US High Oleic Soybeans & High Oleic Soybean Oil Sourcing Guide for International Customers

Fourth Edition – August 2024

Prepared for

US Soybean Export Council

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

DISCLAIMER

This manual is intended as a general guidance document and for information purposes only. Material included in the manual was based on information obtained from various sources along with the industry expertise of the authors and may be subject to revisions and updates. Every effort has been made to ensure that the information provided is accurate.

I. INTRODUCTION AND SOURCING MANUAL PURPOSE

This sourcing manual is intended to provide international customers with basic background information to facilitate the sourcing of US produced High Oleic (HO) Soybeans and HO Soybean Oil. It has been updated from the Third Edition – August 2023 version to reflect the latest progress with High Oleic Soybean seed product development, including the introduction of non-GMO varieties, and new information on supply chain participants.

The development of the High Oleic Soybean is a major innovation that brings the food industry exciting market opportunities. Using cutting edge seed development technology, High Oleic Soybean Oil brings significant consumer health benefits along with major improvements in oil performance in both food service and food manufacturing applications. The excellent heat and oxidative stability of High Oleic Soybean Oil also has value in a variety of non-food industrial applications such as bio-based lubricants and industrial fluids.

High Oleic Soybeans are now being grown by US soybean farmers. Working with soybean processors and soybean exporters, the US soybean industry is committed to developing reliable, cost effective supply chains to service vegetable oil refining and soybean processing customers on a global basis.

High Oleic Soybeans are produced in Identity Preserved (IP) supply chains to avoid mixing with commodity streams, thereby preserving the higher value of the oil. For this reason, there are several supply chain management and market development factors that are different from commodity soybean or commodity soybean oil purchases.

Since many international oilseed crushers and refiners are unfamiliar with purchasing products in an IP system, this manual provides knowledge on coordinating contract production, understanding pricing considerations as well as procedures and timelines for handling and transport.

This updated Guide has been produced for the US Soybean Export Council (USSEC). Headquartered in St. Louis, Missouri, USSEC is a non-profit, single commodity organization dedicated to developing markets for soybeans and soybean products around the world on behalf of US soybean farmers and the US soybean industry.

II. EXECUTIVE SUMMARY

The US soybean industry is committed to continuous improvement in the quality and value of US grown soybeans to better meet the needs of international customers. A key milestone in that effort has been the successful development of the High Oleic Soybean, which produces a soybean oil with significant functionality and health benefits for the global food industry.

High Oleic Soybeans have substantially higher value compared to commodity soybeans. For this reason, identity preservation (IP) of HO Soybeans and HO Soybean Oil in the supply chain is necessary. While this method of production and supply chain management adds cost, the incremental added value of the oil is much greater than these costs.

To properly conduct a cost / benefit analysis, it is important to accurately quantify the value of the improved functionality benefits of HO Soybean Oil, relative to commodity soybean oil or other oils. The most significant value benefits from HO Soybean Oil compared to commodity soybeans and oil for the food industry include:

- A health benefit with a high level of heart healthy oleic fatty acid[1] (monounsaturated fat) comparable to that of olive oil along with reduced saturated fats
- Functionality that is comparable to partially hydrogenated oils and shortenings but without the creation of trans fats
- Up to 2 to 3 times longer fry life in food service applications
- Up to 2 to 3 times longer shelf life in packaged foods
- Opportunity to eliminate artificial preservatives
- A neutral, less oily flavor
- Less polymer buildup on cooking surfaces, resulting in reduced equipment cleaning costs
- Opportunity for soy-based solid or semi-solid shortenings with wide temperature range and excellent melting properties for bakery applications

[1] *The FDA authorized the use of a qualified health claim for oils high in oleic acid, including High Oleic Soybean Oil, and their relationship to a reduced risk of coronary heart disease when replacing oils higher in saturated fats. The claim can be added to the labels of qualifying High Oleic Soybean Oil-containing products. Source:* QUALISOY

USSEC and High Oleic Soybean seed developers are also conducting research to determine possible advantages with using High Oleic Soybeans and Oil in soy food applications such as soy concentrates and isolates in addition to traditional Asian soyfoods such as tofu, tempeh, natto, miso, and soymilk.

Research has been conducted by universities on the value of High Oleic Soybean Oil in animal feeding applications. Multiple studies have shown the inclusion of whole or roasted High Oleic Soybeans in certain dairy rations can lead to higher milk fat production and may be fed at higher inclusion levels than conventional soybeans without compromising overall production. This opportunity for increased milk fat production has been a key driver for the significant number of high oleic soybean acres now being grown for use in dairy feed rations.

For non-GMO High Oleic Soybeans, there may be additional value in the non-GMO soybean meal utilized for animal feeds or food products in markets that prefer non-biotech ingredients. There may also be increased value in the non-GMO nature of the High Oleic Soybean Oil.

High Oleic Soybeans have a positive sustainability story at the farm level as part of the US soybean industry's US Soy Sustainability Assurance Protocol (SSAP). This sustainability advantage is improved even further with the increased frying and shelf-life benefits of High Oleic Soybean Oil which may result in reduced packaging, handling, and transportation costs.

Food companies may find value in the product traceability benefits that are possible with the closed loop, identity preserved High Oleic Soybean supply chain.

Opportunities in non-food applications are also attractive, based on the excellent oxidative stability of High Oleic Soybean Oil. A variety of consumer and industrial lubrication products are in development or early-stage commercialization by several manufacturers. Application research is also underway on other biochemical and industrial fluid uses. In addition, the oleochemical industry has utilized High Oleic Soybean Oil as a feedstock for oleic acid recovery.

There are important differences with HO Soy Identity Preserved (IP) supply chains that first-time HO Soy buyers may not have experienced with commodity soybeans. A key factor is the need to manage a longer decision timeline with suppliers to help assure that production is coordinated to meet demand needs. Because HO Soybeans are a new product in early stages of introduction, there is not a significant uncommitted supply available for spot market demand. For larger volume needs, coordination discussions with suppliers should begin 18 to 24 months in advance of actual commercial product use.

In addition to standard soybean and soybean oil quality specifications, fatty acid (oleic, linolenic, etc.) levels of the HO Soybean Oil also need to be measured at key points along the value chain to assure customer specifications are met.

Because the protein and amino acid content of the meal from High Oleic Soybeans is comparable to commodity soybean meal, there is no need for an IP system for HO Soybean meal since it can be blended into existing commodity soybean meal supply chains. However, if desired, an IP system for the meal (protein) can be utilized for either non-GMO or biotech High Oleic Soybeans to capture the additional value in animal feed or human food applications.

The High Oleic traits are based on genetic changes in the soybean seed, currently achieved either through biotechnology, or conventional breeding. There are multiple HO seed technology developers in the US and therefore differences in the fatty acid profiles of the various seed products. However, the leading High Oleic Soybean products are seeing more consistent alignment around industry standards for composition of key fatty acids such as oleic and linolenic.

While HO Soybeans have generally been defined as having 70% or greater oleic content, there is growing emphasis by seed trait developers on achieving a 75% oleic and less than 3% linolenic content. It is still important to coordinate with suppliers on the specific seed product used and the resulting fatty acid profile that is desired. Fatty acids with the greatest impact on HO Soybean Oil functionality include oleic, linoleic, linolenic, stearic and palmitic.

Recently the Codex Committee on Fats and Oils (CCFO) voted to approve a standard for High Oleic Soybean Oil (HOSO). The standard will be advanced to the Codex Alimentarius Commission for final endorsement, which is scheduled for late November 2024. USSEC applauds the Food and Drug Administration (FDA) and the U.S. Department of Agriculture (USDA) for working to get the standard approved, which will help facilitate the exports of HOSO. The standard aims to facilitate trade by establishing a universally recognized benchmark for the product. In 2020, USSEC partnered with the FDA and USDA, representing the U.S. at Codex, to create a standard to the CCFO. Following efforts and support from regional partners, CCFO acknowledged the necessity for such a standard and tasked the FDA with forming a workgroup for its establishment in 2021. Since then, USSEC has collaborated with the FDA and USDA and other domestic stakeholders within the workgroup to develop the standard, with USSEC providing additional data such as acreage, availability, and composition. Codex standards are the only recognized international food safety guidelines, and they are used as an international reference to facilitate trade.

Because HO Soybean Oil represents a major change from commodity soybean oil, functionality testing in specific food applications is important to fully quantify the value benefits. Samples of both biotech and non-GMO HO Soybeans and Soybean Oil can usually be obtained from participating US suppliers to begin the evaluation process. USSEC staff and consultants can help facilitate these contacts and provide technical and supply chain development assistance.

III. BACKGROUND ON THE DEVELOPMENT OF THE HIGH OLEIC SOYBEAN

HO Soybeans were developed in the US through a collaboration between soybean farmers, seed companies and the soybean processing industry. Partial hydrogenation was widely used in the US food industry to give soybean oil much greater functionality in frying and food manufacturing applications. But with growing evidence that partially hydrogenated products containing trans fats had negative cardiovascular effects on human health, food companies began to eliminate partially hydrogenated soybean oil from their production. Since nearly 50% of US soybean oil was partially hydrogenated, oil demand risk was high for the US industry.

With the availability of new seed development technology and the commitment by the entire US soybean supply chain, work began in the early 2000's to "reinvent" soybean oil.

The goal was to change the fatty acid profile to provide greatly improved heat and oxidative stability, thereby eliminating the need for partial hydrogenation. In addition, health benefits were enhanced by reducing saturated fats and nearly tripling the amount of monounsaturated fatty acid (oleic) to levels comparable to olive oil.

Despite the designation "High Oleic Soybean Oil", it is important to remember that heat and oxidative stability are primarily impacted by the amount of linoleic and linolenic acid present in the oil. High Oleic Soybean Oils can have similar oleic acid content but differ greatly in linoleic and linolenic acids thereby affecting oil stability since these fatty acids are more susceptible to oxidation. For this reason, oil customer specifications should consider the level of all three unsaturated fatty acids (oleic, linoleic, linolenic) compared to commodity soybean oil.

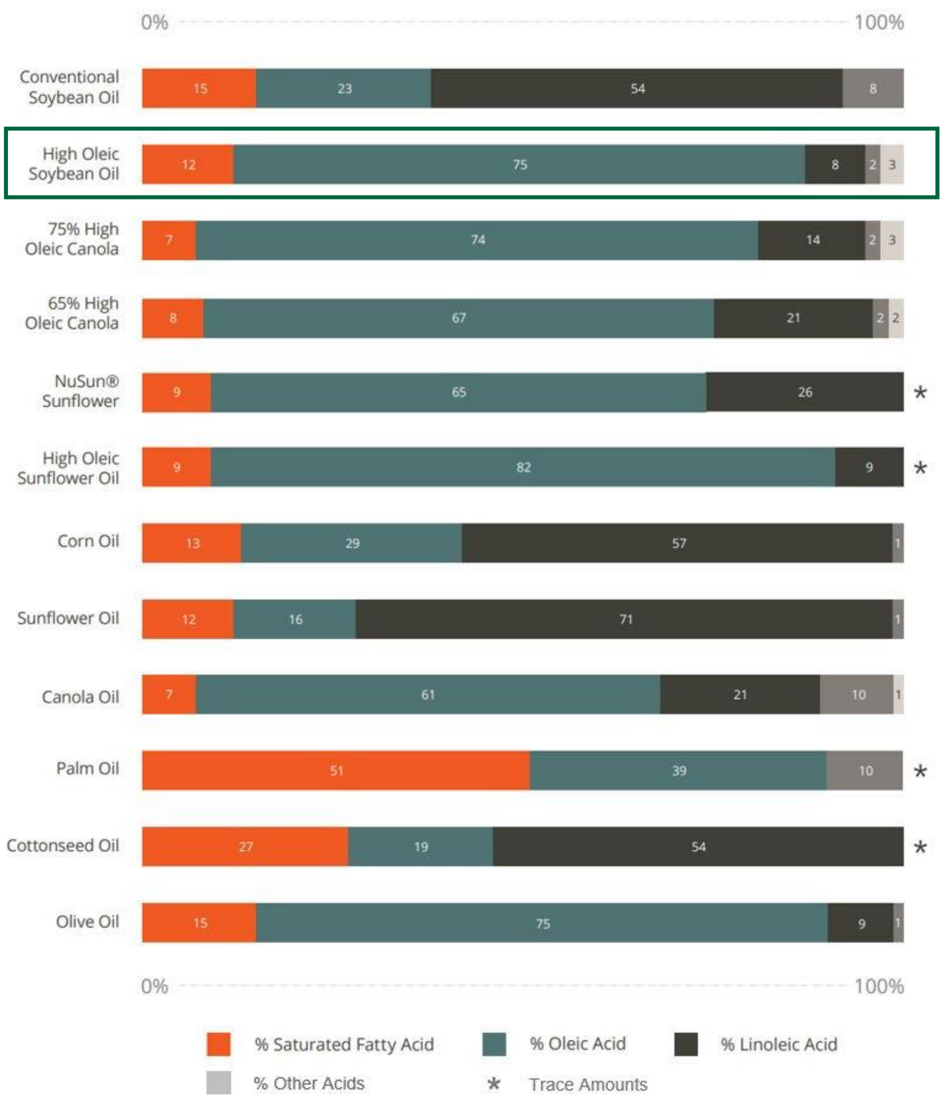
FIGURE 1: FATTY ACID PROFILE EXAMPLE

	Saturated		Monounsaturated	Polyunsaturated	
	Palmitic Acid C16:0	Stearic Acid C18:0	Oleic Acid C18:1	Linoleic Acid C18:2	Linolenic Acid C18:3
Commodity Soybean Oil	11%	4%	23%	54%	8%
Relative rate of oxidation[1]			1	40	98
High Oleic Soybean Oil[2]	≤ 8%	≤ 4%	≥ 75%	≤ 10%	≤ 3%
Olive Oil	12%	3%	75%	9%	1%

[1] *Lipid Oxidation, E. N. Frankel, 2005*
[2] ***The fatty acid profile** in the above table represents what the seed traits typically have been shown to produce using whole soybean Gas-Liquid Chromatography (GLC) analysis. Final oil profile of commercially available oil may be different from the above due to comingling with commodity soybeans or oil in specific supply chains.*

While no official fatty acid profile standard exists for HO Soybeans in the US, current commercially available High Oleic Soybean seed genetics are more consistently able to reach an oleic level of 75% or greater. This compares to a 22–25% oleic content in commodity soybeans. Other fatty acid changes will also be present, such as a significant reduction in polyunsaturates (linoleic and linolenic) as well as a reduction in saturated fat (palmitic acid). General industry seed product development targets include a specification for linolenic content of less than 3%. The fatty acid composition of High Oleic Soybean oil compares very favorably to competitive oils as shown in Figure 2.

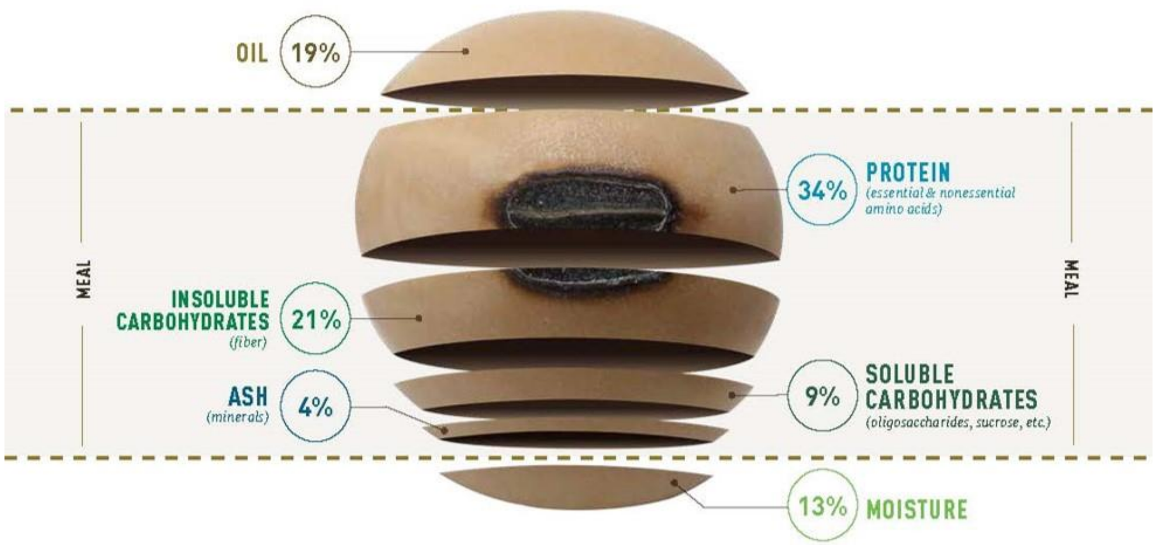
FIGURE 2: COMPARISON OF FATTY ACID PROFILES



Source: *United Soybean Board*

In addition to the improvement that was achieved in modifying the profile of the oil, researchers have also worked to keep the traditional balance between oil and protein content in the HO Soybean to maintain crush economics. Amino acid content of the HO Soybean meal was also not affected to facilitate blending with commodity soybean meal and to eliminate the need for identity preservation of the meal if desired. Other HO Soybean similarities to commodity soybeans include such factors as test weight, oil extraction characteristics, seed variety composition variation, and impact from extreme weather conditions during the growing season.

FIGURE 3: SOYBEAN COMPOSITION PROFILE



Source: *United Soybean Board*

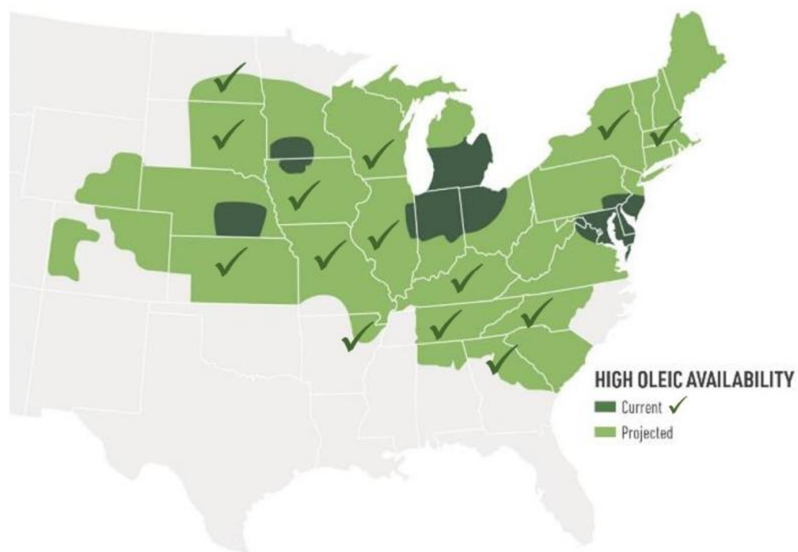
For farmers, it is essential that HO Soybean seed products also have the same high grain yields and necessary agronomic traits as current high-performance commodity seed products. This is necessary to assure that production costs are comparable to commodity soybeans and that HO premiums needed to cover added IP costs are kept as reasonable as possible and competitive with other high stability IP oils.

These general assumptions also apply to non-GMO High Oleic Soybeans, in that yield and agronomic performance must be as good or better than other commodity non-GMO soybean seed products.

With over 10 years of commercial HO Soybean production experience, research data has shown that current market leading HO Soybean seed products are providing farmers with yields comparable to other high yielding commodity soybean seed varieties.

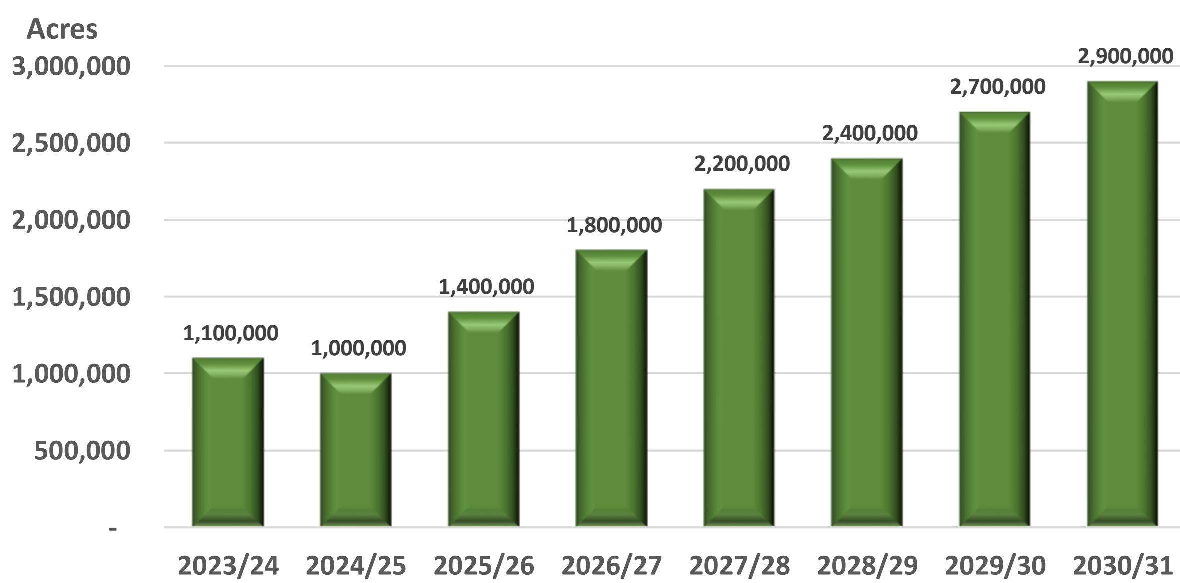
It is also necessary to develop seed products that are adaptable across multiple geographic areas to reduce supply risk from weather variation during the growing season. As a result of industry wide collaboration, the current and future projected HO Soybean growing geography in the US is diverse and the commercialization ramp-up plan is aggressive, as shown by the following chart.

FIGURE 4: PRODUCTION GEOGRAPHIES AND GROWTH PROJECTIONS



Source: *United Soybean Board & Industry*

FIGURE 5: HIGH OLEIC SOYBEAN ACREAGE PROJECTION



Source: *United Soybean Board (Acreage forecast subject to fluctuation)*

IV. CURRENT US HIGH OLEIC SOYBEAN TRAIT DEVELOPERS & TRAIT CHARACTERISTICS

TABLE 1: CURRENT US HO SOYBEAN TRAIT TECHNOLOGY DEVELOPERS AND PRODUCT INFORMATION[1]

High Oleic Soy Trait Technology Developer	HO Soy Product Name	Trait Development Technology	Oleic Range (%)	Linoleic Range (%)	Linolenic Range (%)	Total Saturates Range (%)
Bayer Crop Science	Vistive®Gold	Biotech	65 – 74[2]	17	3	6
Corteva™ Agriscience	Plenish®	Biotech	75 – 80	4 - 7	2	<12
Missouri Soybean Merchandising Council	SOYLEIC®	Non-GMO	78 – 84	6 - 8	1 – 3	<12

[1] *Information provided by HO Soybean Trait Technology Developers*
[2] *Depending on production location*

- The fatty acid profile ranges in the above table represent what the seed trait typically has been shown to produce using whole soybean Gas-Liquid Chromatography (GLC) analysis.
- Individual contractual terms for the oleic and linolenic fatty acid specifications may vary by supplier and should be clearly defined in negotiations.
- Production location, length of the growing season and weather conditions may also impact the profile.

V. IDENTITY PRESERVATION (IP) IN THE HIGH OLEIC SOYBEAN SUPPLY CHAIN

Identity preservation (IP) is the process of implementing and documenting the specific steps in the agricultural supply chain to isolate and preserve the unique characteristics of a shipment. IP designation prevents the loss of value through commingling during storage, handling, and transport. The concept of IP has been more widely practiced with the introduction of specialty crops such as High Oleic Soybeans and non-GMO crops. Added benefits of IP include traceability and consistent quality.

There are 2 basic identity preservation systems used in commercial grain production. They can be defined as follows:

- **Soft IP:** A less complicated and costly level of identity preservation. It is used when supply chain tolerance levels are not as strict as those used for non-GMO certification, but there is still a need to preserve the value and maintain higher grain quality. Quality testing is used to monitor adherence to contractual specifications. However, specification tolerances for farmers are much less stringent and easier to meet.

- **Hard IP:** A more complex process used for non-GMO products involving quality testing using strip tests, ELISA, or PCR assays for GMO presence. Grain production and handling protocols for farmers, grain handlers and processors require higher precision.

Seed products developed with biotechnology (GMO) such as Plenish® High Oleic Soybeans are commercially grown in a Soft Identity Preserved (IP) system process that involves all phases of the High Oleic Soybean supply chain. This is necessary to assure isolation from commodity soybean production and to preserve the unique fatty acid profile of High Oleic Soybean Oil.

Key elements and steps in an effective soft IP system include:

1. Identification of critical control points and risk factors impacting quality specifications
2. Development of action plans needed at each control point
3. Performance standards and metrics to measure effectiveness
4. Measurement tools and technology to enforce standards
5. Economic incentives to reward chain participants for successful performance

The High Oleic Soybean IP system begins with the production of specially developed seed varieties by seed companies. Before seed products are sold to farmers, they must meet quality standards that assure High Oleic commercial soybeans will produce oil consistent with customer specification requirements.

The commercial production guidelines of the IP system are usually implemented through contracts between the farmer and the soybean processor or exporter. These contracts specify quality control requirements that must be met by the farmer to assure that the value of HO Soybeans is maximized. All farming operations, including planting, production, harvesting, storage, and transport are managed to preserve the identity of the High Oleic Soybeans.

All loads of HO Soybeans that the farmer sells to participating elevators, soybean processors or exporters are tested to assure that quality standards are met, including the oleic and linolenic fatty acid content. Farmers are then paid a premium above commodity soybean prices to cover the added costs of these IP requirements.

US processors and soybean exporters who have the production contracts with farmers are responsible for managing soybean delivery schedules for crush or soybean exports. In cases where country elevators are used to aggregate HO Soybean supplies, processors or exporters establish quality control standards that must be met to assure IP specifications are achieved. This may require equipment to test all inbound soybeans for fatty acid composition and other soybean quality factors.

Soybean processors manage identity preservation of the soybeans and oil throughout the crush process. This includes procedures for dedicated high oleic crush runs, isolation of HO Oil in identity preserved tanks, and management of shipping logistics.

In a similar fashion, HO Soybean exporters maintain strict IP quality control procedures to prevent mixing with commodity soybeans. This includes management and isolation of transport vessels to the point of customer delivery.

Non-GMO High Oleic Soybean seed products such as those containing the SOYLEIC® trait are developed using traditional plant breeding and are commercially grown in a hard IP system. In addition to the Soft IP procedures used for biotech High Oleic Soybeans, additional steps are taken to assure non-GMO classification for the soybeans, oil and in some cases the meal. These steps include:

1. Verification of the seed variety's non-GMO classification
2. Thorough cleaning of planting equipment to prevent co-mingling with GMO seed
3. Thorough cleaning of harvesting and grain handling equipment, storage facilities and transportation equipment
4. Testing of soybeans using test strips, ELISA, or PCR assay technology to verify non-GMO classification

Specific hard IP practices used to establish non-GMO tolerances may differ by supplier and should be documented as part of the purchasing negotiations.

SUSTAINABILITY AND TRACEABILITY VALUES:

High Oleic Soybeans have a positive sustainability story at the farm level as part of the US soybean industry's US Soy Sustainability Assurance Protocol (SSAP). This sustainability advantage is improved even further with the increased frying and shelf-life benefits of High Oleic Soybean Oil which may result in reduced packaging, handling, and transportation costs.

Food companies may find additional value in the product traceability benefits that are possible with the closed loop, identity preserved High Oleic Soybean supply chain.

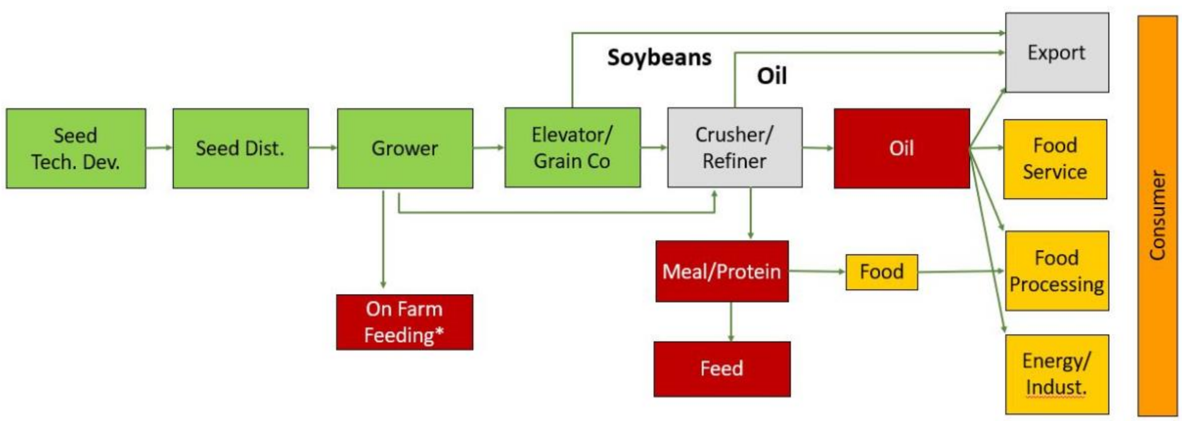
VI. WHY FORWARD CONTRACTING IS NEEDED TO PURCHASE HO SOYBEANS AND HO OIL

High Oleic Soybeans are in the early stage of market introduction. For this reason, soybean processors and exporters do not have large uncommitted supplies of HO Soybeans and HO Oil to meet higher volume spot market demand. The contracting system helps to assure that HO Soybean production volumes are in place to meet the demand from customers.

High Oleic contracting also helps coordinate the actions needed by all participants in the supply chain. The critical functions include seed supply availability from seed companies, production of commercial soybeans by the farmer, soybean storage and transport, and processing or exporting of soybeans.

A generalization of the US High Oleic Soybean supply chain is shown in the following graphic. In some cases, supplier companies may be involved in one or more steps in the supply chain. As an example, some seed companies are further vertically integrated into contracting with growers, crushing/refining, and exporting.

FIGURE 6: US HIGH OLEIC SOYBEAN SUPPLY CHAIN



** On-farm whole HO Soybean feeding to dairy cattle for higher milk fat content*

TABLE 2: PRIMARY RESPONSIBILITIES OF HIGH OLEIC SUPPLY CHAIN PARTICIPANTS

Seed Companies	1. High yielding seed products, adapted to specific production areas 2. Consistent oil fatty acid profile over multiple growing seasons 3. Good protein and oil content balance in the soybean 4. Obtaining export regulatory approvals as needed 5. Seed supply and distribution to contract growers to meet demand
Farmers	1. Commit to a contract with US processor or exporter that specifies grain premiums, IP requirements, delivery terms and grain quality standards 2. Evaluate HO seed variety performance data to meet requirements for yield and agronomics 3. Place the seed order, usually about 6 months prior to planting 4. Clean planters to avoid commodity mixing, plant in dedicated fields with soils that optimize seed genetics 5. Clean harvest and soybean transport equipment 6. Arrange storage in dedicated, cleaned bins, or deliver at harvest to dedicated elevators or the processor 7. Do not co-mingle HO Soybeans with commodity soybeans during handling and transport to assure oleic and linolenic fatty acid and other quality specifications are met since testing may occur at delivery locations 8. Receive HO Soybean premium from the processor or exporter at contract completion and settlement
US Processors/ Exporters	1. Secure customer volume commitments by September of the year before commercial production in order to place farmer contracts 2. Determine contract production locations and acreage targets 3. Determine specific HO Soybean seed trait to establish oil specification, coordinate with seed company to assure seed supply 4. Recruit growers, establish premiums and IP requirements, secure grower contract agreements 5. Arrange for a network of country elevators to aggregate IP soybean volumes and to provide convenient farmer deliveries 6. Manage scheduling for deliveries, crush, or soybean export timing 7. Test inbound soybeans for fatty acid composition and other grain quality factors 8. Manage IP for shipping and handling of oil and soybeans 9. Establish fatty acid specifications with buyer(s). Oleic fatty acid content offered is typically in the 70 to 75% range and linolenic fatty acid typically 3% or less

Soybean Importers and Refiners	1. Obtain HO Soy product samples, evaluate functionality values with end use customers prior to entering contract negotiations 2. Determine fatty acid and oil quality specification requirements based on functionality needs of end use customers 3. Plan for delivery timelines, based on IP production requirements 4. Evaluate and select suppliers from participating US seed developers, processors, and soybean exporters. Specify HO Soybean seed trait to meet specifications 5. Confirm pricing, delivery timeline and fatty acid specification commitments with suppliers 6. Determine IP requirements for inbound handling and processing and educate employees on IP implementation 7. Receive soybean and/or oil shipments and maintain IP in handling and processing

VII. KEY STEPS IN PURCHASING HIGH OLEIC SOYBEANS OR HIGH OLEIC SOYBEAN OIL

The purchasing of HO Soybeans or HO Soybean Oil involves several steps that are different from placing orders for commodity soybean oil or commodity soybeans. Important differences include:

1. **Determining who can supply High Oleic Soybeans or High Oleic Soybean Oil for your market.** Not all US soybean exporters or soybean processors are engaged in contract production of biotech or non-GMO High Oleic Soybeans. USSEC staff and consultants can provide guidance on current suppliers and help facilitate sample requests.

2. **Determining the required High Oleic Soybean or High Oleic Soybean Oil specifications that are needed for the desired application, whether it be for food service, packaged food production or another end use.** In addition to quality specifications used for commodity soybeans or soybean oil, fatty acid requirements can include oleic, typically 70 to 75% and linolenic usually at 3% or less. Suppliers should also verify export regulatory approval status, if needed.

3. **Requesting High Oleic Soybeans and Oil samples from a specific supplier.** Because individual HO Soybean products may have different fatty acid profiles, it is important to receive a sample that is representative of a given supplier's commercial HO product offering. This assures that the HO product purchased has the necessary functionality needed for the desired application.

4. **Initiating supply and pricing discussions with potential suppliers.** Because of the timeline associated with HO Soybean production, a key negotiation topic will involve lead times necessary for whole soybean or oil delivery. The ability of the supplier to reliably

meet fatty acid specifications is also a critical factor. An important consideration is the HO seed source used for the supplier's HO Soybeans, since the various seed HO Soy traits have some variation in fatty acid profile that can impact functionality. Determining whether a non-GMO product is needed is also a key step. It is also helpful to assess the level of technical support that the HO Soy supplier can provide to facilitate oil application testing and market development.

5. **Negotiating the final contract for HO Soybeans or Oil.** In addition to pricing and the delivery time period and method, the buyer and seller should agree on the final fatty acid specifications to include in the contract, along with normal commodity contractual terms. The analytical method used for the official sample analysis needs to be specified in the contract. If a buyer intends to utilize NIR rapid testing at its inbound facilities, they should ask suppliers to provide the appropriate NIR calibrations for accurate fatty acid determination (oleic and linolenic acid content).

VIII. HIGH OLEIC PURCHASING SIMILARITIES AND DIFFERENCES TO COMMODITY

HO similarities and differences to commodity soybean / soybean oil procurement processes are summarized in the following table.

TABLE 3: PURCHASING SIMILARITIES AND DIFFERENCES

HO Soybean and HO Oil Purchasing Considerations Compared to Commodity Soybeans and Oil	
Similarities	***Differences***

• Traded under normal soybean / oil contract terms (NEAGA, GAFTA, NOPA, NIOP or FOSFA) and as referenced in the USSEC Buyers' Guide[1]
• Priced off the CME futures
• USDA GIPSA/FGIS soybean standards apply:
  ○ Test weight
  ○ Moisture
  ○ Damage
  ○ Foreign material
  ○ Splits
  ○ Other colors
• Strip tests, ELISA and/or PCR assays or other industry-approved test methods may be used to confirm non-GMO classification
• AOCS test methodologies are valid for refined oil specifications:
  ○ Flavor
  ○ Color
  ○ FFA
  ○ Peroxide Value
  ○ Moisture
  ○ Iodine Value
  ○ Cold Test
  ○ Stability/OSI
• Larger quantities of HO Soybeans or HO Soybean Oil can utilize existing freight channels
• Same Harmonized System codes used for customs declaration[3]:
  ○ Soybeans: 1201
  ○ Soybean Oil: 1507
	• Isolation of HO soybeans / HO oil throughout the handling, shipping and receiving process
	• More detailed HO specific contract negotiation issues and specifications
	• Determination of HO pricing premium above commodity soybean / soybean oil, based on identity preservation (IP) costs
	• Specifications for fatty acid composition
	• Lack of spot market supply for larger commercial orders, which necessitates contract arrangements
	• Longer timeline considerations for delivery
	• Unique Chemical Abstracts Service (CAS) number for HO Soybean Oil (1280732-24-2)
	• Iodine Value (IV) of HO oil[2]:
	  ○ Commodity Soy IV range 120–143
	  ○ High Oleic Soy IV range 75–105
	• Cold temperature properties for HO that may need to be managed
	• Unique Codex standard for HO Soybean Oil

• Can utilize same CME soybeans and soybean oil futures & options market risk management tools	

IX. TIMELINE FOR PROCURING HIGH OLEIC SOYBEANS AND OIL

NEAR-TERM, SMALLER VOLUME TIMING CONSIDERATIONS:

For smaller, introductory volumes of High Oleic Soybeans and High Oleic Oil, US processors and exporters may have supplies available. Interested international processors or refiners should contact US suppliers for availability.

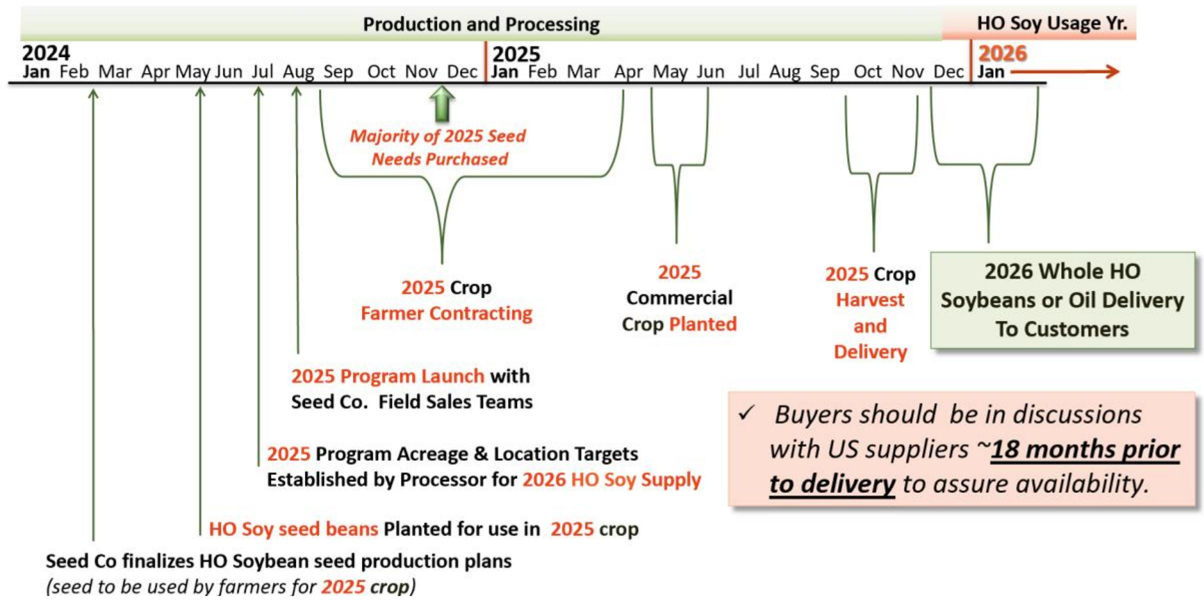
LONGER-TERM, HIGHER VOLUMES FOR ONGOING COMMERCIAL USAGE:

For larger, ongoing supplies longer range planning is needed. Unlike commodity soybeans, HO Soybeans are produced in an IP system that requires coordination of seed production and placement with farmers, planting and harvesting of commercial HO Soybeans, and coordination with processors and exporters on supply chain logistics. And because HO Soybeans are currently still in the early stage of export market introduction, there is a limited uncommitted supply available for spot market demand.

When these factors are considered, the optimal lead time for expressing interest in securing larger commercial supplies of High Oleic Soybeans or High Oleic Soybean Oil can be 18-24 months. This helps provide the greatest assurance of on-time deliveries and lowest cost of procurement.

The key steps in the High Oleic Soy production timeline are shown in the diagram below, using the 2025 crop year as an example.

FIGURE 7: HIGH OLEIC SOY EXTENDED PLANNING TIMELINE


Production and Processing
HO Soy Usage Yr.
2024
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2025
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2026
Jan
Majority of 2025 Seed Needs Purchased
2025 Crop Farmer Contracting
2025 Commercial Crop Planted
2025 Crop Harvest and Delivery
2026 Whole HO Soybeans or Oil Delivery To Customers
2025 Program Launch with Seed Co. Field Sales Teams
2025 Program Acreage & Location Targets Established by Processor for 2026 HO Soy Supply
HO Soy seed beans Planted for use in 2025 crop
Seed Co finalizes HO Soybean seed production plans
(seed to be used by farmers for 2025 crop)
✓ Buyers should be in discussions with US suppliers ~18 months prior to delivery to assure availability.

X. QUANTIFYING THE VALUE OF HIGH OLEIC SOYBEANS AND OIL, RELATIVE TO COSTS

To provide the basis for conducting a cost/benefit analysis, it is important to accurately quantify the value of the improved functionality benefits of HO Soybean Oil, relative to commodity soybean oil or other oil products.

Major value creation categories that should be considered, evaluated, and quantified include:

1. **Health benefits** from 0 grams of trans fats[1], more than 20% reduction in saturated fats, high level of heart-healthy oleic fatty acid[2] (monounsaturated fat) comparable to that in olive oil
2. **Cleaner/lighter flavor** with less oily taste, also provides a good blending opportunity
3. **High OSI** (Oxidative Stability Index) in the 25 to 30 hour range
4. **Up to 2 to 3 times longer fry life** than conventional soy for fewer oil changes, less packaging waste
5. **Up to 2 to 3 times longer shelf life** in packaged foods compared to commodity soy
6. **Higher smoke point** that is about 10 degrees higher than commodity soy, HO canola, or HO sunflower oils
7. **Easier cleaning of cooking surfaces** from reduced polymer formation, with less greasy, varnish-like coatings on equipment surfaces
8. **Cleaner ingredient label opportunity** by eliminating the need for synthetic antioxidants (such as TBHQ, EDTA) given HO Soybean Oil's excellent oxidative stability

[1] Less than 0.5g trans fat per serving based on US FDA guidelines
[2] The FDA authorized the use of a qualified health claim for oils high in oleic acid, including high oleic soybean oil, and their relationship to a reduced risk of coronary heart disease when replacing oils higher in saturated fats. The claim can be added to the labels of qualifying high oleic soybean oil-containing products. Source: Qualisoy

USSEC and High Oleic Soybean seed developers are also conducting research to determine possible advantages with using HO Soybeans in soy food applications such as soy protein concentrates and isolates in addition to traditional Asian soy foods.

Research has been conducted by universities on the value of High Oleic Soybeans in animal feeding applications. Multiple studies have shown the inclusion of whole or roasted High Oleic Soybeans in certain dairy rations can lead to higher milk fat production and may be fed at higher inclusion levels than conventional soybeans without compromising overall production.

For non-GMO High Oleic Soybeans, there may be additional value in the non-GMO soybean meal utilized for animal feeds or food products in markets that prefer non-biotech ingredients. There may also be increased value in the non-GMO nature of the HO Soybean Oil.

XI. PRICING FACTORS FOR HO SOYBEANS OR OIL ON A PREMIUM PLUS BOARD BASIS

Premiums required for High Oleic Soybeans, meal and oil will be driven by overall commodity soybean prices. Important factors include the price of competing commodities, soybean supplies as a result of crop year weather conditions, and overall soybean and oil demand.

As an example, premiums paid to farmers will likely need to be higher in years of high soybean prices because of the need to provide extra incentives for them to produce an IP crop. The reverse is true in times of lower commodity soybean prices. In this analysis, efforts have been made to provide the perspective of a more normal soybean price environment rather than the more extreme pricing volatility seen recently.

HO Soybeans and HO Soybean Oil are traded in the same manner as their commodity counterparts except for the additional premium associated with HO's unique supply and demand factors and supply chain IP considerations. The intrinsic value of HO Soybean Oil is attributed to its superior functional benefits over commodity soy. This includes increased heat and oxidative stability which is directly related to the increased oleic and reduced polyunsaturated fatty acid content.

In order to ultimately deliver these benefits to the final end-user it is important for the entire HO supply chain to minimize mixing with commodity soybeans or oil, which would alter the final fatty acid profile and result in diminished performance for the end user.

The premium for HO soybeans and oil is driven by several primary factors:

- Premiums paid to US farmers to grow and deliver HO Soybeans under identity preservation guidelines to minimize cross-mixing with commodity soybeans. Premiums paid to farmers may vary depending upon seed product yield and whether non-GMO IP is required.
- Possible higher transportation costs for farmers to deliver the HO Soybeans to IP elevators that may be a greater distance than their usual delivery location.
- Segregation costs for other supply chain partners such as receiving elevators, processors, and shippers to minimize mixing with commodity soybeans.
- Fatty acid measurement technology at receiving locations and key processing steps to assure specifications are met.
- Supply/demand of competitive oilseeds and other fats and oils.
- Profit margin requirements for supply chain participants to manage a more complex IP system relative to commodity soy.

As with commodity soy, the HO Soybean basis premium is dynamic and variable. However, due to the closed loop supply chain structure needed to maintain specific HO Soybean trait purity, there is no significant amount of open trading of either HO Soybeans or Oil within the US soybean industry. A supplier's unique situation either in end-user demand and/or capacity to take on new sales commitments will impact their HO Soy premium.

Except for the High Oleic Soy premium, High Oleic Soybeans and Soybean Oil can utilize the same CME soybeans and soybean oil futures & options market risk management tools.

The High Oleic Soy premium is expressed as:

- For Whole HO Soybeans – premium over the commodity #2 Yellow soybean basis
- For HO Soybean Oil – premium over the appropriate commodity soybean oil basis
- For non-GMO High Oleic Soybeans and Oil, additional costs for non-GMO production and IP verification are in addition to the other pricing variables.

The High Oleic Soy premium for either whole Soybeans or Oil can be contracted in advance to the actual shipment position by establishing a basis contract with the seller. The final flat price can then be established through the CME futures market up to commencement of the delivery period.

HIGH OLEIC SOY PREMIUM EXAMPLE:

A. Biotech High Oleic Soy Premium Examples:

- Current farmer biotech High Oleic Soybean IP premiums generally range from $1.00 to $1.75 per bushel.
    - At 11.75 pounds of oil per bushel, this farmer premium adds a cost of $0.09 to $0.15 per pound of solvent extracted HO Soybean Oil
    - HO Soy premiums may vary over time as a result of soybean price changes, economies of scale, and availability of other competitive oils

Estimated US market Biotech High Oleic Soybean Oil Premium Range[1] for the 2024/25 Crop is estimated to be +$.10 to $.20 per pound over commodity RBD soybean oil.

[1] Based on High Oleic seed varieties that are generally yield equivalent to high yielding commodity soybean seed varieties

B. Non-GMO High Oleic Soy Premium Examples:

- Current farmer non-GMO IP premiums generally range from $1.50 to $2.50 per bushel.
    - At 11.75 pounds of oil per bushel, this farmer premium adds a cost of $.13 to $.21 per pound of solvent extracted non-GMO High Oleic Soybean Oil
    - At 7.0 pounds of oil per bushel, this farmer premium adds a cost of $.21 to $.36 per pound of expeller-pressed non-GMO High Oleic Soybean Oil

The US Market Premium for non-GMO HO Soy Oil has not yet been established due to insufficient quantities of openly traded volume at this time.

XII. US SOURCES OF HIGH OLEIC SOYBEANS AND OIL FOR EXPORT

TABLE 4: CURRENT US HIGH OLEIC SOY SUPPLIERS AND SEED TRAITS OFFERED

HO Soy Supplier*	Current HO Soy Trait(s)
ADM[2]	Plenish
Benson Hill[2] [3]	SOYLEIC
Brushvale Seed[1]	SOYLEIC
Bunge[2]	Plenish
Catania Oils[3]	Plenish
CHS[2]	Plenish
Clarkson Grain[1]	SOYLEIC
Perdue Agribusiness[2]	Plenish
Quality Roasting[2] [3]	Plenish
Scoular[1]	SOYLEIC
Stratas Foods[3]	Plenish
Zeeland Soya[2]	SOYLEIC

**Contact information for each HO Soy supplier is included in the Appendix*
[1] HO Soybeans
[2] HO Soybeans and Oil
[3] Packaged HO Soybean Oil Supplier for Food Service & Less Than Truckload Quantities (drum/totes/35 lb. containers)

XIII. DOCUMENTATION AND INSPECTION REQUIREMENTS

A. UNDER SOFT IP SYSTEMS USED FOR BIOTECH HO SOYBEANS AND HO SOYBEAN OIL

There is no standard allowance for the specific level of mixing of commodity soybeans or commodity soybean oil with High Oleic Soybeans or High Oleic Soybean Oil. For this reason, it is important that purchase contracts contain specific fatty acid profile specifications of whole HO soybeans for HO Oil rather than a level of mixing specification. This is critical since the increased value is determined by the improved fatty acid profile in comparison to commodity soy. Buyers will want to receive the proper certification of analysis for the corresponding shipments.

In the case of whole HO Soybeans, the most rapid and reliable method to check the oleic and linolenic fatty acid content along with protein and oil content is by using near infrared (NIR) spectroscopy. While relatively new for widespread usage throughout the soybean supply chain, NIR technology has been widely accepted and officially sanctioned for many grains and for other testing applications in the food industry.

If NIR is used, it is important to verify with HO Soy suppliers that the NIR calibration software was developed to accurately measure the specific HO Soybean seed and trait source being tested. There currently is no single industry HO Soybean NIR calibration being used across the various HO Soybean supply chains.

For HO Soybean Oil the most accurate determination of the oil's fatty acid composition (FAC) is by use of gas–liquid chromatography (GLC). This test procedure is an established method as outlined by the American Oil Chemists' Society (AOCS) and is used by most US soybean oil companies and referee analytical laboratories to report actual FAC results for certificates of analysis.

B. UNDER HARD IP SYSTEMS FOR NON-GMO HO SOYBEANS AND OIL

All documentation and inspection procedures used for GM High Oleic Soybeans and Oil should be used for non-GMO High Oleic Soybeans and Oil in order to assure purity of the High Oleic Soybean Oil properties.

In addition, hard IP practices and testing methods used for commodity non-GMO soybean supply chains should also be applied. **Specific non-GMO specifications, tolerances and compliance procedures may differ by supplier and should be documented as part of the purchasing negotiations.**

XIV. DELIVERY OPTIONS FOR HO SOYBEANS OR OIL

Delivery options for either HO Soybeans or HO Oil are similar to what international buyers often use for importing to their specific destinations. However, as the HO soy market is not nearly as advanced as that for commodity soy, the initial delivery modes might need to accommodate smaller quantities than those used for commodity soybeans or oil. In addition, a given buyer's limitation for onsite segregated storage combined with their initial market demand for the final refined HO Soybean Oil might result in the need to contract smaller quantities.

Buyers will want to discuss early on with potential suppliers what logistical capabilities their supply chain can handle and which export destinations they can reach. Delivery transportation methods might include:

1. 30 Kg bags (minimum one container)
2. One metric ton tote bags
3. Twenty Food Equivalent (TEU) containers
4. Flexitanks in 20-foot containers (oil)
5. ISO tanks (oil)

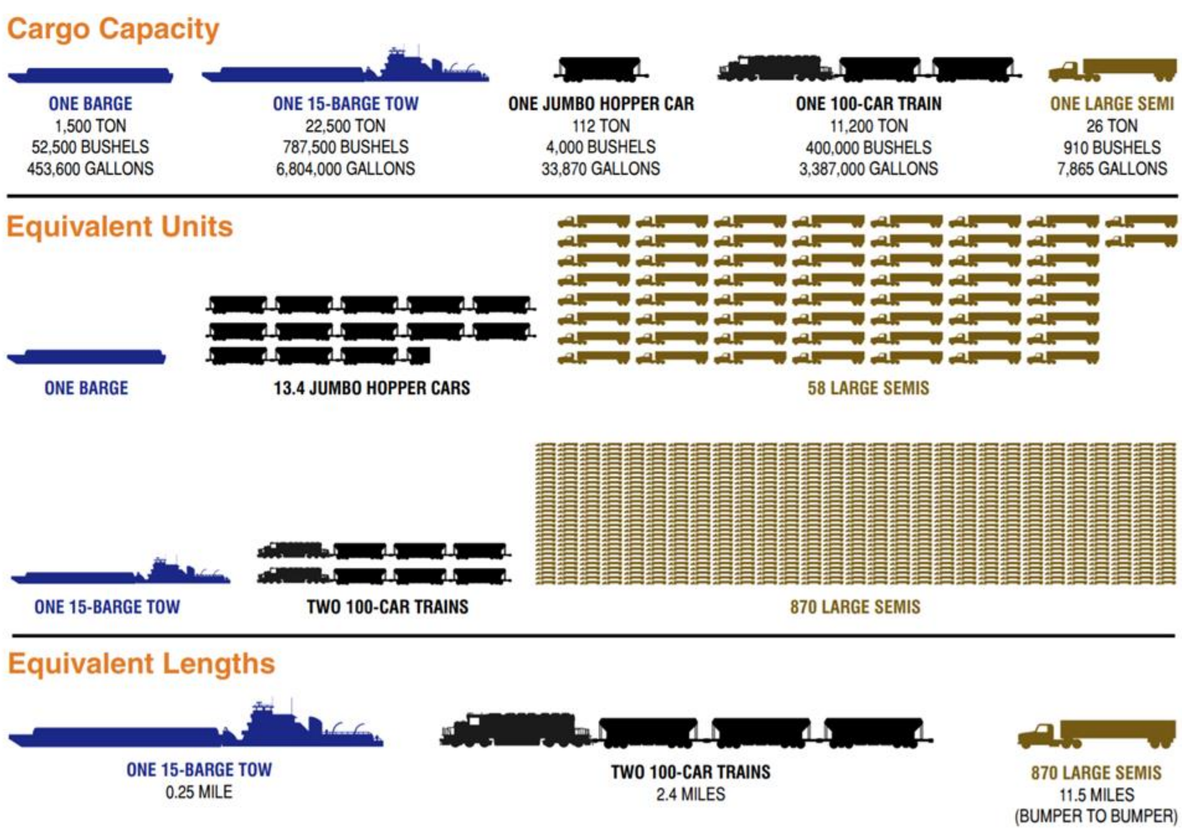
6. Jumbo hopper or tank cars
7. Barges
8. Vessel holds

Segregation considerations for a given shipment need to be taken into consideration at each transfer point where there is a risk for comingling with either commodity soybeans, oil, or other previously handled items. A buyer will want to follow basic Soft IP guidelines in order to minimize any comingling prior to final delivery.

For non-GMO HO Soybeans or Oil, the Hard IP guidelines should be followed to protect the non-GMO classification of the soybeans, oil, and meal. IP procedures will include more detailed segregation practices and non-GMO testing.

Bulk grain and vegetable oil transportation options and capacities and logistics flows are show in Figure 8, Table 4 and Figure 9.

FIGURE 8: BULK GRAIN TRANSPORT



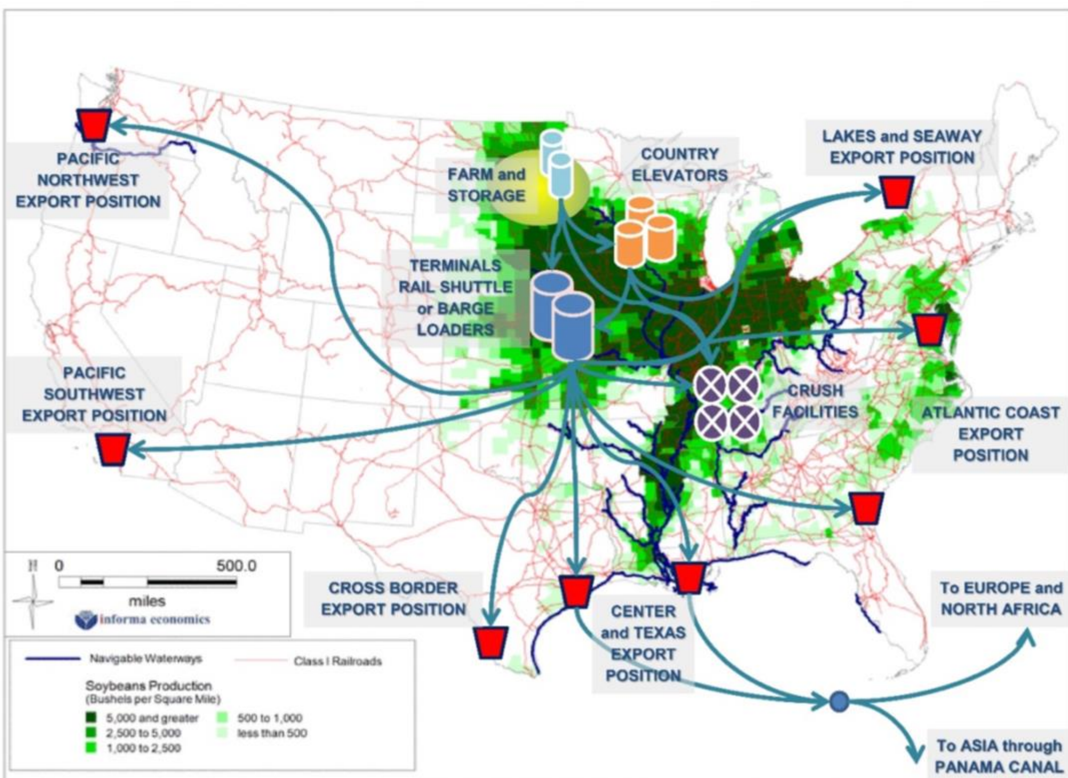
Source: Iowa Department of Transportation

TABLE 5: BULK VEGETABLE OIL TRANSPORT

Transport Method	Approximate Capacity / Net Weight*
Steel Drum	420 lb.
Intermediate Bulk Container Tote (IBC) - rigid	275 gal / 2,100 lb.
IBC Corrugated Tote - collapsible	275 gal / 2,100 lb.
Flexitank for ISO TEU Container	48,000 lb. / 22,000 kg / 6,300 gal / 24,000 liters
ISO Tank Container	48,000 lb.
Jumbo Tank Car	25,500 gal / 185,000 lb. OR
May be insulated with exterior coils	28,000 gal / 205,000 lb.
Tank Truck Wagon	48,000 lb.
Liquid Barge	3,000,000 lb.
Bulk Liquid Vessel	Varies by charter booking

**Mutually agreed upon between Buyer and Seller*

FIGURE 9: SOYBEAN LOGISTICS FLOW



Source: *United Soybean Board*

XV. DETAILS ON STORAGE OF HO SOYBEANS AND OIL

The most important consideration when storing either High Oleic Soybeans or High Oleic Soybean Oil is minimizing comingling with commodity soybeans or oil. The tolerance for comingling should be established between buyer and seller. For biotech High Oleic Soybeans and Oil, specification tolerances can be effectively managed through implementation of the Soft IP process. Maintaining HO Soy product purity is always a critical factor to maximize value capture from the increased functionality of the final refined HO Soybean Oil.

For non-GMO HO Soybean and Oil storage, maintaining product purity specifications is best accomplished through the more stringent Hard IP process which includes additional handling and testing procedures utilized for non-GMO supply chains.

For all HO Soybean oils, fatty acid specification management is important in determining oil functionality and value. As an example, for every one percent mixing of commodity soybeans with 23% oleic content with HO Soybeans with 75% oleic content, the resulting oleic content of the co-mingled oil would drop to 74.5%. So, at a 10% mixing of commodity soybeans with HO Soybeans, the resulting oleic content of the co-mingled oil would drop to 70%. This level of change, along with the associated increase in polyunsaturated fat content, could have a significant negative impact on the HO Soybean Oil's performance in food applications.

Storage of HO Soybean Oil is similar to commodity soybean oil except that the HO oil may be stored longer before the oil begins to deteriorate in quality. Cold temperature properties of HO Soybean Oil also may differ. There is a very different unsaturated fatty acid profile for HO (75-85% oleic, 7–20% polyunsaturates) compared to commodity soybean oil (23% oleic, 62% polyunsaturates).

For this reason, the handling characteristics of HO Soybean Oil will be different when exposed to lower temperatures and is similar to that of olive oil. Olive oil naturally solidifies once temperatures drop below 2–4 degrees C (35–40 degrees F), slowly changing from a liquid oil at room temperature to ultimately a solid once temperature reaches -12 to -18 C (10 to 0F).

Congealing and solidification might occur either with bulk HO Soybean Oil transport or in storage tanks located in colder climates or when using HO Soybean Oil in refrigerated conditions. While most HO Soybean Oils will meet a 5.5-hour cold test, which is typical for bottled retail salad oils, exposure to near freezing or lower temperatures for greater periods of time will result in HO Soybean Oil viscosity increases and ultimately solidification if temperatures are low enough.

Laboratory testing of HO Soybean Oil has indicated increased viscosity onset at ~-10°C and solidification onset at -16 to -23°C. It should be noted however that the volume of oil and other physical factors will affect the actual temperatures at which oil may change physical states.

This solidified state does not harm the oil, which will return to a liquid once the oil is warmed above freezing. If a buyer anticipates the exposure of HO Soybean Oil to cold temperatures, either in bulk transport or storage it is advisable to use insulated transport vessels and/or tanks that can also be gently heated along with heat traced insulated pipes. Bulk tanks with agitation in addition to steam coils will also help in keeping the oil circulating for uniform exposure to the heat source.

XVI. MAINTAINING IDENTITY PRESERVATION FOR HO SOYBEANS AND OIL

RECEIVING AND HANDLING

Typical IP guidelines for handling HO Soybeans would include:

1. Conduct employee training on High Oleic Soybean IP protocols.
2. If possible, utilize storage facilities that do not share dump pits & grain legs with other grain at time of the HO Soybean delivery.
3. Clean or use dedicated grain pits, grain legs and grain conveyance to minimize mixing HO Soybeans with other grain or commodity soybeans.
4. Prior to delivery, all bins used to store HO Soybeans should be cleaned (bin swept) and visually verified to be free of other grain.
5. Visually check that trucks are clean of other grain prior to hauling HO Soybeans.
6. Test each incoming HO Soybean load with NIR for oleic and/or linolenic content.

CRUSHING

Typical IP guidelines for crushing HO Soybeans:

1. Conduct crush plant employee training on High Oleic Soybean IP protocols.
2. Use the same IP guidelines as above for handling whole HO Soybeans up to point of crushing.
3. Determine whether crush plant will:
    a. Shut down and clean out prior to beginning the HO crush run or
    b. Begin HO crush without shutting down and test oil exiting extractor to determine when to begin segregating to designated crude HO Soybean Oil tank.
    c. Each processor will need to determine which method best suits their unique plant situation and will minimize comingling of commodity and HO Soy crude oils and related flush costs. Cost factors include downtime, cleaning expenses and loss of HO Soybeans or HO crude oil to lower valued commodity stream.
4. HO Soybeans and Oil should be sampled on a scheduled basis throughout the crush and refining process to document the purity of the oil.

5. No special handling or IP considerations should be needed for the soybean meal produced during the HO Soy crush run.

REFINING

Segregation protocols will be very similar to what a buyer's refinery uses when refining different vegetable oils.

Typical IP guidelines for refining HO Soybean Oil would include:

1. Conduct refinery employee training on HO Soybean Oil IP protocols.
2. If possible, purge all process oil lines ahead of HO Soybean Oil conveyance to minimize comingling with prior oil.
3. Use appropriate means to segregate HO Soybean Oil through refining process and deodorizer.
4. Verify that dedicated HO Soybean Oil tank(s) are clean prior to use.
5. Verify that lines from RBD tank(s) to loadout have been purged.
6. Verify that each tank wagon or mode of shipment has provided a wash certificate and has been visually inspected prior to loading for all bulk refined shipments to final end-users.

For non-GMO High Oleic Soy supply chains, non-GMO protocols and verifications will be in addition to the above.

XVII. APPENDIX WITH CONTACTS, TERMS & DEFINITIONS

US HIGH OLEIC SOY CONTACT INFORMATION:

ADM
Trait(s): Plenish
Katie Howley
4666 Faries Parkway
Decatur, IL 62525
Phone: + 1-217-358-2050
Website: www.adm.com
e-mail: katie.howley@adm.com

Bayer Crop Science
Trait(s): Vistive Gold
Kara Isaak
800 N. Lindbergh Blvd.
St. Louis, MO 63167
Phone: + 1- 314-243-7725
Website: www.bayer.com
e-mail: kara.isaak@bayer.com

Benson Hill
Trait(s): SOYLEIC non-GMO
Josh Miller
1001 North Warson Rd.
St. Louis, MO 63132
Phone: +1 314-579-4678
Website: www.bensonhill.com
Email: jamiller@bensonhill.com

Brushvale Seed
Trait(s): SOYLEIC non-GMO
Travis Meyer
1656 280th Street
Breckenridge, MN 56520
Phone: +1 218-643-2311
Website: www.brushvaleseed.com
Email: seed@brushvaleseed.com

Bunge*
Trait(s): Plenish
Rodrigo Vasconcelos
1391 Timberlake Manor Parkway
Chesterfield, MO 63017
Phone: +1 905-825-7962
Website: www.bunge.com
e-mail: rodrigo.vasconcelos@bunge.com

Catania Oils*
Trait(s): Plenish
3 Nemco Way
Ayer, MA 01432
Phone: +1 978 772-7900
Website: www.cataniaoils.com

CHS
Trait(s): Plenish
Todd Biedenfeld
5500 Cenex Drive
Inver Heights, MN 55077
Phone: +1 651-355-6414
Website: www.chsinc.com
e-mail: todd.biedenfeld@chsinc.com

Clarkson Grain
Trait(s): SOYLEIC non-GMO
Drew Whalen
320 East South Street, Box 80
Cerro Gordo, IL 61818-0080
Phone: +1 217-763-0101
Website: www.clarksongrain.com
e-mail: drew.whalen@clarksongrain.com

Corteva Agriscience
Trait(s): Plenish
Roger Theisen
7100 NW 62nd Avenue
Johnston, IA 51031-7050
Phone: +1 515-205-9220
Website: www.healthyoils.corteva.com
e-mail: roger.theisen@corteva.com

Missouri Soybean Merchandising Council
Trait(s): SOYLEIC non-GMO
Bryan Stobaugh
734 South Country Club Drive
Jefferson City, MO 65109
Phone: +1 573-635-3819
Website: www.soyleic.com
e-mail: bstobaugh@mosoy.org

Perdue Agribusiness
Trait(s): Plenish
Tanner East
6906 Zion Church Road
Salisbury, MD 21804
Phone: +1 410-341-2438
Website: www.perdueagribusiness.com
e-mail: tanner.east@perdue.com

Perdue Agribusiness
Trait(s): SOYLEIC non-GMO, Organic
Robert Davis
6906 Zion Church Road
Salisbury, MD 21804
Phone: +1 706-459-7398
Website: www.perdueagribusiness.com
e-mail: robert.davis@perdue.com

Quality Roasting*
Trait(s): Plenish
Sara Rabe
2514 Marken Road
Valders, WI 54245
Phone: +1 920-775-9279
Website: www.qualityroasting.com
e-mail: sara@qualityroasting.com

The Scoular Company
Trait(s): SOYLEIC non-GMO
Rhonda Cole
250 Marquette Ave, Suite 1050
Minneapolis, MN 55401
Phone: +1 612-851-3707
Website: www.scoular.com
e-mail: rhondacole@scoular.com

Stratas Foods LLC*
Trait(s): Plenish
Jonathan Gilbert
7130 Goodlett Farms Parkway
Suite #200
Memphis, TN 38016
Phone: +1 901-387-2224
Website: www.stratasfoods.com
e-mail: jonathan.gilbert@stratasfoods.com

Zeeland Farm Services, Inc.
Trait(s): SOYLEIC
Robb Meeuwsen
2525 84th Avenue
Zeeland, MI 49464
Phone: +1 616-748-1831
Website: www.zfsinc.com
e-mail: robbm@zfsinc.com

**Packaged HO Soybean Oil Supplier for Food Service & Less Than Truckload Quantities (drums/totes)*

INDUSTRY INFORMATION SOURCES FOR HIGH OLEIC SOYBEANS AND/OR OIL:

- **Bayer** (Vistive®Gold High Oleic Soybeans)
  https://www.cropscience.bayer.us/traits/soybean/vistive-gold-soybeans

- **Corteva Agriscience** (Plenish® High Oleic Soybeans)
  https://www.healthyoils.corteva.com/about/plenish.html

- **Missouri Soybean Merchandising Council** (SOYLEIC® High Oleic Soybeans)
  https://www.soyleic.com

- **Soy Connection**
  https://www.soyconnection.com

- **United Soybean Board**
  https://unitedsoybean.org/topics/high-oleic-soy/

- **US Soy (USSEC/USB/ASA)**
  https://food.ussoy.org/food-industry-solutions/high-oleic-soybean-oil

- **US Soybean Export Council**
  https://solutions.ussec.org/high-oleic-soybean-oil

GLOSSARY:

Biotech /Genetically Modified Organism (GMO): Crops developed through genetic engineering, a more precise method of plant breeding. Genetic engineering, also referred to as biotechnology, allows plant breeders to take a desirable trait found in nature and transfer its DNA from one plant or organism to the plant they want to improve, as well as make a change to an existing trait in a plant they are developing.

Closed Loop Supply Chain: A system of defined quality assurance control procedures that involves all functions in the supply chain. High oleic soybeans are grown in coordinated closed loop supply chains involving seed suppliers, commercial soybean farmers, soybean processors and exporters. Identity preservation procedures are also implemented in the grain and oil channel between the HO soybean and oil exporter and the international customer.

Enzyme-Linked Immunosorbent Assay (ELISA) Test: A more sensitive antibody-based GMO detection method. A microtiter plate is used to detect the protein expressed by a GM crop. The most common microtiter plate used is the 96-well plate. Each well is capable of performing an assay (detecting GM protein). ELISA plates are popular with users that need a relatively high throughput testing solution. ELISA tests are generally more sensitive than strip tests because of the amplification system used to visualize the antibody binding event. The ELISA procedure is longer than that of a strip test (hours vs. minutes) and is often more sensitive, with a limit of detection in the 0.01–1% range.

GMO Strip Test: The most commonly used immuno- or antibody-based test for GMO detection is the strip test (also called a lateral flow device or dipstick). Strip tests are thin strips comprised of a nitrocellulose membrane covered by a sample pad on one end and a wicking pad on the other end. The strip test as a GMO detection method has an important place in the production system. The assay is rapid, is appropriate for qualitative or semi-quantitative detection of GMO proteins and can be performed in the field. Strip tests are therefore applicable for an initial screen of seed/grain at, for example, the elevator, or from the truck upon arrival at the processing plant.

High Oleic Soybean: Soybeans with an oil profile that contains a very high level of monounsaturated oleic fatty acid (18:1) relative to commodity soybeans. While no official fatty acid profile standard exists, general US industry consensus is that an oleic level of 70 to 75% or greater is appropriate for High Oleic Soy classification. This compares to a 22–25% oleic content in commodity soybeans. Other fatty acid changes may also be present, such as a significant reduction in polyunsaturates (linoleic and linolenic) as well as reductions in saturated fat levels (specifically the palmitic acid content).

High Oleic Soy Pricing Premiums: The incremental price for High Oleic Soybeans and/or Oil and expressed as a premium over the commodity soybean/oil cash price or basis. It can vary by HO Soy suppliers and is primarily determined by the added cost of identity preservation across the HO Soy supply chain.

Iodine Value: An expression of the degree of unsaturation of a fat. It is determined by measuring the amount of iodine which reacts with a natural or processed fat under prescribed conditions or may be calculated directly from a known fatty acid composition with a mathematical formula sourced from the American Oil Chemists' Society (AOCS method Cd 1c-85).

Identity Preservation (IP): The process involved in all phases of the High Oleic Soybean supply chain that prevents the mixing of High Oleic Soybeans or oil with commodity soybeans or oil. This process protects the High Oleic fatty acid content from being diluted.

- **Soft IP:** A simpler and less costly level of identity preservation that is used in instances where supply chain tolerance levels are not as strict as those used for non-GMO certification, but there is still a need to preserve the value and maintain higher grain quality. Quality testing is still used to monitor adherence to contractual specifications. However, specification tolerances for farmers are much less stringent and are more often expressed in whole percentages rather than parts per million.

- **Hard IP:** A process involving testing such as strip tests and ELISA or PCR assays for GMO presence along with specific grain production and handling protocols for the farmer, grain handlers and processors.

Near-Infrared (NIR) Assay: A spectrophotometric determination of a sample's constituents. An NIR rapid test is the primary commercial test to measure the oleic and linolenic acid content of High Oleic Soybeans in addition to protein and oil content.

Non-Genetically Modified Organism (Non-GMO): Crops not developed through genetic engineering. Non-GMO crops use traditional methods of modifying plants, like selective breeding and crossbreeding. Conventional breeding develops new plant varieties by the process of selection and seeks to achieve expression of genetic material which is already present within a species.

Oxidative Stability Index (OSI): A widely used method to measure an oil's resistance to oxidation and the resulting level of stability resulting in greater fry life and packaged food shelf life.

Polymerase Chain Reaction (PCR) Assay: A genetic analysis that uses molecular techniques to detect the inserted transgenic DNA (GMO) in a sample and is more sensitive than the ELISA method. The PCR technique amplifies (copies) the DNA billions of times for detection and quantitation to be possible. PCR is a highly sensitive and specific GMO detection method that is typically performed with laboratory equipment and by trained personnel. Major disadvantages of PCR include length of the test time needed (2 to 3 days) and cost.

Polymerization: The cross-linking of carbon-carbon double bonds into long chains within fatty acids that occurs in the presence of oxygen and is accelerated by heat. Oils with a high percentage of fats (multiple double bonds) are more prone to polymerize and lead to a buildup of greasy, varnish-like coatings on equipment surfaces.

Refined, Bleached and Deodorized (RBD): Is an acronym that describes how a vegetable oil has been processed. Fully refined vegetable oils suitable for human consumption are commonly referred to as "RBD" which implies the oil has been refined, bleached, and deodorized.

- **Refining**: Alkali refining (i.e., treatment of the fat or oil with an alkali solution) is the most widespread method and is performed to reduce the free fatty acid content and to remove other impurities such as phosphatides, proteinaceous, and mucilaginous substances. This process results in a large reduction of free fatty acids through their conversion into high specific gravity soaps. Most phosphatides and mucilaginous substances are soluble in the oil only in an anhydrous form and upon hydration with the caustic or other refining solution are readily separated. After alkali refining, the fat or oil is water-washed to remove residual soap.

- **Bleaching:** The term "bleaching" refers to the process for removing color producing substances and for further purifying the fat or oil. Normally, bleaching is accomplished after the oil has been refined. The usual method of bleaching is by adsorption of the color producing substances on an adsorbent material. Acid-activated bleaching earth or clay, sometimes called bentonite, is the adsorbent material that has been used most extensively. This substance consists primarily of hydrated aluminum silicate. Anhydrous silica gel and activated carbon also are used as bleaching adsorbents to a limited extent.

- **Deodorization:** Is a vacuum steam distillation process for the purpose of removing trace constituents that give rise to undesirable flavors, colors and odors in fats and oils. Normally this process is accomplished after refining and bleaching. The deodorization of fats and oils is simply a removal of the relatively volatile components from the fat or oil using steam. This is feasible because of the great differences in volatility between the substances that give flavors, colors and odors to fats and oils and the triglycerides. Deodorization is carried out under vacuum to facilitate the removal of the volatile substances, to avoid undue hydrolysis of the fat, and to make the most efficient use of the steam. In the case of vegetable oils, sufficient tocopherols remain in the finished oils after deodorization to provide stability. Deodorization does not have any significant effect upon the fatty acid composition of most fats or oils. Depending upon the degree of unsaturation of the oil being deodorized, small amounts of trans fatty acids may be formed by isomerization.

TEU Shipping Container: Twenty-foot Equivalent Unit. A twenty-foot equivalent unit (TEU) is a shipping container whose internal dimensions measure about 20 feet long, 8 feet wide, and 8 feet tall.

Traditional / Conventional Plant Breeding: Identifying and selecting desirable traits in plants and combining these into one individual plant. The most frequently employed plant breeding technique is hybridization. The aim of hybridization is to bring together desired traits found in different plant lines into one plant line via cross- pollination. Grains produced through this process do not require regulatory approval and are considered non-GMO.

UNIT CONVERSIONS AND BASE ASSUMPTIONS:

1. Bushel of Soybeans = 60 pounds
2. Metric Ton of Soybeans = 36.74 bushels
3. Short Ton of Soybeans = 33.33 bushels
4. One Pound = 0.453592 kilograms
5. One Veg Oil Gallon = 7.65 pounds / 3.467 kilograms / 3.785 liters
6. Metric Ton = 2,204.6 pounds
7. Metric Ton = 1.2204 short tons
8. Acre = 0.4046 hectares
9. Hectare = 2.471 acres
10. Crude soybean oil yield per bushel estimate = 11.4 pounds per bushel (solvent extracted)
11. Crude soybean oil yield per bushel estimate = 7.0 pounds per bushel (expeller pressed)
12. Average US soybean yield per acre (2020 USDA): 50.2 bushels per acre
13. Average pounds of oil produced per acre at US 2020 average yield: 572 pounds

ACRONYMS

1. FAC (Fatty Acid Composition)
2. FFA (Free Fatty Acids)
3. FGIS (Federal Grain Inspection Service)
4. GC (Gas Chromatography)
5. GIPSA (Grain Inspection, Packers and Stockyards Administration)
6. HO (High Oleic)
7. HOS (High Oleic Soybean)
8. IBC (Intermediate Bulk Container)
9. IP (Identity Preservation)
10. ISO (International Organization for Standardization)
11. NIR (Near Infrared)
12. PCR (Polymerase Chain Reaction)
13. TEU (Twenty Foot Equivalent Unit)

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FOOTNOTES

[1] US Soy: International Buyers' Guide, USSEC

[2] Food Chemicals Codex, Seventh Addition, and industry sources

[3] US Census Bureau, Schedule B Classification of Exports, 2019, Seventh Edition

[4] Food Fats and Oils, Institute of Shortening and Edible Oils, Inc., 2016, Tenth Addition

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