Oilseed Rape as a Source of Different Fatty Acids :

an Opportunity or a Challenge ?

Melvyn F. ASKEW
Head of Alternative Crops and Biotechnology Group,
Central Science Laboratory, Sand Hutton,
York, YO41 1MLZ, U.K.

INTRODUCTION

Whilst oilseed rape is not new, cole or colza oil being used to fuel lights during the 1500's, it did not occupy a substantial crop area until about 30 years ago. According to FAO, the Food and Agriculture Organisation of United Nations, lists it is the third most important oilseed in the world in terms of area at present. FAO statistics show an area of 24,9 million ha and a total world production of 33.5 million tonnes in 1998.

The rapeseeds of the late 1960's and early 1970's were almost exclusively moderately high in erucic acid content and high in glucosinolate content. Fatty acid composition of the oil varied season to season and as a generality there was less saturation of the carboxylic acids from crops produced in more northern regions than more southern regions.

FIRST CHANGES IN FATTY ACID COMPOSITION

During the mid 1970's North American evidence indicated potential adverse effects from intake of erucic acid by mammals, and, some time later the European Commission instituted new aids to assist in the expansion of low glucosinolate rapeseeds. These latter limited the potential rate for inclusion of rapeseed meal into feeds intended for non-ruminant livestock, primarily pigs. Hence the so-called double-low or 'zero-zero' rapeseeds were introduced. Clearly fatty acid composition varied as indicated above, but indicative fatty acid content of double low rapeseed oil was :

		% of oil
C 16:0	Palmitic acid	3-6
C 18:0	Stearic acid	1-4
C 18:1	Oleic acid	40-70
C 18:2	Linoleic acid	17-30
C 18:3	Linolenic acid	5-15
C 22:1	Erucic acid	< 1-5

In addition small quantities of other fatty acids (eg eicosenoic) are present.

Whilst the primary market in tonnage terms for oilseed rape was for the food, that is, double low types, a specialist non-food market began to develop for true high erucic rapeseed cultivars. Contracts for these cultivars stipulate a truly high erucic acid content in excess of 45% of total fatty acid content. Currently, EU-15 uses in excess of 20,000 tonnes of erucic acid per annum. Uses include slip agents for plastics (as in plastic bags) and plastics manufacture.

THE CURRENT POSITION OF FATTY ACIDS IN RAPESEED

Apart from double low rapeseed and high erucic acid rapeseed (HEAR), a number of types with enhanced content or new fatty acid content are in development. These include :
High oleic acid rapeseed
Low linolenic acid rapeseed
High linoleic acid rapeseed
High stearic acid rapeseed
High myristic acid rapeseed
High lauric acid rapeseed

Rapeseeds for plastic manufacture eg containing polyhydroxybutyrate
Additionally it is likely that rapeseeds with high contents of ricinoleic acid or petroselinic acid could be developed in future. Clearly either of these latter 2 examples would have significant potential non-food markets.

WHY RAPESEED AS A SOURCE OF DIVERSE FATTY ACIDS

Since the 'rediscovery' of rapeseed as a mainstream agricultural crop, considerable research, developmental and practical information and experience have been accrued and, despite the poor harvest index of the crop, its production is relatively predictable and stable on a year on year basis. Additionally, rapeseed is well-adapted to cool temperature agriculture and, where winters are less severe, autumn established rapeseed has benefits in terms of yield and in terms of preventing nitrogen leaching over winter.

During the early 1980's the first steps in biotechnology, as transgenic techniques, began. Whilst initial emphasis was upon tobacco as a model system, a large number of other species were investigated and of those, potato, tomato and rapeseed were the particularly amenable to gene transfer and regeneration. Hence rapeseed became a potential recipient of novel genes as well as being a major existing crop : a major commercial opportunity. At the present moment, high lauric rapeseed is the most commercially advanced of transgenic rapeseeds with modified fatty acid content.
It has to be recognised however that transgenic developments in rapeseed have been paralleled by those created through traditional plant breeding means.

RAPESEED AS A PRIMARY SOURCE OF DIVERSE FATTY ACIDS - THE DISADVANTAGES

Rapeseed, though primarily self-pollinated can be up to 30% cross pollinated. Evidence suggests that rapeseed pollen can be found 4 km from the original crop when carried by bees or at 1-2 km from the crop if wind-borne. In these instances the quantities of pollen involved are small and its viability may be reduced. Nonetheless cross pollination occurs and could be significant where rapeseeds with specialist quality traits were grown in close proximity.
Whilst variations in fatty acid composition can be corrected during refining this adds to cost and for non-food markets in particular could reduce financial viability.

Similarly, contamination of a given rapeseed with rapeseed of different fatty acid compostion is undesirable and could cause rejection of specialist crops, particularly for non-food markets. Hence the development of rapeseed as a major source of diverse fatty acids would incur additional costs ; some are not easily quantified as in the case of time taken in extra cleaning of harvesting, storage or processing facilities and equipment whilst others, for example, additional storage/holding facilities could cost up to 330 Euros per tonne.

Additionally there is a need to develop a universally applicable and universally acceptable quality assurance scheme and identify preservation methodology for novel rapeseeds. As well as embracing oil quality, such assurance schemes must include meal quality, since enhancement of value of co-products from rapeseed will be essential to maintain financial viability post the World Trade Organisation round due at the Millennium.

THE CHALLENGES TO GCIRC

From the outlines given above GCIRC should be assessing and quantifying risks and opportunities. It should then be developing strategies to obviate or overcome these in terms of R&D needs and priorities and in practice. This latter must involve elucidating scientifically based guidelines for the establishment of quality assurance throughout the production, marketing and processing chains. This must involve oil and meal.

Where major problems are highlighted then GCIRC has 2 options :

i) To identify trouble free alternative sources for production in the field of the field.

ii) Where opportunity exists to identify types of functionality required from rapeseed produced oils and develop research programme to examine and prove viable options.