High Oleic, low linolenic (HOLL) specialty canola development in Australia

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Abstract

The development of High Oleic, Low Linolenic acid (HOLL) canola is a high priority for the Australian oilseed industry. HOLL canola oil, with >65% oleic acid content and <3% linolenic acid content, has increased oxidative stability compared with conventional canola oil. The demand for a stable, healthy oil that can replace hard fats commonly used in the fast food industry has increased with the mandatory labelling of trans fat content and an increased health awareness being observed in many parts of the world. Of the more than 40 cultivars currently available in Australia, only 5 are HOLL specialty canola, and most in limited availability. This number is expected to increase in coming years, with the development of herbicide tolerant and hybrid HOLL cultivars. It has been estimated that in the domestic market more than 50,000 tonnes of oil could replace hard fats that are currently imported. This would be worth an extra $25 million annually to the oilseed industry in Australia. The Department of Primary Industries – Victoria, in collaboration with Cargill Specialty Canola Oils, are working on developing agronomically suitable HOLL cultivars for Australia. The first two cultivars from this collaborative program were released in 2006, with two replacement cultivars now in commercial seed production. Cargill 102 and Cargill 103 (due for release in 2007) have yields competitive with other conventional mid canola cultivars combined with high provisional blackleg ratings.

Key words: Specialty oils, HOLL, *trans* fatty acids, hydrogenation, deep frying, oxidative stability, yield, blackleg

Introduction

Australian oilseed breeders are seeking to ensure the sustainability and competitiveness of the Australian canola industry through the development of specialty oilseed *Brassica* cultivars with a range of maturities adapted to diverse growing regions of Australia. The Australian domestic market is beginning to see a trend towards healthier foods, as major food companies switch from hard oils high in saturated fats, to soft oils low in saturated fats, and high in mono- or poly- unsaturated fats (AOF Strategic Plan, 2005). The production of High Oleic, Low Linolenic acid (HOLL) canola has been identified as a high priority for the industry, as HOLL canola oil offers increased health benefits to alternative oils. In particular the development of HOLL canola suitable to the Australian environment will benefit the industry by enabling replacement of the hard fats previously imported and increase the opportunities for domestic processors. It is estimated that if the current usage of hard fats (palm and tallow) was replaced there could be a market for more than 50,000 tonnes of HOLL canola, worth an estimated $25 million to the Australian Oilseed industry annually (AOF Strategic Plan, 2005). While the availability of such cultivars is currently limited, the increased demand for this product has resulted in an increased focus on developing HOLL canola in Australia.

HOLL Canola

Traditional canola oil is very low in saturated fats (7%). It typically has approximately 60% of the monounsaturated fatty acid oleic acid, with around 20% and 10% of the two polyunsaturated fatty acids linoleic and linolenic acids, respectively. Canola oil is highly popular in the domestic market, and recognised by consumers as a healthy oil for use in their general food preparation. The high level of polyunsaturated fatty acids renders the oil fully liquid at room temperatures. However, as with many highly unsaturated oils, it has decreased oxidative stability compared to oils high in saturated fatty acids (Strayer, 2006). The lack of stability makes the oil unsuitable for use in long term food preservation or deep frying as the fat can become rancid with time, producing distasteful odours and flavours, thus canola oil is not widely used in commercial applications such as the take away food and restaurant industries. Oxidative stability can be increased through partial hydrogenation of the oil whereby solid fats are produced artificially by heating the oil in the presence of metal catalysts (often nickel) and hydrogen (Ascherio *et al.,* 1999, Strayer, 2006). Partially hydrogenated oils have been used as a replacement for animal fats since the 1960s, when research indicated that a high level of saturated fats in the human diet lead to increases in coronary heart disease (Strayer, 2006). In recent years however, it has been recognised that *trans* fatty acids, produced during partial hydrogenation, can have significant impact on our health and may also contribute to the development of coronary heart disease (Willet *et al.,* 1993). Research indicates that *trans* fatty acids, may in fact be as bad, if not worse for human health than saturated fats. There are suggestions that because of the increase in Low Density Lipoprotein (LDL – 'bad' cholesterol), combined with the reduction of High Density Lipoprotein (HDL – 'good' cholesterol), *trans* fatty acids could be twice as bad for us as saturated fats (Ascherio *et al.,* 1999).

Conventional deep frying oils (e.g. palmolein) are high in saturated fats. Palm oil typically contains 45% palmitic acid, a fatty acid with a high melting point (62.9 ^{o}C) and high oxidative stability. Some market movement toward partially hydrogenated oils (particularly in the snack food and baking industries) has seen a decrease in saturated fats in the diet. The introduction of these oils into food products has exposed the consumer to much higher levels of *trans* fatty acids than they have previously been exposed to when eating meat and dairy products, which contain naturally occurring *trans* fats in very small amounts. With the increased understanding of the role that oils can have on health, consumer trends now show a movement away from saturated fats and a demand for healthy '*trans* fat free' alternatives. The production of oil with increased oxidative stability, low saturated fats, and no *trans* fatty acids would both increase the healthiness of commercially prepared foods and also enable a decrease in imports of foreign oils for use in the Australian food industry.

While conventional canola oil is low in saturated fats, and contains no *trans* fatty acids, its low oxidative stability makes it unsuitable as a replacement oil in the commercial food industry. HOLL canola oil, however, has no trans fatty acids, but has increased oxidative stability, providing an increased frying life (Table 1), without the need for partial hydrogenation.

Table 1. Frying life of different oil products, measured as Active Oxygen Method (AOM) hours

Product	Frying life (AOM hours)
Conventional canola oil	12
Conventional soybean oil	12
Hydrogenated soybean	25
CV65 HOLL	30
CV75 HOLL	34
CV85 HOLL	60

HOLL canola oil refers to High Oleic (>65%), Low Linolenic (<3%) acid. It is the combination of these two parameters that increases the oils oxidative stability compared with conventional canola oil (Figure 1). The frying life of a HOLL product is dependent on the percentage of polyunsaturated fatty acid species in the oil. CV 65 HOLL (>65% oleic acid), CV75 (>75% oleic acid) and CV85 (>85% oleic acid) have increasingly longer frying life than conventional canola (Table 1).

Low linolenic canola has been available in Canada since 1988 when the University of Manitoba released 'Stellar'. Oil evaluation revealed that stability was increased by 17.5% in the accelerated oxidation method test (Scarth *et al*., 1988). Stability has been further increased with the combination of high oleic and low linolenic acids – HOLL canola. There are many minor constituents of oils that could effect stability and flavour of the final product, and therefore accelerated aging and sensory testing should also be performed to ensure flavour and stability are as required.

Historically, the narrow gene pool available in the initial cultivars led to reduced yields. Today this problem has been overcome with improved genetic diversity and hybrid development, putting the specialty canola varieties on par with their conventional counterparts.

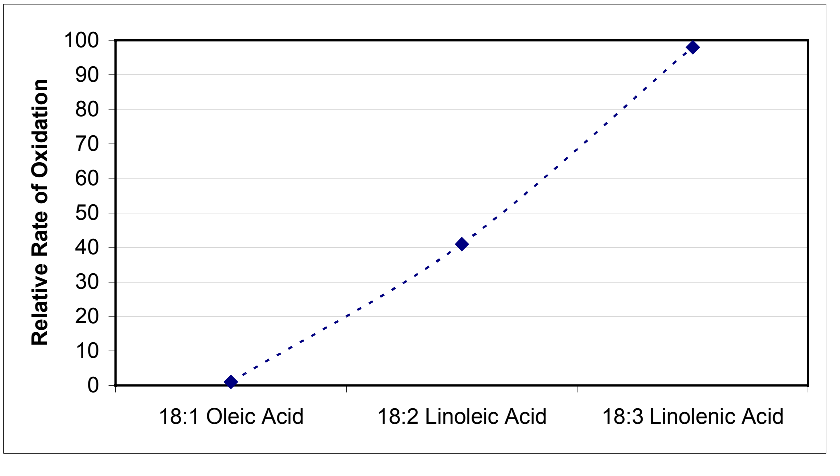

Fig 1. Oxidation rate of different 18 carbon chain fatty acids in conventional canola (values from Frankel, 2005)

Cargill Specialty Canola Oils and Dow AgroSciences now market HOLL canola in Canada, with 1.7 million acres of specialty canola sown in 2005 (Hausmann, 2005) producing about 10% of the Canadian canola production. This is expected to rise to 3 million acres (20% production) in the next 2 – 3 years (Canola Council of Canada, 2006), and that these figures will continue to increase as the awareness of the role of *trans* fat in the diet increases. Currently *trans* fat content must be labelled separately from other fats on product packaging in the USA and Canada, and the United States Food and Drug Administration (USFDA) recommends a zero daily intake of *trans* fat. Many food manufacturers are in the process of reformulating existing brands with HOLL canola oils, and it is expected than many new products will become available over the next several years. In Denmark no foodstuffs may be sold which contain more than 2 grams of *trans* fat per 100g of fat (i.e. no more than 2% *trans* fat) (Stender and Dyerberg, 2003), and the findings from the Danish Nutrition Council have been submitted to the EU for consideration. To date New Zealand and Australia have no *trans* fat labelling requirement and only require that the source of fats (animal or vegetable) be listed (FSANZ, 2005).

In Australia three HOLL canola cultivars were commercially grown in 2006. NMC 130 was bred by Nutrihealth, a subsidiary of Nufarm, and released in 2006, with an expected production of 20,000 tonnes this year (Gororo, pers. comm.). The product, marketed as MONOLA is available at supermarkets, and is used in some commercial food preparation ventures. NMC 130 contains 67-72% oleic acid with less than 3% linolenic acid and in 2005 National Variety Trials (NVT) averaged 110% of ^{AV}SAPPHIRE, an Australian mid maturing conventional canola. Nutrihealth expects to release two new HOLL cultivars in 2007, including one with triazine tolerance.

CARGILL 100 and CARGILL 101 were developed as part of a collaborative breeding program in Australia between Cargill Specialty Canola Oils (CSCO) and the Department of Primary Industries Victoria (DPI-Vic). These cultivars were available under limited release in 2006 and were grown in southern NSW under an Identity Preservation (IP) contract. Growers of these lines were paid a premium for delivery of HOLL quality oil, and to allow for the slightly reduced yields compared with conventional mid maturity cultivars. Two replacement cultivars are due for release in 2007. In multi-location trials in Victoria during 2005, the two new cultivars – CARGILL 102 and CARGILL 103 - averaged 100% and 108% of ^{AV}SAPPHIRE. They both have good blackleg resistance with provisional ratings of 8.5 and 8.0 respectively on a 0-9 scale with "0" susceptible and "9" most resistant. Yield, blackleg resistance and oil quality are key breeding priorities for the collaborative program, which expects to have hybrid cultivars for release in 2008, and herbicide tolerant cultivars in the following years.

The Department of Agriculture and Food, Western Australia (AgWA) are also working on the development of HOLL canola suited to Australian conditions. AgWA has one cultivar ready for commercial release, and is in the early stages of developing triazine tolerant HOLL canola (Walton, pers. comm.).

Following extensive multi-site, multi-year agronomic studies, mid season environments with warm ripening temperatures and adequate moisture during seed filling were identified as the major target area for HOLL production. These conditions are required to ensure minimum fatty acid specifications are met on a regular basis. The development of herbicide tolerant and hybrid HOLL cultivars will also increase the potential area of adaptation for HOLL canola. Contract production of HOLL cultivars under identity preservation is also crucial to maintain product quality.

Given the direction the major global food organisations are going, and the current interest in specialty oil canola in Australia, it is expected that the area of HOLL production will continue to increase. The increase is likely to be steady, rather than spectacular, with perhaps 10% of the Australian crop being HOLL cultivars within 5-7 years (White, pers. comm.). This will create a significant market opportunity for Australian growers. The ultimate relative importance of HOLL compared with conventional canola will depend on market demand.

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