Nutrisun is a special programme within Advanta Technologies in sunflower which aims at developing and implementing traits related to oil quality. Advanta owns intellectual property on high stearic high oleic materials and thus our objective is to capture value out of these special qualities at industrial level.

Being Advanta a seeds company our challenge is to integrate by means of strategic alliances with oil crushers and manufacturers in order to deliver premium oils for different industrial applications.

Introduction

NUTRISUN High stearic high oleic sunflower oil (HSHO) is the oil yield from seeds obtained through conventional breeding techniques (non GMO). Nutrisun oils should be produced under identity preservation schemes in every value chain steps until its final distribution. Hybrids development has been performed jointly by the Instituto de la Grasa of Sevilla, CSIC (Superior Council of Scientific Research), Spain, and Advanta Seeds Nutrisun Business Unit in its Biotechnological Center in Buenos Aires Province, Argentina. These hybrids are currently commercialized by Advanta under Nutrisun™ brand.

Quality and properties.

Compared with regular sunflower oil fatty acid profile, the main difference relies on the stearic acid content, which is fourfolds compared with regular sunflower oil, and it is threefolds in oleic acid content. (Min. stearic acid content 12 %, Min. oleic acid content 60 %). A typical composition is shown in the table below.

The said different FA profile yields a higher oxidative stability, even in blends with other vegetable oils as soybean, rapeseed, canola, palm and its fractions and any vegetable oil. This means that Nutrisun can be used to confer very good resistance to the high temperatures normally used in frying, and to increase shelf life in packaged foods more than any other commercial oil. Nutrisun OSI (oil stability index) at 110° performed with the Rancimat instrument (a measure that roughly indicates the time to become rancid) is 1.4 times greater than HO sunflower oil, and 6.0 times higher than regular sunflower oil as shown in the next figure.

The fatty acid composition and distribution in the triacylglycerol (TAG) molecules, is also the reason of the significant physical behavior difference between Nutrisun and regular sunflower oil. While the latter is liquid at room and fridge temperature Nutrisun behaves as a solid fat at temperatures below 15°C. In the next figure the SFC profile of HSHOSO is shown.

1. Versatility: Customized fats for each food application by means of fractionation and interesterification

Using different process like fractionation by crystallization, (dry or wet), chemical or enzymatic interesterification and blends with other fats and oils, Nutrisun and its different products obtained from those modification process are the most versatile fats that could be potentially used in food applications.

By means of fractionations a whole range of different stearin fractions can be obtained, having melting profiles (in terms of SFC: solid fat content) ranging from that of the original entire high stearic, high oleic Nutrisun oil to hard stearin fractions with SFC values above cocoa butter.

On the other hand the olein fraction is similar to the oil in terms of fatty acid composition and SFC profile. One of the main reasons is that an important portion of the stearic acid content is in the triglyceride type: StOO, which during fractionation remains in the olein fraction. As a consequence, the olein stability is very high and in frying or some bakery applications, it can be used instead of the non fractionated oil.
2. Functionality in Food Applications

HSHOSO and its fractions are successfully applied in most food categories

- Bakery

Nutrisun is used in croissants, bread and biscuits using 100% pure product and blends with butter. Other kind of bakery applications are cookies and crackers where Nutrisun is used in the dough or as spraying oil whereas its soft stearins can also be used in fillings like sandwich, cookies or wafers.

- Confectionery fats

One of the most interesting food applications is the field of confectionery fats, cocoa butter alternatives or specialty fats. As mentioned previously fractional crystallization of HSHOSO can yield different kinds of stearins and oleins that cover almost the whole range of fats used in foods. Some of the HSHOSO stearins were used for CBE (Cocoa Butter equivalent) or CBI (cocoa butter improver) formulations as an alternative source of StOSt TAG (Stearic, oleic ,stearic) from tropical wild plants like shea. It was also used in formulations of dark chocolate bars with 100% of HSHOSO stearin and different blends with Palm Mid Fraction (PMF). Samples obtained, showed good acceptance by potential customers (chocolate manufacturers).

- Frying

As mentioned above, due to its low content in polyunsaturated fatty acids, Nutrisun is one of the most stable oils, giving unique properties for packaged foods which need long shelf life. It also gives a very good frying resistance, one of the most demanding applications in terms of thermal stress.

- Fast food frying: Nutrisun high stability means that in this segment between 30 % and 70 % longer times in the fryer are achieved before discarding the oil compared with palm olein or high oleic sunflower oil with the mentioned nutritional benefits.

Industrial frying conditions are completely different from fast food ones. In the first process, frying is performed continuously and the oil is always in contact with food. This generates a double protective effect: isolation of the oil surface from the oxygen of the air due to a steam layer coming from the boiling water content of the food, and a permanent renewal of the oil that is being replenished as it is absorbed by the food.

There are also basically 2 types of industrial frying:

- Snacks as potato chips and par frying frozen fries. In snacks, the oil is an important part of the final food (i.e. up to 30/35 % oil in potato chips). So oil stability determines (together with other aspects like packaging and the use of Nitrogen), the shelf life of the fried food. The high oxidative stability of HSHOSO makes it an excellent choice for this application.

- In frozen par frying, it is very important to avoid clumping or dusting originated in the use of very low melting fats (like liquid oils, as they crystallize far below 0°C). The presence of certain solid levels in the oil is very important in the range between 0°C and -10°C and this cannot be achieved with regular liquid oil.

Again in industrial frying a significant improvement in the nutritional profile is achieved compared with palm oil products.

- Ice Cream

An outstanding nutritional benefit arises from the use of Nutrisun in ice cream. With just 24 % of total SAFA, its use in ice cream allows a significant reduction of SAFA compared with milk fat (67 % de SAFA), palm oil (50 %) and coconut oil (90%). Functionality in terms of overrun, firmness, and melting behaviour are similar to the fats commonly use for replacing milk fat and for milk fat itself.

- Margarines and spreads

By means of Nutrisun soft stearin it is possible to structure significant amount of liquid PUFA oils. This allows the possibility of 0 % trans fatty acids and 0 % of palm oil, and to use different liquid oil in the formulation to reach the current nutritional recommendations in terms of omega 3, 6 and 9 balance.
3. Scientific Merit
A brief summary of some of the steps involved in the synthesis of fatty acids in developing sunflower seed cells. This is a complex process that implies reactions that take place in the plastid and endoplasmic reticulum. From all the enzymes that participate to metabolize fatty acids we highlight the stearoyl-CoA desaturase (SCD, which has two isoforms in sunflower) the oleoyl-CoA desaturase (OLD) and thioesterases (FAT A and B). The SCD enzyme, which is located in the plastid, catalyzes the conversion from stearic to oleic acid through the addition of one unsaturation at carbon 9 in the fatty acid hydrocarbonated chain. The OLD enzyme is in the endoplasmic reticulum and catalyzes the transformation from oleic to linoleic acid through the addition of a second unsaturation in carbon 12. The FAT enzymes regulate the transportation of the fatty acids synthesized in the plastid (palmitic, stearic and oleic acids) to the endoplasmic reticulum.

4. Health and Nutrition
Hydrogenation was widely used as the most extended fats modification method for food applications. The reason for this was that partial hydrogenation of vegetable oils yields a high level of trans fatty acids, which contribute to a significant percentage of solids (SFC) at room temperature and a melting point close to body temperature, conferring good structure and mouthfeel to end products, mainly in margarine and confectionery applications.

Since the 90’s, there has been a growing evidence and consensus on the deleterious health effect of industrial trans fatty acids, which increase LDL and decrease HDL cholesterol, raising accordingly the cardiovascular disease risk. For that reason in the last decade many changes took place in food labeling and legislation in almost all countries and regions as in USA, Canada and Mercosur (labeling rules since 2006). In Denmark regulations limited trans fatty acids consumption, and in the near future similar rules will be applied in Canada and Argentina. This was a dramatic change for the fats&oils and food industry, which faced the need of searching for alternatives almost everywhere in the world. Among these alternatives there are: chemical and enzymatic interesterification, a return to animal fats like tallow or lard, and palm oil and its fractions. None of these alternatives fulfill all the requirements in replacing trans fats because of nutritional drawbacks like animal fats and palm oil, or because of technical reasons like the possibility of having good SFC profile (significant solids at room temperature and good melting behaviour at body temp).

Because of its high oleic acid content (omega 9) and stearic acid (which is cholesterol and CVD neutral while the other SAFA are the opposite), NUTRISUN is potentially the most healthy alternatives to partially hydrogenated oils rich in trans fatty acids, and other animal and vegetable fats like tallow and palm because of its raising cholesterol type of fatty acids content, leading to CVD risk. By replacing palm oil the SAFA content is reduced in more than 50 %.

These are the most outstanding and innovative aspects of NUTRISUN:

- Replacing current sources of current “solid fats” used in the food and restaurant industries, as partially hydrogenated oils with trans fatty acids, animal fats including tallow and dairy fats with a high content of SAFA and cholesterol, and palm oil with a large content of palmitic acid that is considered one of the raising LDL cholesterol fats.

- Clean labeling: GMO free, Trans free, Palm free. This involves not only nutritional and health issues but also sustainability and consumers perception issues compared with the current fat sources. See below the 2 boxes including excerpts from FAO, and USDA documents.

The change of labeling rule in Europe in Dec. 2014 involves that it will be necessary to specify in the label the type of oil used. (i.e. Palm oil, hydrogenated oil, etc).