to the competition of α-linolenic acid and linoleic acid at the level of the Δ6-desaturase, the interpretation of experiments using *B. orientalis* seed oil is thus complicated. Consequently, we looked for other sources of sciadonic acid, with four criteria in mind:(i) commercial availability of the seeds, (ii) abundance of oil in the seeds, (iii) content of sciadonic acid in the oils, and (iv) absence of α-linolenic and juniperonic acids. Although sciadonic acid may occur in a few rare angiosperm species, it is a common constituent of gymnosperm seeds. With regard to the commercial availability of the seeds, we found three sources, two in the United States, Lawyer Nursery, Inc. (Plains, MT) and F.W. Schumacher Co., Inc. (Sandwich, MA), and one in Europe, Sandeman Seeds (Pulborough, Great Britain), but other tree seed sellers surely exist. After having screened approximately 170 conifer species (corresponding to *ca*. 30% of all extant species), we selected the species mentioned in Table 1 (3–6). All these species have seeds with a moderate to high content of oil, with usable levels of sciadonic acid, and they are practically devoid of α-linolenic acid (≤2%) and juniperonic acid (≤0.5%, except *Sciadopitys verticilatta*, 2%). When considering the content of sciadonic acid relative to the weight of seeds (mg/g), the best source is *Podocarpus andinus* (its seeds contain almost 18 times more sciadonic acid than those of *B. orientalis*, i.e., 107 mg per g of seeds), but when considering the percentage of sciadonic acid relative to total fatty acids, the best source is *Podocarpus nagi* (26.4%, which is eight times more than in *B. orientalis* seed oil). We included two *Pinus* species, in particular *P. pinaster*, the seed oil of which is the richest in sciadonic acid among 75 pine species analyzed (from Europe, Asia, and North and Central America). Moreover, the seeds of *P. pinaster* are collected in the southwest region (the Landes) of France on a multi-ton scale and thus easily available in large quantities (e.g., from I.E.M., Vendays-Montalivet). The sciadonic acid content of *P. koraiensis* seeds is identical to that of *B. orientalis*, but here too, the seeds are easily available, being sold in supermarkets for edible purposes. They are also available from the Chinese wholesaler Da Yu Chemistry Co. Ltd., Shanghai. Most interesting, the oil from *P. koraiensis* (cold pressed) is produced in France (Société Bertin, Lagny-le Sec) for cosmetic use. For these two *Pinus* species, it may also be feasible to increase the level of sciadonic acid by appropriate chemical (7) or enzymatic (8) means, but this acid will be accompanied by large

TABLE 1
Sources of 5,11,14-20:3 (sciadonic) Acid[a] Selected Among 170 Conifer Species

		Sciadonic acid content and purity		
Species	Oil content[b]	% of total fatty acids[c]	mg/g of seeds[d]	% of total Δ5-olefinic acids
Torreya grandis	51.7	11.2	55	91.4
T. nucifera	49.7	6.7	32	88.5
Cephalotaxus drupaceae[e]	65.5	9.9	62	90.6
Podocarpus andinus	67.3	16.7	107	95.4
P. nagi	30.8	26.4	77	99.4
Pinus koraiensis	67.0	0.9	6	5.1
P. pinaster	36.0	7.1	26	45.1
Sciadopitys verticillata	37.1	15.1	53	78.7
Biota orientalis	18.0	3.3	6	25.7

[a]The complete fatty acid compositions are given in References 3–6.
[b]Weight percentage relative to the dehulled seeds, except for *S. verticillata* and *B. orientalis*. The oils were solvent-extracted.
[c]Determined by gas–liquid chromatography of fatty acid methyl esters prepared with the crude oils.
[d]Calculated.
[e]Other interesting *Cephalotaxus* species with similar characteristics are *C. fortunei, C. sinensis,* and *C. harringtonia.*

amounts of pinolenic (5,9,12-18:3) acid, the generally prominent Δ5-olefinic acid in the genus *Pinus*, which may complicate the purification of sciadonic acid. In the seed oil from other conifer species in Table 1, with the exception of *B. orientalis*, sciadonic acid represents between 78 (*S. verticillata*) and 99% (*P. nagi*) of total Δ5-olefinic acids, which is a supplementary advantage for its purification. In conclusion, regarding both the percentage of sciadonic acid in the oils and its purity relative to total Δ5-olefinic acids, the best sources of sciadonic acid among all conifer species analyzed so far are the seeds from *P. andinus* and *P. nagi*. However, owing to their availabilty and their oil characteristics, *P. pinaster* seeds also appear as a good source of sciadonic acid. If the cost is considered, *P. pinaster* seeds may be economically advantageous: their price is approximately 30–35 U.S.$/kg, similar to that of *B. orientalis* seeds (depending on the supplier), whereas that of *P. nagi* seeds, for example, is *ca*. 110 U.S.$/kg.

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