Oleic Sunflower production: current situation and trends for the future

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ABSTRACT

- The oil obtained from the classical sunflower type contains around 65 % of linoleic acid and 20 % of oleic acid. During the two last decades, efforts have been made by the breeders to select varieties displaying a high content in oleic acid (range from 70 % for the mid-oleic-type until more than 90% for the very high oleic ones). The aim of this paper is to give an overview on the oleic sunflower production at the international level with focus on the largest sunflower cultivation area in the world which covers European Union (EU) and the black sea countries. Key factors of its successful introduction are analysed and some perspectives are drawn for the future.
- The used methods consist of an analysis and a synthesis of data collected through contacts with operators (surfaces, prices), through analytical surveys (grain quality) and through surveys about the outlets for France. Results of different private or public studies (panel Nielsen about the oil consume in France, prospective study on bioproducts needs in France and in EU..). The case of France which is the worldwide leading country is detailed.
- Our estimates for the most important sunflower area in the world (EU27+ Turkey + Russia+ Ukraine) show that the surfaces of oleic sunflower have quite doubled in 5 years, from around 500 000 hectares (ha) near to 950 000 ha. The oleic types are mostly introduced in the South-Western Europe and in Hungary where their proportion reach around 30 % of the total sunflower acreage meanwhile the eastern countries starts only cultivating such types (1% of the total surfaces). In Europe, the development is based on the oleic type (more than 75 % of oleic acid). Very high oleic types (> 90%) are only cultivated for minor outlets (especially for biolubricants).
  France is the leading producing country of oleic sunflower oil (estimation of 284 000 tons in 2010-2011)
  The success of the oleic introduction in Europe is based i)on the quick progress of varieties performances ii)on the know-how of farmers, cooperatives and crushers in building a reliable supply chain, including a incentive premium (about +10% of the commodity price for the farmer) iii) on the good quality of the harvested seeds (the 5 years ONIDOL/CETIOM survey shows that the mean oleic content ranged in France between 82 % and 86,5%) iiii)on the oil demand for food market and in a less extend for non food uses.
- Oleic sunflower performances have now reached a level very close to the classical ones and a good know-how has been implemented by the actors of the supply chain in several European countries. New producers are experimenting the oleic cultivation in the Eastern and Black See areas. The oleic surfaces can be expected to continue to grow for several reasons such as higher healthy concerns leading to substitute hydrogenated fats by oleic oil and to better balance the fatty acids intakes, societal ban of palm oil, and the interest of the predominant C18:1 fraction of the oleic sunflower oil for non food application in a context of high fossil prices and biosourcing needs (for biopolymers, biosurfactants, synthesis intermediary..). Several questions can be addressed: moving towards 100 % oleic production in some Western European countries ? or/and transfer of the know-how in promising areas like Ukraine ? Changes in the market demand in traditional consuming countries like Turkey ?

- This study delivers useful quantitative and qualitative data on the oleic sunflower introduction in Europe and on the major points which allowed such a success. The extension of oleic sunflower is expected to continue and to accelerate in response to stronger demand of the food industry (heath and environmental concerns) at short term. At short/medium long term (2020, 2030) oleic sunoil could find large outlets in the oleochemical industry (especially chemical intermediates and biopolymers) thanks to the ongoing innovation and to more severe regulatory context.

Key words: sunflower – oleic sunflower oil – market – diversification –

INTRODUCTION

The oil obtained from the classical sunflower type contains around 65 % of linoleic acid and 20 % of oleic acid (figure 1). During the two last decades, efforts have been made by the breeders to select varieties displaying a high content in oleic acid (range from 70 % for the mid-oleic type until more than 90% for the high oleic one). During the last five-years period, oleic sunflower acreage seemed to increase fast especially in Europe. The aim of this paper is to give an overview on the oleic sunflower production at the international level with focus on the largest sunflower cultivation area in the world which covers European Union (EU) and the black sea countries. Key factors of its successful introduction are analysed and some perspectives are drawn for the future.

MATERIAL AND METHODS

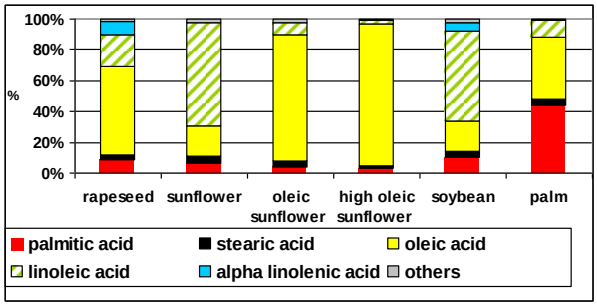
The used methods consist of an analysis and a synthesis of data collected through contacts with operators (surfaces, prices), through analytical surveys (grain quality) and through surveys about the outlets for France. Results of different private or public studies (panel Nielsen about the oil consume in France, prospective study on bioproducts needs in France and in EU..). More details on the hypothesis and calculation we made to complete the estimated figures are given in the results paragraph. The case of France which is the worldwide leading country for sunflower oleic production is detailed.

RESULTS

The sunflower oleic types differ from the classical one by a lower content of linoleic acid (C18:2, also called omega 6) and a higher level of oleic acid (C18:1 also called omega 9) - (figure 1). These differences lead to different chemical-physical behaviour in relation with the unsaturation level and also to different nutritional effects. Both types don't contain linolenic acid (C18:3) which a good technological point because of the bad hydrolytic and oxidative resistances of this poly-unsaturated fatty acid and of unpleasant smells flavour while fried.

According to the oleic genetic sources involved and to the genotypes of the parents of the hybrid, variable levels of oleic acid can be obtained from 60- 70% (called mid-oleic type) to oleic type (> 75%) and high oleic ones (> 90%) – (figure 1). Segregation of the oleic production is necessary along the supply chain from field to oil user which leads to a premium on the seed and oil prices.

Figure 1: Fatty acid profile of the three cultivated types of sunflower in France in comparison to the competitive oils.



1. Oleic sunflower introduction follows a decreasing gradient west-east and south-north in the large Europe

The current surfaces of oleic sunflower estimated for the main sunflower producing countries in EU and in the black sea area show that introduction is still low in average with 6 % of the considered surfaces (table 1). However variable introduction rates are noticed and the largest oleic shares are found in the most southern countries of the considered area (Spain, Italy) or/and in the most western countries (France, Hungary) (Jouffret and Coll, 2011). Several reasons can be suggested:

- Adapted climate condition (high temperatures) to obtain stable and high oleic contents in the southern and western countries of the area;
- the more advanced know-how of IP production process in the European western countries in relation to the high technological level and the yield level of the agriculture;

- the existence of more valuable markets for speciality production and oils in the western countries of Europe to be related to the gross domestic product which offers better condition for operators to develop it.

Table 1: share of the oleic type in the total sunflower acreage in the main sunflower producing countries of European union and of the black sea area in 2010 (estimates from the French oil seed crop organisation).

		France	Spain	Hungary	Italy	Romania	Bulgaria	Turkey	Ukraine	Russia	Total
Sunflower	**Total acreage (1000 ha)**	700	690	500	120	790	700	485	4 800	6 500	15 285
Oleic sunflower	**Surface (1 000 ha)**	380	210	165	50	25	7	7	60	45	949
	% of the total acreage	54%	29%	31%	33%	3%	1%	1%	2%	1%	6 %

The oleic sunflower introduction started in the 90's in southern Europe and the market demand was oriented especially towards oleic types (>75 %) which are adapted to uses in the food and the non food markets. The situation seems different in the United States where sunflower can be considered as a speciality market compared to the soybean area. In the US, the acreage would have become quite 100 % oleic and would be shared between the mid-oleic type (the first one historically in US) and the oleic type. In Argentina, oleic has also been introduced but its share seems still being quite low (around 15% of the total acreage).

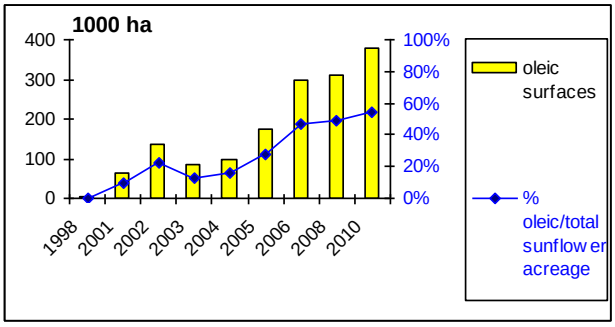
All in all, the estimated surface of oleic sunflower in the main producing countries in the world reaches quite 2 millions hectares (Mha) in 2010 that represent 11 % of the total surface. These figures show that oleic sunflower has become a significant production at the international level and that the very variable dynamic of development seems to be related to the economical level of the country or the neighbouring area. However, the oleic cultivation has now started in each big sunflower producing country which is thus acquiring the necessary know-how to deliver the required quality. That suggests that these countries will be soon ready to increase the production if the market demand grows significantly.

2. Focus on the leading country : France

- **A performing supply chain from breeding till processing**

France is probably the leading country for the oleic type (>75 %) sunflower cultivation with 54% of the total acreage in 2010 (57% in 2011) (table 1). The oleic production started in the 90's in France and was considered as a promising diversification crop in the context of the CAP change. At this time, the oleic production was cultivated under contract to meet the emerging demand of oleic oil for the combined healthy balanced oils but also to be incorporated in the recently launched biodiesel. The extension of the crop was quite low during more than ten years due to lower yielding of oleic sunflower, to a weak and unstable market demand and to the difficulty to find ways to share the economical risks and premiums.

Figure 2: Oleic sunflower surfaces and oleic share of the total sunflower acreage in France



From 2000 to 2003, the oleic acreage increased progressively and after sharply raised between 2004 and 2006 (x3) – (figure 2). Several factors can explain this recent great increase:

- the improved agronomic performances of the oleic sunflower varieties which display a large range of precocities, quite similar yields to linoleic types (less than 5% lower) and incorporation of disease resistance or tolerance traits such as in the classical types (downy mildew, phomopsis,

sclerotina). The creation of a special category in the variety French catalogue for oleic types made easier the identification of the characteristics of the oleic varieties in a transparent way;
- the development of a good know-how of all actors of the supply chain promoted by the cooperatives and the industry (isolated fields, dedicated storage, machine and equipment cleaning, traceability, special crushing campaigns..)
- set-up of contracts between suppliers and industry which take into account the different constraints of the production and the needs of the user (minimum of 80-82% of oleic acid, minimum oil content of 44%, premium of around 10 % of the commodity price..).

Today the oleic sunflower is cultivated in different regions of France and some areas have been encouraged by cooperatives to concentrate the production only on oleic types (especially in the centre of France). The quality of the oleic harvest has reached a good and quite stable level fitting the standard requirements of the industry (table 2)

Table 2: Oleic acid content of the French sunflower oleic harvest (Source: annual analytical surveys of CETIOM-ONIDOL). The standard deviation is given between parentheses.

Year of harvest	2006	2007	2008	2009	2010
Mean oleic content (%)	86.5 (3.2)	85.4 (3.5)	86.7 (4.2)	86.3 (2.5)	85.9 (4.3)

- **A food oriented market for the sunflower oleic oil in France**

At the present time, food market is by far the most important outlet for oleic sunflower oil in France like in the other producing countries. In France, thanks to its high content in omega 9, oleic sunflower oil has become an important ingredient of the blended oils (rate around 10-12 %) which offer a balanced combination of fatty acids and thus of oils fulfilling the nutritional recommendation. Such combined oils were one of the first uses of the oleic sunoil for food in France. In parallel, due to its good oxidative resistance at high temperature and the absence of linolenic acid (no unpleasant frying smells) the oleic sunflower oil appeared as a good alternative to the hydrogenated oils (like hydrogenated soy and palm) which generate trans fatty acids bad for health. So oleic sunflower was introduced as ingredient in the home oils marketed for deep frying and in frying oil products for out of home restaurants (especially fast food) and in the food industry (pre-cooked French fries for example) in France and also in western Europe. Today, we estimate that the oleic sunflower oil could represent 15% of the total sunflower oil bought by the consumers in France against only 4% in 2000 (based on Nielsen panel of oils consumed and our estimates for oleic sunflower oil introduction rates).

- **Biodiesel as main non food outlet for oleic oil in France**

The survey about the non food uses of the sunflower oil in France showed that around 50 000 tons go yearly to the industrial market and that the oleic share remains quite low with 20 000 tons for 2010 (6.8 % of the oleic oil produced in France). The most important non food outlet for oleic oil is the biodiesel blend (estimates of 18 000 tons in 2010) meanwhile biolubricants represent between 1000 and 2000 tons a year only (Borredon and Coll, 2011). The incorporation rate in biodiesel was higher some years ago but the demand increase of the food industry as well as the premium to pay for oleic oil led to a decrease of this outlet.

3. Opportunities at short term for oleic sunflower : stronger demand of the food industry and performing varieties

For the forthcoming years driving forces would come especially from the food market. Oleic sunflower should thus continue to expand cultivation and uses in the EU and in the black sea countries for several reasons:

- oleic sunflower is a sustainable crop (low inputs, good water restriction resistance..);
- performance of oleic varieties have quite reached those of the linoleic varieties making easier their acceptation by farmers;
- oleic sunflower oil takes advantages of the good image of sunflower and should be easily accepted by the consumers even in the areas where it is not introduced;
- nutritional recommendation application should lead to the increase of the oleic sunflower use which allows a better balance between ω9 (oleic) and ω6 (linoleic) and which is well suited for frying;
- food industry and out of home fat and oil consume are expected to grow in all areas and oleic oil is definitively a good and healthy alternative to hydrogenated oils.

4. Opportunities for medium term for high oleic sunflower: oleochemistry and biolubricant

At short/medium term oleic sunflower oil presents good assets to find huge outlets in the oleochemistry field. Societal concerns about renewables and green products, increase of price of the fossil sources and health constraints should lead to a significant rise of the biosourced oils and oils derivatives at 2020 and 2030 terms.

- **High oleic content sunflowers for lubricants**

The high oleic content allows a better lubricity, a good oxidative resistance and a good behaviour at low temperature. Formulation still exist but market share will probably increase thanks to the new Ecolabel set up at the EU level and to forthcoming regulatory schemes obliging the use of renewable lubricants while used in sensitive environment. Market size of biolubricant market is of 5 Mt/year and biosourced rate is only of 2% (100 000 tons), so huge potentialities are open for the future.

- **High oleic content for chemical industry**

According to a French study (ADEME/ALCIMED 2007), polymers and chemical intermediates would be the most promising bioproducts (table3). The high oleic sunflower with the presence at a high level of one fatty acid (oleic acid) limits the formation of undesirable sub-products and make easier the purification stage of the obtained products in the chemical processes. A lot of innovations are under process in order to deliver a large and diversified range of monomers with different chain lengths and functional properties. They will be then involved in the surfactant, polyesters, polyamides…manufacture.

Table 3: Perspectives of bioproducts market development in France (ADEME/ALCIMED 2007).

Bioproducts (in kT)	2005	2015	2030
Chemical intermediates	≈ 0	4500	11250
Biosurfactants	110	184	205
Biolubricants	1	95	145
Biosolvents	9	46	84
Pigments, inks, paints, coatings	29	109	198
Biopolymers	10	2334	4623

For biolubricants and chemical bioproducts, high oleic sunflower (>90%) which is close to a mono-acid oil is better suited than the oleic type (>75 %).

DISCUSSION

This study emphasizes the promising market perspectives of the oleic sunflower in its major growing area. All in all, we could imagine than the oleic surfaces will be at least doubled in 2015 (2 Mha) and will reach at least 50% of the total acreage in 2020 (7 to 9 Mha) of the EU and black sea countries area. In 2020, some countries could be expected planting more than 80% of oleic types (France for example). However some threats can be pointed and following challenges are to be taken up for the future:

- **Need of competitiveness at the cultivation level**

Advantage of the oleic sunflower is the absence of linolenic acid for the uses in high temperature conditions (food and non food) but regarding uses as cooking and dressing oil the high oleic (>75%) and low linolenic (<3.5%) rapeseed type (HOLLI) can be a good nutritional alternative to sunflower oil. In a lot of European and black sea countries rapeseed has gained or is gaining surfaces. Therefore in some areas sunflower enters in competition with rapeseed which benefits from efficient R&D efforts research at the international level and which offers improved HOLLI varieties. Sunflower yields are in general lower than those of rapeseed and it will be necessary to emphasise the R&D research on this crop to keep a good competitiveness of the oleic sunflower in these areas.
Moreover, the efficiency of carrying out two breeding programs in parallel on sunflower one for linoleic and one for oleic could be discussed especially for small or medium sized seed companies and some of them could concentrate the breeding on one type in the future to generate faster genetic progress.

- **Strengthen the research and the standardisation process in the bioproducts sector**

More research and innovation have to be directed toward the chemical valorisation of the high oleic oil in order to offer sustainable, efficient and cost-effective chemical derivatives able to the chemical industry and to the end-users. Standardisation works would have also to accelerate so as to provide a secure

framework for the development and commercialisation of bio-based products. This work has started at the EU level in response to mandates 52/2008 and 53/2008 (EU, 2008). Moreover, at the EU level, regulatory measures are expected aiming at forcing the use of biolubricants or biosourced products for heath or/and nature preservation concerns. They definitively will emphasise the interest of oleic sunflower sources.

- **Oleic or high oleic?**

For non food uses, high oleic types (>90%) are more adapted than the oleic types (>75%). For frying purposes high oleic level is also very good. So, breeding would have to provide more high oleic performing varieties to meet the requirements of the oleochemical industry. We can then imagine than the high oleic type will replace totally the oleic one at the 2020 term. In this context, the fatty acid profile of the sunflower oil for food market would be adjusted, if needed, by mixing linoleic sunflower and high oleic sunflower in order to avoid too much segmentation at the cultivation level.

- **Management of both markets : oleic and linoleic**

In relation to possible oleic sunflower extenstion, several options can be envisaged like a specialisation of some countries (for example the most advanced in the oleic market like France, Hungary, Spain, Italy..) or a progressive introduction according to the observed gradient (see first paragraph) in order to share the climatic, technical and economical risks as well as the existing added value of the oleic market and to supply the domestic market. Second option seems more believable because of the possible extension of the oleic demand in all the sunflower area production and the know-how transfer by the international seed and crushing companies into the emerging oleic sunflower cultivation areas. If oleic surface will durably exceed the linoleic ones, question of the justification and of the value of premium for oleic should be addressed. Moreover adequate commercial strategies would have to be adapted in relation to the specific habits of the countries in order to convince the consumers that the oleic sunflower oil is as good (even better) than the referenced classical without introducing doubts about the quality of sunflower in general.

- **Oleic oil cannot answer all the needs of the food industry in the context of palm banning**

Oleic sunflower oil will be not able to substitute all the palm oil uses because it doesn't display the requested technological characteristics given by the palmitic acid (C16:0) for some uses in food industry and in oleochemistry. So, a larger introduction of the sunflower oil in the European food industry would require the release of performing and commercial varieties offering alternative fatty acid profiles with saturated fatty acids (like stearic or palmitic acids) using the existing referenced sources of mutations.

CONCLUSION

To conclude, in the traditional areas of sunflower cultivation oleic type has been introduced at variable rates depending on the local market demand and on the technology and organization levels of the supply chain. During the last three years we noticed faster growing of the oleic surfaces in the most advanced countries (south Western Europe and neighbouring countries like Hungary). This extension is expected to continue and to accelerate in response to stronger demand of the food industry (heath and environmental concerns). Non food outlets are less developed and first uses are concentrated in biodiesel (France, Italy, Hungary) and in biolubricant (lower volumes). They are expected to become significant in the next decade especially in the oleochemical industry. For those uses, high oleic (>90%) would be better suited and we can imagine that it could replace the oleic one in the future. To make successful the oleic expansion in the world, research would have to be strengthened at each stage of the chain especially at breeding and chemical processing stages. In the year 2020, we could expect more than 50 % of the sunflower acreage turned up into high oleic cultivation if the traditional consumers accept this new trait. Some questions could be addressed: will linoleic sunflower become a niche crop and market ? Will other traits like high content in stearic or palmitic acids be developed (in response to palm oil reject in EU) and will this new trait follow the same development as the oleic sunflower ? Soil competition will be hard and good crop performances and technological characteristics will be key factors for a successful extension.

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