

Sandalwood Seed Oil

Anti-inflammatory Activity of Sandalwood Seed Oil

Sandalwood Seed Oil

Sandalwood Seed Oil is the supercritical carbon dioxide extract of the Australian Sandalwood (*Santalum spicatum*) seed kernel. This oil is rich in a rare acetylenic fatty acid, known as Ximenynic Acid, which accounts for over 30% of the total fatty acid composition. The major fatty acid in Sandalwood Seed Oil is oleic acid as commonly found in many seed oils used for skin care.

| Fatty acid | Carbon chain | Composition (% w/w) |
|-----------------------|----------------|---------------------|
| Saturated fatty acids | (< C16) | <0.1 % |
| Palmitic acid | 16:0 | 3.0 to 3.5 % |
| Palmitoleic acid | 16:1 (n-7) | 0.2 to 1.0 % |
| Stearic acid | 18:0 | 2.0 to 3.5 % |
| Oleic acid | 18:1 (n-9) | 50.0 to 53.0 % |
| Linoleic acid | 18:2 (n-6) | 1.7 to 2.0 % |
| ?-Linoleic acid | 18:3 (n-3) | 2.5 to 3.5 % |
| Stearolic acid | 18:1 (9a) | 1.0 to 2.0 % |
| Ximenynic Acid | 18:2 (9a, 11t) | 28.5 to 36.5 % |

Table 1: Fatty acids as percentage of total composition of Sandalwood Seed Oil (Hettiarachchi et al., 2013).

Ximenynic acid has a triple bond at the 9th position and a trans isomer double bond at the 11th position (Liu et al., 1996). This unique fatty acid is not metabolised in the same way as other unsaturated fatty acids, thus resulting in a xenobiotic effect on tissues. (Liu and Longmore, 1997).

Inflammation

Inflammation is the body's reaction to external or internal stimuli resulting in pain, swelling, redness and heat. Inflammation on skin can be an acute or a chronic condition, where most of the symptoms are recognised as signs of aging, stress, environmental or sun damage.

Inflammation is facilitated through an internal mediator biochemical group known as prostaglandins. Among the prostaglandins, prostaglandin class E (PGE) is more prevalent as a mediator of inflammation. Prostaglandins are made in-situ upon stimulation through a process called eicosanoid synthesis. The cellular fatty acid, arachidonic acid, is converted into PGE through a series of enzyme mediated reactions. Arachidonic acid is an Omega-6 (ω -6) fatty acid with unsaturation at 5, 8, 11 and 14 on a 20 carbon chain. This process can be terminated in different pathways; the most commonly used method is blocking enzymes by binding irreversibly to hinder the inflammation process (Lawrance et al., 2002; Nugteren, 1987).

Anti-inflammatory action of Ximenynic Acid

Enzymes reacting with arachidonic acid have been found to bind at their saturated 9th position of long chain fatty acids which are usually a double bond. Ximenynic Acid is a natural C18 fatty acid with a triple bond at its 9th position. When Ximenynic Acid binds to arachidonic acid it does so irreversibly; this binding is unable to convert or detach. This action hinders the entire local inflammation process of producing prostaglandin mediators and other downstream products of the arachidonic acid pathway (Nugteren, 1987). There are other therapeutic agents which block this process, but very few are in the form of a natural lipid which is readily absorbed trans-dermally and distribute similar to the prostaglandin precursor arachidonic acid.

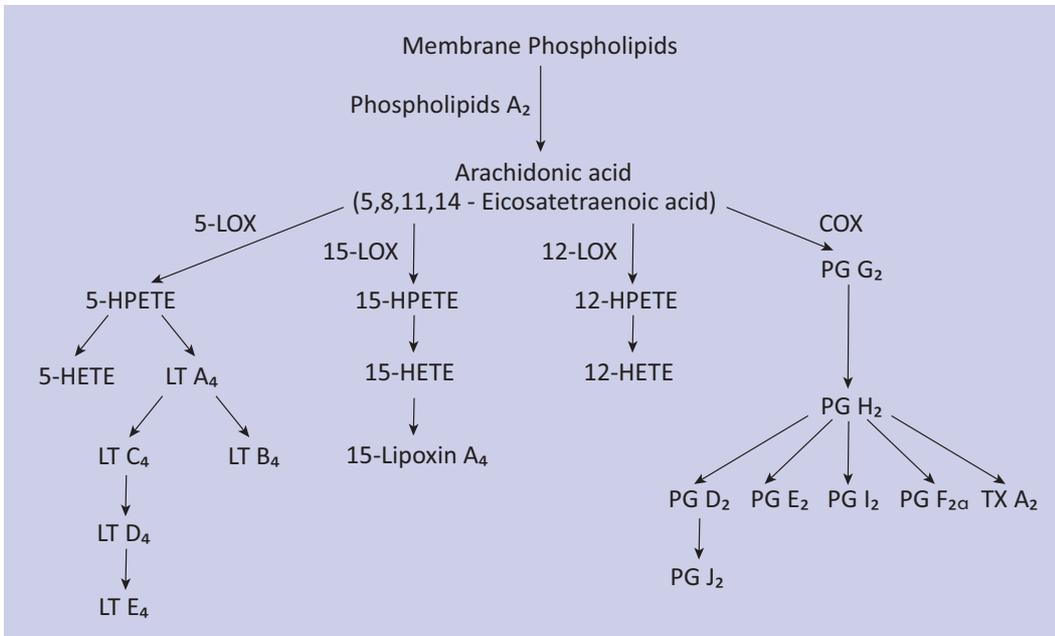


Figure 1: Arachidonic acid pathway of lipid derived inflammatory mediators; COX, Cyclooxygenase; PG, Prostaglandins; TX, Thromboxane; LOX, Lipoxygenase; HPETE, Hydroperoxy eicosatetraenoic acid; HETE, Hydroxyeicosatetraenoic acid; LT, Leukotrienes

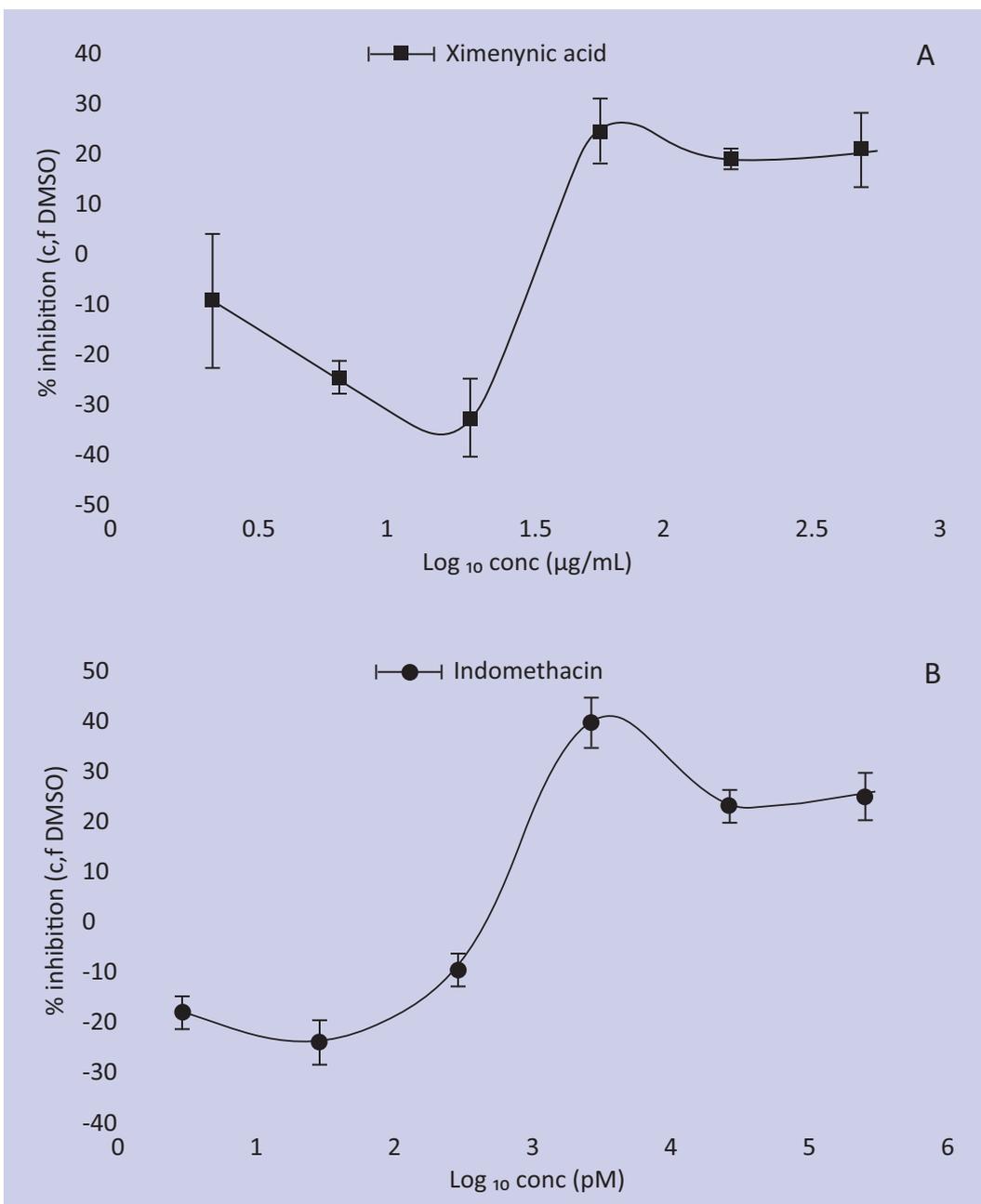


Figure 2: The dose-response curve for (A) Ximenynic Acid shown in comparison with that of (B) indomethacin

Sandalwood Seed Oil as a natural oil with anti-inflammatory properties

Sandalwood Seed Oil is a natural blend of Ximenynic Acid and oleic acid with minor quantities of other common fatty acids. Ximenynic Acid and oleic acid forms several triglyceride species in natural form of the seed kernel.

The supercritical extracted oil contains the same triglycerides with low free fatty acids. It has been found that neither the Sandalwood Seed Oil nor the triglycerides show any anti-inflammatory activity; only the free Ximenynic Acid shows such activity.

Sandalwood Seed Oil in its triglyceride form needs to be hydrolysed to release the active free Ximenynic Acid. Ximenynic Acid in its free form shows anti-inflammatory activity and a low level of toxicity. Upon hydrolysis, the majority of the free fatty acids are of oleic acid, a common ingredient in many cosmetic preparations. Hydrolysed Sandalwood Seed Oil exerts the effects of Ximenynic Acid while balancing the emollient and soothing effects of oleic acid.

Effective concentration of Sandalwood Seed Oil in a formulation

Sandalwood Seed Oil exhibits the physicochemical characteristics of general seed/vegetable oils. The active

free Ximenynic Acid is produced only upon hydrolysis; otherwise the level of anti-inflammatory activity depends upon the natural or intentional hydrolysis of the oil. Ximenynic Acid is reported to be active at a concentration of 0.004% w/w at the in-vitro cellular level. Formulations containing pure Ximenynic Acid are limited to 0.5% w/w in semisolid formulations. Considering the hydrolysis occurring in emulsions and the level of Ximenynic Acid in Sandalwood Seed Oil, it is suitable to suggest 7% w/w of Sandalwood Seed Oil in total preparation as an effective concentration.

Summary

Sandalwood Seed Oil is a reliable source of Ximenynic Acid which is an established anti-inflammatory lipid. This rare active oil can be formulated and delivered in a similar manner to normal carrier oils. Having excellent stability and favourable physicochemical characteristics, Sandalwood Seed Oil may offer the Personal Care Formulator an exciting ingredient with anti-inflammatory activity on skin together with the known emollient and nourishing properties of oleic acid (Hettiarachchi et al., 2014).

References

- Croft, K. D., Beilin, L. J., Ford, G. L. 1987. Differential inhibition of thromboxane B2 and leukotriene 84 biosynthesis by two naturally occurring acetylenic fatty acids. *Biochimica et Biophysica Acta (BBA) - Lipids and Lipid Metabolism*, 921, 621-624.
- Hettiarachchi, D. S. 2014. *Pharmaceutical Evaluation of Sandalwood Seed Oil*. Doctor of Philosophy, Curtin University.
- Hettiarachchi, D. S., Liu, Y. D., Boddy, M. R., Fox, J. E. D., Sunderland, V. B. 2013. Contents of Fatty Acids, Selected Lipids and Physicochemical Properties of Western Australian Sandalwood Seed Oil. *Journal of the American Oil Chemists' Society*, 90, 285-290.
- Lawrance, T., Willoughby, D. A., Gilroy, D. W. 2002. Anti-inflammatory lipid mediators and insight into the resolution of inflammation. *Nature Reviews Immunology*, 2, 787-795.
- Li, G., Singh, A., Liu, Y., Sunderland, B., Li, D. 2013. Comparative Effects of Sandalwood Seed Oil on Fatty Acid Profiles and Inflammatory Factors in Rats. *Lipids*, 48, 105-113.
- Liu, Y., Longmore, R. B. 1997. Dietary Sandalwood Seed Oil Modifies Fatty Acid Composition of Mouse Adipose Lipids, 32, 965-969.
- Liu, Y. D., Longmore, R. B., Fox, J. E. D. 1996. Separation and identification of ximenynic acid isomers in the seed oil of *Santalum spicatum* R. Br. as their 4, 4-dimethylxazoline derivatives. *JAOCS, Journal of the American Oil Chemists' Society*, 73, 1729.
- Nugteren, D. H. 1987. Naturally occurring conjugated octadecatrienoic acids are strong inhibitors of prostaglandin biosynthesis. *Prostaglandins*, 33, 403.

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Down Under Enterprises, with operations in the US and Australia, provides pure Australian essential oils to customers around the world. Our roots are in Tea Tree Oil (*Melaleuca alternifolia*), but we also offer a full range of 100% pure Australian Essential Oils and Carrier Oils, many of which are US Department of Agriculture (USDA) Certified Organic.

We only deal with Australian essential oils and carrier oils directly from the source - our family and friends - who own and operate plantations across Australia. When you work with Down Under, you're working with the direct link to the farmer, with access to our full distribution facilities in Australia and in North America.

Down Under Enterprises has always focused on providing clients with superior quality - always 100% - pure Australian ingredients, and we back it up with the best Customer Support in the industry.

Down Under Enterprises is accredited by the Australian Tea Tree Industry Association (ATTIA) Code of Practice (CoP), offering exclusively Pure Australian Tea Tree Oil®. This distinctive logo is the assurance you are getting the very best quality Tea Tree Oil - pure, true and unadulterated Australian Tea Tree Oil.



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