

## New Plant Oils : Possible Applications and Economic Perspectives

A discussion round in Hamburg, Germany, 30.09.-01.10.1993

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About 35 participants gathered for a seminar in Hamburg-Blankenese organized by the lipid group of the Center for Applied Molecular Biology of Plants. This center is an institution of the University of Hamburg and financed in part by the University, by the Federal Ministry of Research and Technology and by private industry. The idea of this meeting was to bring together a heterogeneous and representative, but nevertheless small group of potential users of plant oils from private industry («consumers») with the molecular biology groups and private plant breeders committed to the production of transgenic oilseeds («producers») in Germany. This world-wide success of the last few years in cloning various genes of interest for oilseed manipulation has created a situation, which enables producers to realize various projects of oil design in the near future. Since it may take ten years to develop a useful crop from a transgenic prototype plant, the producers have to decide well in advance, which projects have to be followed with priority. Therefore, the aims of the meeting were severalfold. Firstly, the consumers should be briefed about projects started worldwide in transgenic oil design and about other possibilities in this field. Secondly, and of particular interest for the work of the molecular biologists, representative consumers were asked to predict future developments in oleochemistry as well as in food industry. They should try to identify qualities of importance not available in conventional oils and to assess the implications of the availability of transgenic oils with new properties for various applications and uses. On this basis, a discussion between the various groups was expected to

define the consumers' future demands, help to select new projects and approve or modify the work going on in German laboratories. This last point is of particular relevance for scientists, since their funding by the Ministry of Research and Technology depends on support by the chemical industry, which in turn is urged by the Ministry to substantiate this approval by participation in funding. Delegates from two ministries (Research and Technology, as well as Agriculture) were present and had the chance to follow the frank evaluation of a field, the development of which is dependent on the continuity of public funding. To restrict the discussion to the oil field, topics such as release of transgenic plants and public acceptance of such products were not included.

Ten speakers highlighted the different aspects of this diversified field. E. Heinz (Hamburg) outlined the biochemical basis of presently known projects to produce transgenic oils, including those going on in German laboratories (Hamburg, Münster, Köln). The availability of cDNAs for thioesterases, desaturases and acyltransferases has prompted a first generation of obvious projects to manipulate chain length and unsaturation of acyl-groups in plants oils, which will suit different demands in chemical and food industry. The first results are encouraging and demonstrate that the transgenic approach will be particularly feasible in the field of oilseeds.

Mr. Frauen (Norddeutsche Pflanzenzucht, Hohenlieth) emphasized the role and additional time required by plant breeders to convert a laboratory plant into a commercially successful

crop. Another part of his presentation was concerned with various aspects of filing patents for gene-technological procedures and their realization in established crop varieties. Plant breeders have anticipated this development and initiated an international legislation to strengthen their position by creating the «essentially derived variety». This term describes a crop variety resulting from transformation of an established variety and thus protects previous efforts invested by plant breeders. Transfer into national legislation is in preparation.

K. Gross (Board of Oilseed Pressers, Bonn) gave an overview of global, European and German oil markets regarding production, import and financial volumes. Human consumption is saturated in Europe, but may eventually change with the availability of new qualities. Increased use in the oleochemistry will be coupled to a market for oilseed meal which (as then transgenic product) is passed through various food chains in animal production. A particularly successful transgenic oil for oleochemical use could require different transgenic oilseeds to enable crop rotation.

H. Eierdanz (Henkel AG, Düsseldorf), as representative of the largest non food consumer of plant oils, gave a most interesting and controversially discussed presentation on possible impacts of new oil qualities in oleochemistry. First of all, their acceptance will strictly depend on price, superior quality and annually guaranteed large quantities. Besides, an improved high oleic oil from transgenic plants would exert pressure on existing refineries working with animal fats and production lines optimized for only partly enriched oleic acid. In the absence of competition, established infrastructures obviously cannot support the development of transgenic oilseeds, which at present is mainly producer-pushed. In addition, German legislation regarding new products on the basis of rapeseed oil instead of the established soybean oil would necessitate a completely new evaluation and registration procedure with estimated costs of about 1 million DM. The responsibility for maintaining proved production lines and the obstacles of installing new ones in parallel explain the reluctance of the oleochemistry in this field. At present, they still can afford to wait in a stand-by position and watch the new development knowing very well that an interesting potential is rising.

R. Wildersohn (Lubricants GmbH, Mannheim) pointed out the use of plant oils for lubrication under conditions of high losses and a concomitant risk to contaminate soils and water. Plant oils can be used for various applications

and have the ecological advantage of degradability, but drawbacks regarding thermal and oxidative instability. Free fatty acids (oleic, saturated, branched) are preferred over triacylglycerols.

R. Frische (Frische GmbH, Frankfurt) represents one of the small, but innovative companies, which offer more new ideas than actual products in large quantities. According to his own investigations, polyester and polyurethane fabrics can be produced from different plant oils of homogeneous fatty acid composition (exceeding 90% of one type of acyl-group) at competitive costs. The resulting products compare favourably in many properties such as oil and water resistance, elasticity, brilliance, transparency, etc, with conventional plastics derived from mineral oil. Whether such innovations will create a substantial pressure on the big companies or, supported by ecological arguments, can develop a consumer-pull, will be seen in the future.

S. Warwel (Federal Institute of Lipid Research, Münster) outlined the diversified chemistry based on methyl oleate. The versatility of the olefin metathesis reactions developed in his laboratory open high oleic plant oils access to many new products areas and provide independence from the tensid sector, which dominated and limited the non-food use of plant oils in the past. Since high oleic oil could at the same time be used in the food industry, its production in large quantities would be possible without risk for producers. This situation would be ideal for the chemical industry: without additional commitment in advance, they would have a regular supply of a new product of nearly unlimited quantity. With these perspectives, an oleate-based chemistry could be developed and grow steadily with an increasing market, thus minimizing the risks of other alternatives. On the other hand, a commercial large-scale trial of a particular oleate metathesis reaction does not seem to be run at present.

K. Reuter (Bayer AG, Uerdingen) outlined the use of plant oils and fatty acids in the production of paints and varnishes. At present, soybean oil is preferred due to its content of linoleic acid, but the actually desired component for this limited market would be a conjugated octadecadienoic acid. Genes for corresponding enzymes are not yet in sight.

W. Holtmeier (Noble/Thörl GmbH, Hamburg), as representative from the food industry, stressed the completely different demands of his branch: instead of a monotonous make-up with one type of fatty acid, the wide

spectrum of fats in manufactured food items requires an appropriate variation in the triacylglycerol structure to develop the right feeling in the mouth while eating. Melting behaviour, flavour development and other aspects of the complex process of perception and recognition of a characteristic taste are intimately connected. At present, molecular biologists have difficulties in translating terms like lardiness into genes to be cloned and expressed or to suit the subtle differences required to make a nougat filling or the coating of confectioneries. On the other hand, there is no doubt that elimination of linolenic acid from the large shares of plant oils going into margarines or being used for cooking and baking would be an advantage regarding handling and stability (but not necessarily for human biochemistry).

O. Adam (University Clinic, München) gave an overview of the requirement of various fatty acids in human nutrition. As a result of present knowledge, widely accepted recommendations may include a general reduction of fat consumption, in particular avoidance of saturated and trans-fatty acids, but a proportional increase of linolenic acid to rise the n-3/n-6 ratio. This does not correspond to the demands expressed by food manufacturers, although the question, whether humans can elongate 18:3 to 20:5 as efficiently as required, does not seem to be settled. Oleic acid does not interfere with these correlations, and a heavy

helping of fish per week may be a safe alternative to contribution to a balanced 20:4/20:5 ratio.

The final discussion showed general agreement that in the near future a truly high oleic oil would be the most interesting product. It can be used in large quantities in both food industry and chemistry, provided it will be available at a competitive price. From the standpoint of biochemistry/molecular biology, rapeseed and in particular the presently available high oleic varieties would be the oilseed of choice to realize this project as first entrance into a new market. Trierucic rapeseed oil was ranked next followed by medium chain triacylglycerols, although in this case biochemical realization and competition by tropical oils may pose problems.

In his concluding comment, E. Warmuth (Ministry of Research and Technology) encouraged the participants to stay in contact and to continue this kind of dialogue. The ministry is aware of its role in maintaining and developing research activities which operate between direct application and basic science required for subsequent innovations. Moreover, funding has to comply with EC regulations and is not intended to overlap with activities of other granting authorities. But as long as projects represent or promise to initiate technological innovations suitable for immediate or future impact in industry or agriculture, there is a realistic change for future support.