Nuvistix BioProjects

Literature Pointers to the Potential for Unusual Fatty Acids from Plant Seed Oils

Innovations in pharmaceuticals, functional foods, cosmetics, crop protection agents, adjuvants and other formulants could all potentially come from unusual fatty acids which are currently generally unknown or undervalued. These are present in the seed oils of plants with the potential to develop as niche crops in the UK. This is a brief overview of some of the potential for unusual fatty acids already reported in academic and patent literature.

Major oilseeds and their common fatty acids

Oily seeds from crops such as soybeans, sunflower, cotton, oil palm and rapeseed are major world food and animal feed commodities, and their oils have also become feedstocks for biodiesel and various biomaterials. Oils of these species contain fatty acid molecules with predominantly 16 or 18 carbon atom chains and zero, one or two double bonds, *eg* palmitic, stearic, oleic, and linoleic acids. Other common fatty acids include lauric and myristic acids, with 12 and 14 carbon atom chains, respectively, usually sourced from coconuts.

Niche crops

In Europe, new niche oilseed crops have been introduced from time to time, *eg* borage and evening primrose for their oils rich in gamma linolenic acid (C18:3)[1] in the 1980s. Health and nutritional benefits have been ascribed to GLA.

More recently, crambe has been developed for its oil rich in erucic acid (C22:1); and there has been interest in marigold seed oil for calendic acid. Erucic acid is useful as a lubricant and paint additive. Calendic acid (C18:3) has three conjugated double bonds and is useful in the manufacture of paints and coatings because it 'dries' (oxidises) quickly on exposure to air.

Marigolds: a source of calendic acid

[1] This is shorthand for 18 carbon atom chain length with 3 double bonds

Properties and applications of unusual fatty acids

Many other fatty acids have been identified in plant seed oils. In addition to often longer carbon chains, these potentially undervalued fatty acids include those with double bonds in various positions and the presence of functional groups. Good examples of such exotic fatty acids are the long chain nervonic acid (C24:1) and the more chemically complex dimorphecolic acid (C18:2).

Nervonic acid is involved in the biosynthesis and maintenance of nerve cell myelin. There is growing interest in its potential for the treatment of neurological diseases, including multiple sclerosis and dementia, as well as to aid cerebral development in babies who have not been breast-fed. In Canada, a GM brassica crop has been engineered to produce nervonic acid. Certain derivatives of this fatty acid have been claimed to possess anti-inflammatory and immunomodulatory activity.

Dimorphecolic acid, although with the same carbon chain length as linoleic acid, a common polyunsaturate, and similarly possessing two double bonds, one of these is in a different position. Different isomers of dimorphecolic acid may be in *cis* or *trans* conformation around the other double bond, giving the molecule distinctly different shapes. In addition, dimorphecolic acid is hydroxylated. Besides anti-bacterial activity, it has been noted as having potential uses in the manufacture of surface coatings, plastic foams, lubricants and surfactants. It can be used in the synthesis of flavours and fragrances, and also of a commercial insect sex pheromone. Several other fatty acids are also active as pheromones or used as starting materials, including lignoceric and vernolic acids.

Unusual fatty acids with potential uses in pharmaceuticals include sterculic acid (containing a cyclopropene group) which is a Δ-9-desaturase inhibitor. After its administration, changes in fatty acid ratios in body fat have been reported to effect the growth of breast tumours. Gondoic acid has been observed to inhibit lipid absorption.

Nutrition is another area of potential innovation. There are literature reports of animal feeding studies using plant oils, *eg* rich in vaccenic acid, to lactating animals with a view to improving the human nutritional properties of their milk. Stearidonic acid is an omega 3 fatty acid used in functional foods and usually sourced from blackcurrants, but present in other seed oils too.

The long chain behenic acid has many 'well-being' uses and is also used as a smoothing agent in cosmetics. Gondoic and gadoleic acids have been included in patented preparations which claim anti-aging properties. Apart from biological activity *per se*, common fatty acids such as oleic acid are well known adjuvants. Lipophilicity and molecular shape are undoubtedly important properties in this respect. Gondoic, vaccenic and malvalic acids have all been reported as facilitating skin penetration of drugs or increasing membrane fluidity.

Some fatty acids found in reasonable quantities in seed oils which seem to have received little attention from their sparser literature include the allenes: laballenic and lamenallenic acids. Many other fatty acids including taxoleic, alpha-eleostearic, ranunculeic, paullinic, phlomic, podocarpic, juniperonic, cetoleic, cerotic, epoxyoleic and 2-hydroxysterculic have been noted to be present in other species.

Nuvistix BioProjects and plant sources of unusual fatty acids

Nuvistix works with partners including Herbiseed who specialise in botanical and agronomic aspects of unusual plant species: researching and developing new crops; identifying and testing diverse biotypes and alternative botanically related species to find better sources; and supplying high quality seed and plant material. Extensive literature searching has revealed potential sources of unusual and diverse fatty acids from species generally regarded as 'weeds' but with potential to develop as new niche crops. We are looking to work with supply chain partners already involved in existing markets for these fatty acids and downstream derivatives, or interested in seeking new ones.