Assessment of Western Australian sandalwood seeds for seed oil production

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Summary

The Western Australian sandalwood (*Santalum spicatum* R.Br.) industry is transforming into an agro-forestry industry in which the seeds are being considered as a valuable secondary income-generating product. Oil extracted from the seeds has a potential use in the cosmetic industry. This study aimed to identify the quality parameters for seeds to obtain oil of better and consistent quality, and the effect of seed source, seed size and storage time.

Different seed samples varied in oil content, moisture content and fatty acid profile. Larger seeds from plantation trees in the wheatbelt region of Western Australia are the most suitable source of seed oil thus far evaluated.

The seed grading system currently used by the sandalwood industry was suitable for selecting seeds from plantations (but not from natural stands in arid regions—'wild wood') for seed oil production. Basic parameters for the selection of seeds for oil extraction were identified.

Keywords: ximenynic acid; seed oils; sandalwood; Western Australia

Introduction

The genus *Santalum* comprises some 25 species the natural occurrence of which extends from India to Australia and the Pacific Islands. Of the six species in Australia, five are endemic. The exception is Indian sandalwood, *S. album*, introduced in relatively recent times (George 1984). Western Australian sandalwood (*S. spicatum* R.Br.) is naturally found in most parts of Western Australia (WA). It is absent in the forests of the south-western temperate and northern tropical regions. It occurs in some relatively dry parts of South Australia (Fox 2000). *Santalum* species are root parasitic shrubs to small trees; they depend upon host trees for nutrition throughout their life.

Western Australian sandalwood is an important commercial timber crop. It is the source of more than half the sandalwood used globally. Its aromatic heartwood is used to produce essential oil and for other traditional uses such as agarbatti (Joss stick) manufacture and ornamental carvings. Most Western Australian sandalwood is harvested sustainably under state government supervision from natural stands (wild wood) in state forests and other reserves. Wild wood alone cannot satisfy the growing global demand for sandalwood. To meet this demand, plantations have been established by the state of WA (the Forest Products Commission, FPC) and private farmers, mostly located in the wheatbelt region of WA (Jones 2002). This area has a semi-arid climate with annual rainfall of 500–600 mm. Sandalwood is a slow-growing tree and requires at least 20 years to yield a significant quantity of heartwood. Plantations currently provide no secondary income from agistment over these long rotations as the foliage of the trees is highly palatable and consequently subject to browsing, but their seeds have been identified as a potential source of additional income for growers.

The fruit of *S. spicatum* is a spherical (15–22 mm) drupe. The innermost kernel is white, oily and edible. This is enclosed by a smooth woody endocarp that must be broken to access the kernel. The outermost layer of the fruit is initially green and hard; on ripening this becomes brown and disintegrates on the ground after fruitfall (Fox 1992). The successful establishment of plants, fruit-bearing by 1992, allowed a comparison of the fruit from different trees. Mean quantities, mass and diameter of fruit and kernel produced on some 30 established trees in the period 1989–1992 (Barrett and Fox 1995) were observed to vary such that it was considered selection between provenances for significant traits could yield considerable improvement. Kernels were found to contain 50–60% of lipids (Hatt 1956), and further research into this seed oil has found that it contains ximenynic acid (XYMA), a rare acetylenic fatty acid (Liu 1996).

Initial pharmacological studies of this oil revealed it produced no toxicity or pathological damage in mice, but reduced fat deposition in adipose tissue and stimulated the enzymes of lipid metabolism (Liu and Longmore 1997). Other studies of XYMA found it to alter the cytochrome P-450 enzyme in rats, indicating a pharmacological change in the hepatic metabolism (Jones *et al.* 1999). The ethyl ester of XYMA has been associated with microvasular kinetic properties, which could be beneficial in treatment of varicose veins (Bombardelli *et al.* 1994).

As global demand for novel cosmetic agents is ever increasing, sandalwood seed oil could enter the market as a cosmetic ingredient that could also act as a vehicle for other oil-soluble agents (Hettiarachchi *et al.* 2010). Studies continue on oxidative