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NuSun Sunflower Oil: Redirection of an Industry

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In 1995, leaders in the US sunflower (*Helianthus annuus* L., Asteraceae) industry took a long hard look at the future and determined that it could no longer depend on export markets of sunflower oil as the primary market outlet. Up to this time, more than 80% of the market was export-dominant. This was largely due to strong demand from Mexico for this preferred oil. North African countries also preferred sunflower oil and often paid considerable price premiums. However, in the decade of the 1990s, most of these countries eliminated their government-buying agencies in favor of the private market. The private sector quickly determined that cheaper oils could satisfy customer demand if other alternatives were not available. In the meantime, Argentine and East European sunflower production increased. All of these factors put considerable pressure on world sunflower oil prices. United States industry leaders recognized this competition was not likely to abate in the near future. Furthermore, being one of the cheapest oils in the world market was not going to sustain a consistent sunflower crop area base in the US.

The domestic market for sunflower oil has always intrigued the sunflower industry. However, sunflower oil did not have anything particularly unique for domestic users. Traditional sunflower oil consists of 68% linoleic acid (C18:2) and about 20% oleic acid (C18:1). Linoleic acid is well recognized as a healthy and desirable fatty acid. But the US produces a number of oils with high levels of linoleic acid. The most predominant is soybean [*Glycine max* (L.) Merr.] oil. This oil dominates the domestic market. It is always available and is generally the least expensive oil on the market. And there is corn (*Zea mays* L.) oil. It has been in the domestic market a long time, has been heavily promoted and is one of the domestic icons. It is also similar to soybean and sunflower oils with lots of linoleic acid. So unfortunately for sunflower oil, there simply was not room in the domestic market for another "look-alike" linoleic oil. That is unless the price of sunflower oil would consistently be priced at or below soybean oil levels (Kleingartner and Warner 2001).

Oil drives the value of sunflower. It is a high oil content seed of 40% or more. Low sunflower oil prices severely impact the price of seed to the farmer resulting in reduced sunflower plantings. Soybean is an 18% oil content seed. It obtains most of its value from protein. Soybean oil is often a by-product and can, therefore, be sold at a discount without as much pain to the producer. Corn oil is a total by-product of other industries and can also be sold at discounts if required. So the domestic market did not provide a "friendly environment" for sunflower oil when it was introduced in the 1970s.

LOOKING FOR A NICHE

Leaders of the sunflower industry recognized that to find successful domestic market outlets, sunflower oil had to be different. Sunflower industry leaders talked to food manufacturers about vegetable oil performance requirements. Human nutrition studies were pointing to trans fatty acids as human health concerns (Gupta 1998). Trans fatty acids are produced when a vegetable oil is hydrogenated. There were strong signals that the US Food and Drug Administration planned to require the labeling of trans fatty acids. Food manufacturers admitted that there were few oil choices, especially for frying, that were free of trans fatty acids. Most oils high in polyunsaturated fatty acids, soybean, canola (*Brassica napus* L.), and traditional sunflower, need to be hydrogenated when used as a frying oil.

The challenge was to rearrange the fatty acids in sunflower oil so that the oil would not require hydrogenation when used as a frying medium. It was well recognized in the food industry that oleic and saturated fatty acids provide frying functionality. Increasing saturated fatty acids was not a choice since highly saturated oils had already been largely eliminated from the domestic market because of health concerns. Oleic acid was the obvious choice and the US sunflower industry already had experience with this fatty acid in breeding programs. High oleic sunflower oil (HOSO) with 80% or more oleic acid had already been developed and was available in limited quantities. The difficulty with HOSO for the sunflower industry was a patent on the hybrid planting seed with oleic levels at or above 80%. The patent holders chose not to license the breeding material to other companies, thus HOSO production was very limited and the price of the oil was

quite high compared to commercial oils. However the patent holder did agree to license breeding material for the development of mid-level oleic sunflower seed.

In July of 1995, the National Sunflower Association (NSA) decided to take this new direction of increasing oleic acid and decreasing linoleic acid in sunflower oil. The NSA established a steering committee to address the many obstacles in redirecting an entire industry. It was determined at the onset that this new sunflower oil would need to be commercially competitive and the market would determine its value based on functionality and availability. The first challenge was to convince the sunflower hybrid seed companies to make an investment in breeding a new line of hybrid sunflower planting seeds. There were no guarantees, just hopeful signs that this mid-level oleic sunflower oil would be a functional and preferred oil.

The steering committee determined, based on discussions with major users, that mid-oleic sunflower oil should consist of about 65% oleic acid, 10% or less saturates and the remainder linoleic acid. Frying oil experts indicated that this type of balance should provide functionality in the fryer and provide an appealing taste profile. It was mandatory that linolenic acid (C18:3) not be present in any measurable quantity.

Most of the seed companies already had some experience in working with high oleic sunflower breeding programs so most were not starting from absolute ground zero. Breeding a mid-level oleic sunflower requires at least one oleic parent (Hardin 1998). The USDA Agricultural Research Service Sunflower Research Unit at Fargo, North Dakota provided breeding lines to the private companies. The hybrid seed was developed by traditional breeding methods. There are no transgenic sunflower hybrids or varieties.

By 1997, the seed industry had developed a minimal amount of hybrid seed that could be planted and harvested. Key producers were contracted. The harvested seed was crushed at a commercial processing plant. The oil was refined and sent to a major snack food company for testing. The mid-oleic sunflower oil was compared to cottonseed (*Gossypium* spp.) oil, the "Gold Standard" for frying. The report was positive. "*Both fresh and aged NuSun products were comparable to the corresponding control product made of cottonseed oil*" (Gupta 1998). More seed was developed and grown in farmer's fields and further testing was done at commercial locations, the USDA ARS National Center for Ag Utilization Research and the University of Illinois. Again, all of the tests were positive (Campbell et al. 2000). This provided enough evidence to the sunflower hybrid seed companies to accelerate their investment in a mid-oleic sunflower hybrid seed development.

Another issue confronting the NSA steering committee was a name for mid-oleic sunflower oil. The market was already familiar with sunflower oil, HOSO and confection or edible sunflower. There were three audiences that had to be reached with this new development in sunflower: the farmer, the seed companies, and the end user. The farmer was most critical at this early juncture. It was important that he understand the difference between this new planting option and other sunflower choices. The seed companies had to differentiate this new sunflower as well in their seed sale promotions. Finally, it was going to be necessary to communicate with the end user of the oil. Names like "mid-oleic" or "low sat sun" had little appeal. With little fanfare and no research, the name 'NuSun' became the standard bearer for the industry. The NSA has since trade marked the name. Seed companies and others using the term NuSun on commercial products must sign an agreement with the NSA.

THE PROCESS OF COMMERCIALIZATION

The 1999 crop marked the first year of commercial production of NuSun. Basically one hybrid was available for planting on a large scale and it is estimated that approximately 36,000 tonnes (t) of NuSun oil was produced from approximately 61,000 ha. This provided a number of companies to do extensive testing of the oil. The oleic content of this first year production was about 54%, lower than the original target of 65%. Several regional potato chip companies began using the oil commercially and provided very positive reports regarding functionality and consumer response (NuSun News 2001). More hybrid cultivars of planting seed were available in the 2000 crop season and NuSun hectarage increased considerably. It is estimated that 115,000 t of NuSun oil was produced from the 2000 crop.

One of the concerns of the market place was segregating NuSun from traditional linoleic sunflower types at the point of "first handler." NuSun was priced at a premium to entice the producer to plant these new

cultivars. But it also provided an incentive for mixing of traditional seed with NuSun to gain the premium. Testing truckloads of sunflower at country points was needed to protect all of the players in the market chain. Innovative NSA members developed a simple test using an inexpensive hand held refractometer. The test is quick and provides the buyer a clear indication of oleic or linoleic type sunflower. The instrument does not provide a precise level of oleic acid. In the first two years of commercialization the minimum acceptable oleic level at the crushing plants was 50%. That was raised to 55% in the 2001 season. A borderline oleic sample tested at the elevator is often sent onto one of the crushing plants for a more definitive test on a gas chromatograph. A truckload of sunflower that does not meet the minimum oleic levels is sold as traditional sunflower and the farmer does not receive the NuSun premium.

Because of good communication and training, there were minimal market rejections because of low oleic content. The process was very smooth considering all of the probable problems that the committee was able to conjure. Anticipating those problems in a committee setting provided the basis for good communication and eventually problem avoidance.

In July of 2000, the NuSun program got the best news it could have wished. Procter & Gamble (P&G) announced that it would begin using NuSun sunflower oil in the production of its Pringles line of potato chips for North America, parts of Europe and Asia. This was a resounding vote of confidence by a major user. Subsequent reports from P&G confirmed that the oil was meeting their requirements. David Chang of P&G presented a paper entitled *The Experience of Using NuSun in an Industrial Frying Application* at the National Sunflower Association Research Forum in January 2001. He affirmed that NuSun has the required stability in a frying application because of its mid-range oleic (C18:1) level and negligible trace of linolenic acid (C18:3). Chang indicated that his company would prefer oleic acid levels in the range of 60% to 65% (average 58% in 2000 crop). He also noted very low polar compounds in NuSun in comparison to other oils. Low polar compounds are important for an extended shelf life in a finished product. He further suggested that NuSun's appealing, cleaner taste might be attributed to lower polar compounds (Chang 2001).

It is estimated that 200,000 tonnes of NuSun oil will be produced from the 2001 crop. Harvest of the 2001 crop has been completed and the average oleic level is 60%. This is much closer to the target of 65% set by the steering committee in 1995. The difference is the advent of new hybrids that have improved oleic stability.

CHALLENGES IN THE FUTURE

There is a great satisfaction among NSA members in what has been accomplished in such a short amount of time. The combination of the private and public sectors working together has been exceptional. Growers are enjoying a small premium in the market place and there is good demand for their production. However, challenges still remain.

The most immediate challenge is to continue to improve the NuSun hybrids in terms of oil content, yield, and other agronomic factors. This will happen through private and public research programs if there is sufficient demand for planting seed to justify the investment. The most immediate challenge is maintaining an adequate sunflower crop area base. First of all the world oil market has had sufficient supplies of soybean and palm (*Elaeis guineensis* Jacq.) oils. These surpluses pressure the market downward. This is especially painful for high oil content seeds like sunflower. Secondly, soybean cultivar improvements have allowed that crop to be planted in more western and northern areas. These areas were not sustainable for soybean production five years ago. The addition of "Roundup Ready" technology for soybean, canola, and other crops puts sunflower at a distinct disadvantage. Farmers have readily adapted this technology. It has simplified production of those crops.

To remain competitive, sunflower oil must generate more value in order to attract sufficient acres. That was and continues to remain the driving force for changing the sunflower industry to NuSun. NuSun does provide superior performance for frying applications without requiring hydrogenation, it provides a very pleasing taste profile, its high level of oleic acid has recognized health benefits and the crop is conventionally breed. All of those positive attributes must add up to greater value compared to traditional sunflower oil. There is confidence that the market will recognize that value.

REFERENCES

Campbell, E.C., J. Gerdes, and T.R. Tiffany. 2000. NuSun frying stability. Proc. 22nd Sunflower Research Workshop. Natl. Sunflower Assn. p. 96–102.

Chang, D.S. 2001. NuSun quality and industrial frying application. Proc. 23rd Sunflower Research Workshop. p. 24–25.

Gupta, M.K. 1998. NuSun—the future generation of oils. INFORM 9:1150–1154.

Hardin, B. 1998. Mid-oleic sunflower hybrids debut. Agr. Res. 46(6):14–15.

Kleingartner, L. and K. Warner. 2001. A look at a new sunflower oil. Cereal Foods World 46:399–404.

NuSun News. 2001. Positive report from users of NuSun. Natl. Sunflower Assn. Winter ed.