美国高油酸大豆及高油酸豆油

U.S. Oleics Soybeans & High Oleics Soybean Oil

国际客户采购手册

Sourcing Guide for International Customers

为美国大豆出口协会编写
Prepared for
U.S. Soybean Export Council
编者
Prepared by
桑德斯咨询公司 罗斯•桑德斯
特格德咨询公司 大卫•特格德
Russ Sanders, Sanders Advisors
David Tegeder, Tegeder Consulting

目　　录

*译者注：商品大豆指依据标准化合约进行交易的大豆，其价格是大豆期货交易的基础。

表　格　索　引

图　表　索　引

免　　责　　声　　明

本手册为通用指导性文件，仅供参考。手册中的内容根据不同渠道的信息以及编者的行业知识整理而成，可能需要修正及更新。编者尽其所能保证所提供信息的准确性。

一、介绍

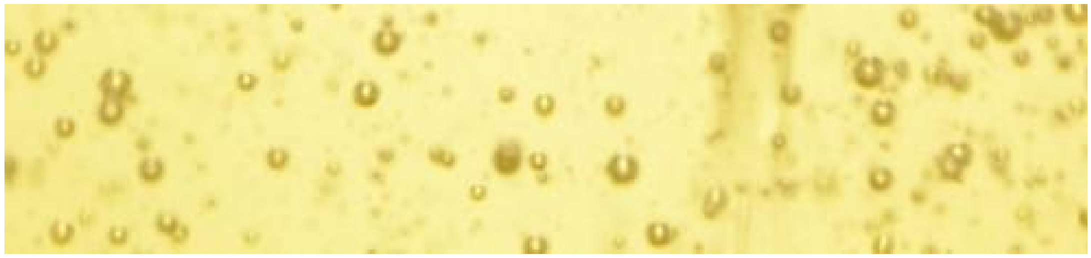
本采购手册旨在为国际客户提供基本的背景信息，从而协助其采购美国生产的高油酸大豆及高油酸豆油。

高油酸大豆的开发是一项重大创新，为食品工业带来令人振奋的市场机会。采用尖端种子开发技术，高油酸豆油为消费者提供极大的健康益处，并在餐饮业与食品生产应用领域极大提升了豆油的性能表现。高油酸豆油极高的氧化稳定性也在很多非食品行业应用上具有价值，比如生物基润滑油及工业用液体产品等。

美国的豆农们目前已经在种植高油酸大豆，美国的大豆行业同领先的大豆加工商及出口商合作，共同致力于创造一个可靠的、具有成本效益的供应链来为全球的植物油精炼及大豆加工客户提供服务。

高油酸大豆是在特性保护供应链体系下进行生产的，以避免同商品大豆发生掺混，从而保护其产出豆油的高价值。出于这一原因，高油酸大豆和豆油在供应链管理及市场开发方面的一些要素也同采购商品大豆或豆油产品时有所不同。

由于许多国际油籽压榨商及精炼商不熟悉如何在特性保护体系中进行产品采购，本手册提供安排订单生产、定价因素、原料处理及货物运输等方面的信息。



本手册为美国大豆出口协会（USSEC）编写，USSEC总部位于密苏里州圣路易斯市，是一家非盈利的单一农产品机构，致力于为美国大豆种植者及美国大豆行业在全球范围开发大豆及大豆产品市场。

二、概要

美国大豆行业致力于不断提升美国大豆的品质和价值，以更好地满足国际客户的需求。高油酸大豆的成功开发是这些工作中的一个重要里程碑，用高油酸大豆生产出来的豆油对全球食品工业生产具有重要功能性和健康益处。

与商品大豆相比，高油酸大豆具有更高的价值，因此，有必要在供应链中对高油酸大豆和高油酸豆油进行宽松的特性保护。

虽然这样的一种生产及供应链管理方式增加了成本，但所带来的豆油价值方面的增加远远超出了这些成本。

为了有效地进行成本/效益分析，对照商品豆油及其它油类产品，对高油酸豆油的改良功能性效益价值准确地进行量化是非常重要的。同商品豆油及其它油品相比，高油酸豆油为食品行业所提供的最突出的一些价值效益包括：

- 与橄榄油相当的油酸水平和较少的饱和脂肪对健康有益
- 功能性可以与部分氢化油及起酥油相媲美，但不产生反式脂肪
- 餐饮应用中可延长2-3倍的煎炸使用时间
- 包装食品的保质期可延长3倍
- 可以取代人工防腐剂
- 中性少油风味
- 炊具表面聚合物更少，从而降低设备清洁成本
- 在烘焙应用方面可使用固态或半固态的豆油起酥油应用温度范围更大，融化性能更优秀

对于包括高油酸豆油等油酸含量高的油品经过验证在替代一些饱和脂肪含量高的油品会产生的降低冠心病风险等健康效益，对此FDA（美国食品药品监督管理局）允许使用此类声明，并允许将此声明使用在合格的含高油酸豆油的产品的标签上。

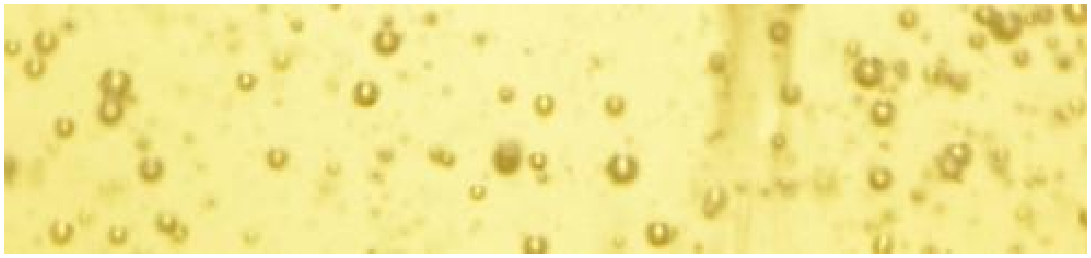
高油酸大豆的闭环式特性保护供应链可提供产品追溯性方面的益处，这一点对于食品企业来说也具有价值。作为美国大豆行业的美国大豆可持续保障计划（SSAP）的一部分，高油酸大豆在农场这一层面有着积极的可持续发展的表现，而由于高油酸大豆豆油具有更长的煎炸时间及储存使用期限，这一可持续发展的优势得以更加增强。

由于高油酸大豆豆油具有非常高的氧化稳定性，其在非食品领域方面的应用机会也非常有吸引力。一些生产厂商正在开发多种消费类及工业类润滑产品，有些已进入初期的商业化阶段，在其它生化及工业类液体产品领域也在进行应用研究。此外，油脂化学行业也开始使用高油酸豆油来作为其回收油酸的原料。

首次采购高油酸产品的客户会体会到高油酸大豆的特性保护供应链同商品大豆的供应链有着重要的不同，其中的一个关键因素是需要同供应商一起管理一个更长的决策时间线，以确保能够有效地协调生产来满足需求。由于高油酸大豆是一个新产品，尚处在推向市场的初期阶段，目前没有太多订单外的产品供应来满足现货市场的需求。对于较大量的产品需求，应该在实际投入商用之前的18个月到24个月就开始同供应商进行协商。

除了标准的大豆及豆油的质量标准之外，高油酸豆油的脂肪酸（油酸、亚麻酸等）水平也需要在价值链的各个关键点上进行测定，以确保达到客户的要求。

由于其蛋白质及氨基酸含量同商品大豆豆粕相当，高油酸大豆生产的豆粕可掺混进现有的商品大豆豆粕供应链，不需要特性保护体系。



大豆高油酸的特性来自于对其种子所作的遗传基因改变，目前这种改变是通过生物科技或者常规育种手段实现。美国有很多家不同的高油酸种子科技开发公司，因此不同的种子产品的脂肪酸含量也有所不同。

虽然高油酸豆油的通常定义是其油酸含量需要达到70%以上，但是在整个业界并没有一个高油酸产品的标准。因此，同供应商协调好所使用的特定种子产品并确定最终需达到的脂肪酸含量非常重要。对高油酸豆油的功能性具有最大作用的一些特定的脂肪酸包括：油酸、亚油酸、亚麻酸、硬脂酸、棕榈酸等。

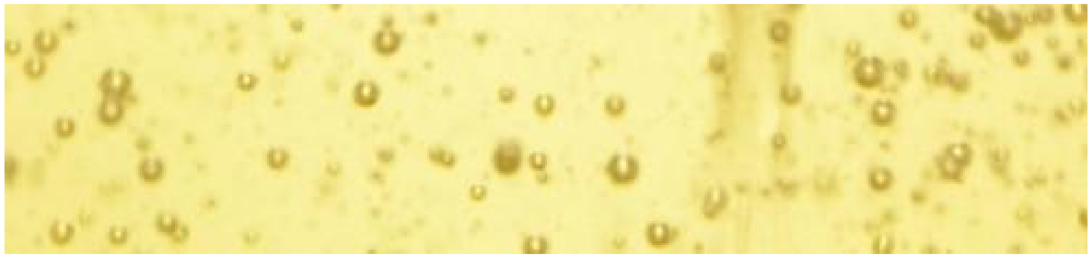
由于从商品豆油到高油酸豆油是一个很大的改变，为了完整量化其价值效益，在特定的食品应用中进行功能性测试就很重要。测试的第一步是从备选的美国供应商处索取高油酸豆油样品，美国大豆出口协会的职员及顾问可以帮助同这些供应商取得联系，并提供技术及供应链开发方面的协助。

三、高油酸大豆开发的背景

在美国，高油酸大豆的开发是豆农、种子公司与大豆加工行业共同合作的结果。部分氢化加工在美国的食品行业广泛使用，使豆油在煎炸及食品生产中发挥更大作用。但是，随着越来越多的证据表明部分氢化的产品含有反式脂肪，对人体健康会产生心血管方面的负面影响，食品公司开始在其生产中去除部分氢化的豆油产品。由于美国近50%的豆油都是部分氢化的，大豆生产行业面临豆油需求骤减的风险。

随着新型种子培育技术的出现，以及美国整个大豆供应链的不懈努力，在2000年代初期，豆油的“再造”工作开始启动。

该工作的目标是要改变豆油中的脂肪酸含量，以大幅提升热稳定性和氧化稳定性，从而不再需要进行部分氢化。此外，通过减少饱和脂肪酸和将单不饱和脂肪酸（油酸）的含量增加近三倍达到类同于橄榄油的水平，健康效益还能得到增强。



尽管被称为“高油酸”，但要记住，热稳定性和氧化稳定性主要是受到豆油中亚麻酸和亚油酸含量的影响。不同的高油酸豆油可能在油酸含量上基本相同，但在亚麻酸及亚油酸含量上却有着很大的差异，从而影响到其稳定性，因为这些脂肪酸更易氧化。因此，客户对于豆油的要求应考虑到所有三项不饱和脂肪酸（油酸、亚麻酸、亚油酸）的水平，并同商品豆油的水平进行对比。

图 1: 脂肪酸含量举例

	饱和		单不饱和	多不饱和	
	棕榈酸 C16:0	硬脂酸 C18:0	油酸 C18:1	亚油酸 C18:2	亚麻酸 C18:3
商品豆油	**11%**	**4%**	**22%**	**55%**	**8%**
*相对氧化率**			*1*	*40*	*98*
高油酸豆油**	**6.5%**	**4%**	**76%**	**7.5%**	**2%**
橄榄油	**12%**	**3%**	**75%**	**9%**	**1%**

* ***Lipid Oxidation**, E. N. Frankel, 2005*
** *科迪华农业科技™提供的 Plenish® 高油酸豆油含量指标*

虽然高油酸大豆没有官方的脂肪酸含量标准，美国的行业共识是油酸水平达到70%或以上才适合被归入高油酸大豆类别。相比之下，商品大豆的油酸含量只有22-25%左右。其它脂肪酸变化也可能存在，比如多不饱和脂肪酸（亚油酸及亚麻酸）的显著减少、饱和脂肪（棕榈酸及硬脂酸）水平降低等。

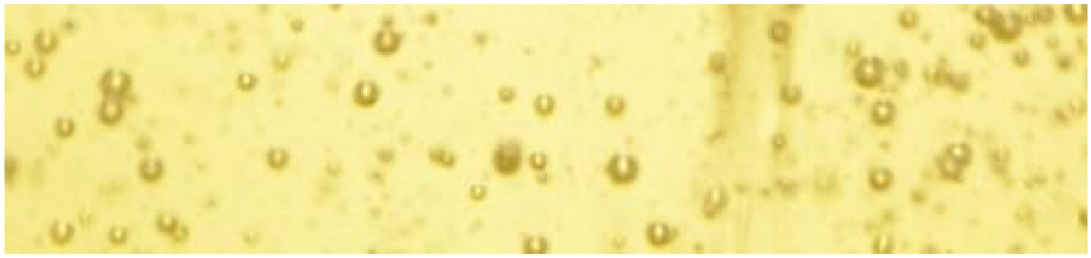
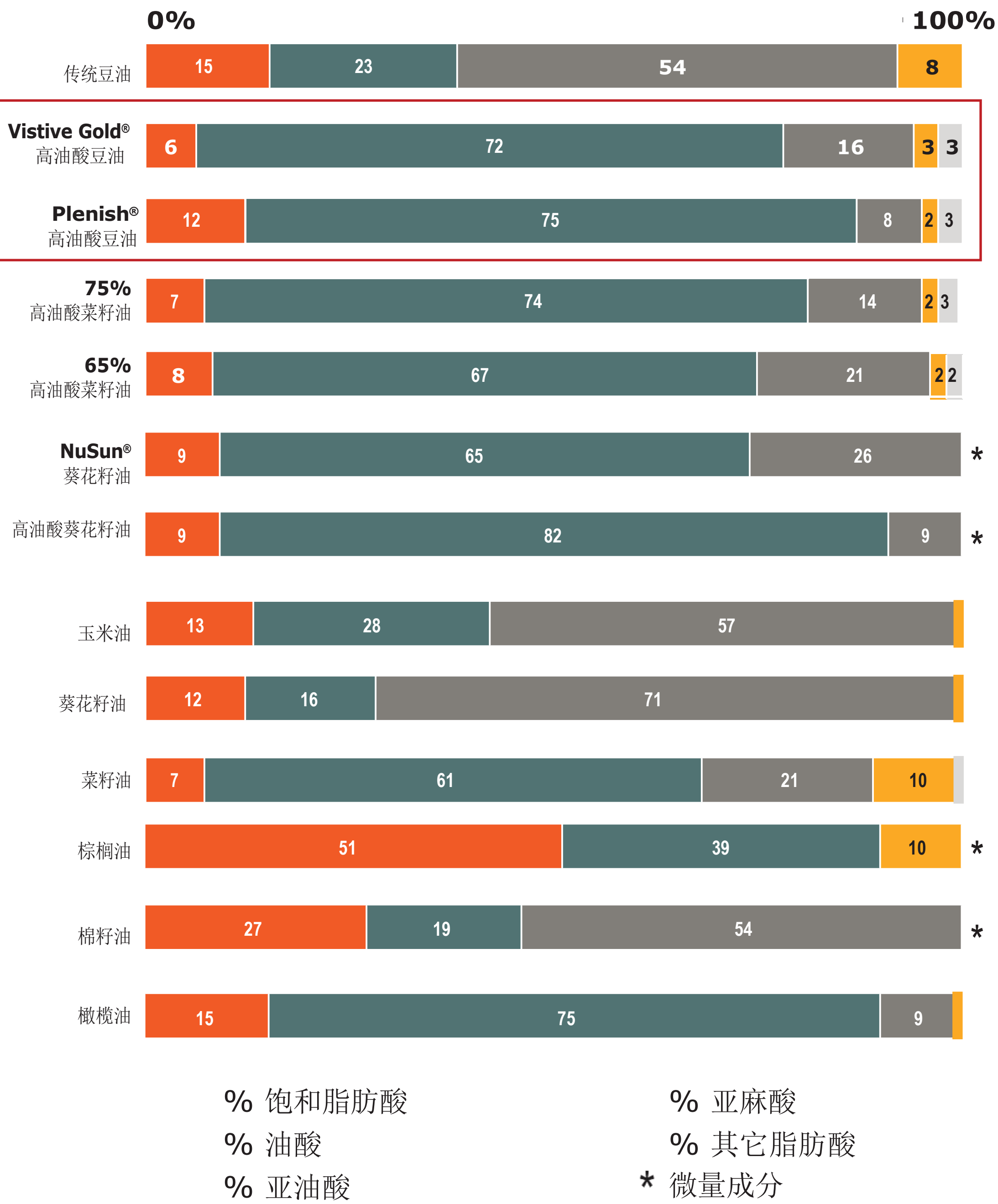
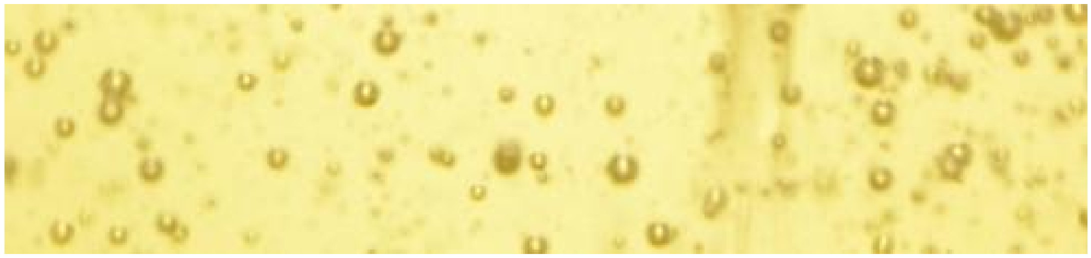


图 2: 脂肪酸含量对比

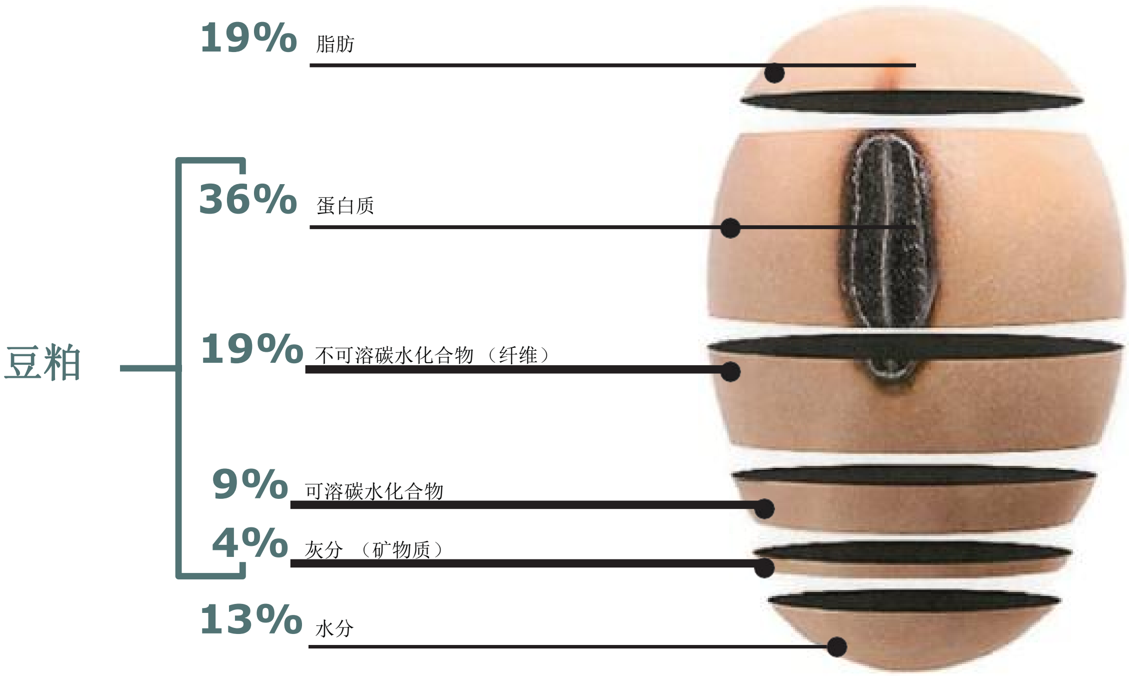


资料来源：Qualisoy



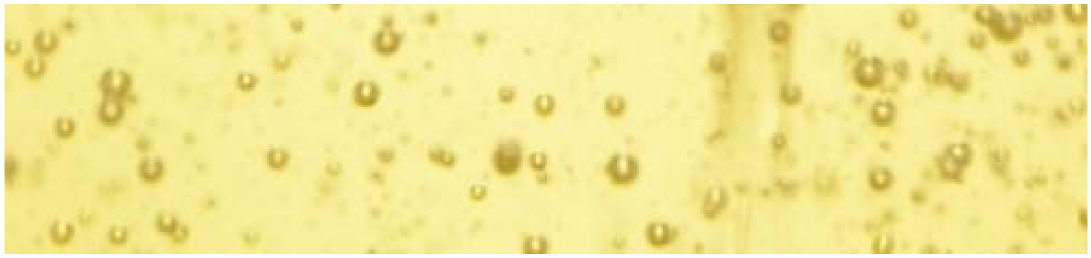
除了通过改变其成分来提升油的质量表现之外，研究人员还努力在高油酸大豆的油分及蛋白质成分之间保持传统的平衡状态，以维持其压榨时的经济性。高油酸大豆豆粕中的氨基酸成分也保持不变，从而使其可以同商品大豆豆粕掺混而不需要进行特性保护。高油酸大豆与商品大豆的其它相似之处还包括容重及榨油特性等。

图 3: 大豆成分



资料来源：美国大豆基金会

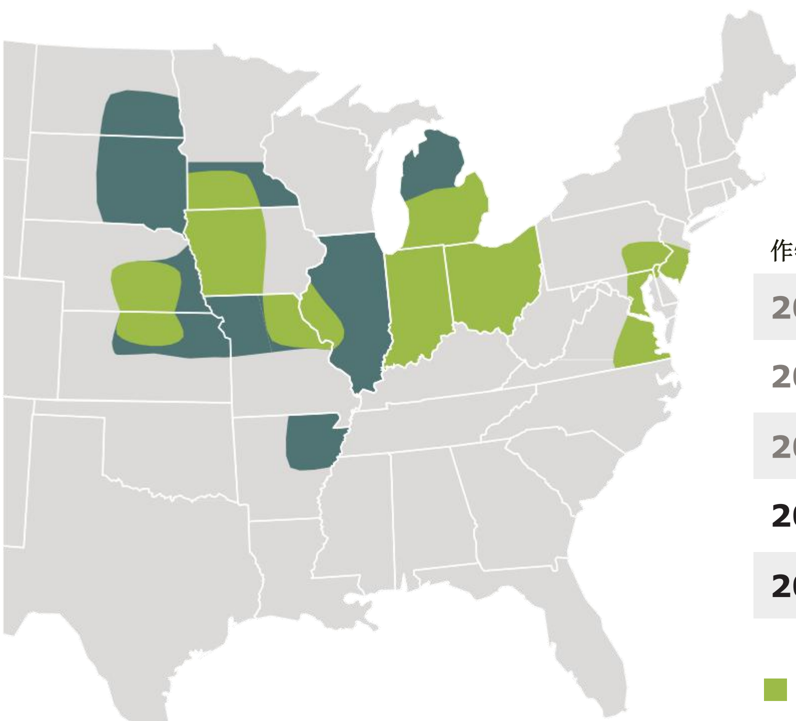
对豆农来说很关键的一点是，高油酸种子产品需要有着同目前使用的高性能商品大豆种子产品一样的高单产及必要的农艺性状，这样才能保证其生产成本同商品大豆大致相同，而用于支付所增加的特性保护成本的高油酸溢价才能保持在尽量合理的水平上，以便能同其它高稳定性特性保护油籽和油料产品进行竞争。



经过五年多的高油酸生产实践，研究数据表明：目前市场上领先的高油酸大豆种子能够给豆农提供同其它高产商品大豆种子品种类似的单产水平。

为了降低播种季节期间由于天气变化而造成的供应风险，培育能够广泛适用不同地理区域条件的种子也很有必要。经过业界的广泛合作，美国目前及未来预估的高油酸大豆种植区域非常多样，商业化增产计划也非常有潜力，见下图。

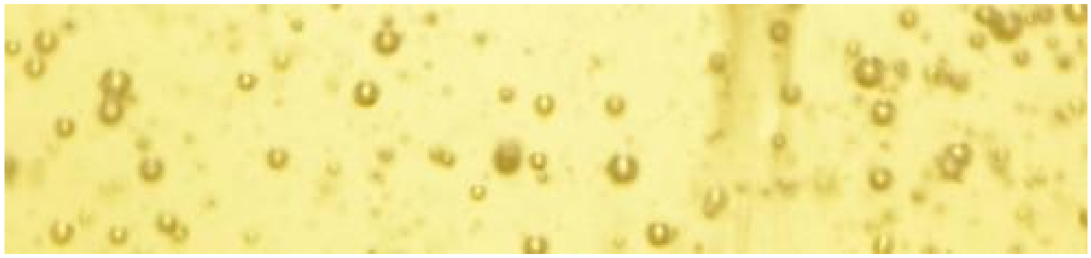
图 4: 产区及增产预测



作物年份	种植英亩数
2012	50,000
2015	275,000
2018	400,000
2021	3,750,000
2026	14,850,000

已种植地区
计划种植地区

资料来源：Qualisoy



四、目前美国高油酸大豆种子公司及其产品特性

表 1: 目前美国高油酸种子科技开发商及产品信息*

种子科技开发商	产品名称	种子培育科技	油酸含量范围（%）	亚油酸含量范围（%）	亚麻酸含量范围（%）	饱和脂肪酸含量范围（%）
拜耳作物科学	**Vistive® Gold**	生物科技	**74**	**17**	**3**	**6**
科迪华农业科技™	**Plenish®**	生物科技	**75 – 80**	**5 – 10**	**2**	**12**
密苏里大豆销售委员会	**Soyleic™**	传统育种	**79 – 85**	**2.8 – 10.8**	**0.8 – 4.5**	**5.6 – 12.2**

* *信息由高油酸种子科技开发商提供*

- ***上表中的脂肪酸含量代表了对整粒豆进行气相色谱分析时不同品牌种子的表现情况。***
- ***在特定供应链中如果同商品大豆或豆油发生掺混会导致最终的油分含量可能会同上表中数值有所不同。***
- ***作物产区也会影响到含量水平。***

五、高油酸大豆供应链中的特性保护（IP）

商业作物生产中使用两种基本的特性保护体系，分别定义如下：

- **宽松的特性保护体系：**一种较为简单且成本低廉的特性保护体系，应用于供应链要求并不像非转基因认证时那么严格但仍需要保持作物的价值及高质量的生产。宽松的特性保护体系通过使用质量检测来保证产品符合合约规定要求，对于豆农提出的合格率以整数百分比为要求，而无需精确到小数点后6位。

- **严格的特性保护体系：**一种更为复杂的流程，涉及大量的质量检测，比如检测转基因成分的PCR报告，以及对豆农、谷物处理商及加工商更为严格的谷物生产及处理流程的要求。规格及杂质检测方面的合格率也通常以小数点后6位进行定义。

高油酸大豆的生产采用宽松的特性保护体系，涉及到高油酸大豆供应链的全部阶段。这样做可以保证同商品大豆的生产隔离开来，保持高油酸豆油独特的脂肪酸含量。

有效的宽松的特性保护体系包括以下关键因素及步骤：

1. 判明影响质量规格的关键控制点及风险因素
2. 制定每一控制点所需的行动计划
3. 用以衡量有效性的绩效标准及指标
4. 用以执行标准的衡量工具及技术
5. 对达标的供应链上的参与者进行奖励的经济激励手段

高油酸大豆特性保护体系始于种子公司生产出特别培育的种子品种。在将种子产品卖给豆农之前，必须要符合质量标准以保证商用高油酸大豆会生产出满足规格要求的豆油。

豆农与大豆加工商或出口商之间通过合同来执行特性保护体系中的商业生产指导方针。这些合同指明了豆农必须满足的质量控制方面的要求，以保证高油酸大豆的价值能够实现最大化。所有的种植工作，包括播种、生产、收割、储存及运输，都进行相应管理以保持高油酸大豆的特性。

豆农销售给参与供应链的谷仓、大豆加工商或出口商等的所有批次的高油酸大豆都需进行检验，以保证达到相应的质量标准，包括油酸及亚麻酸等脂肪酸含量水平。然后，豆农会收到高于商品大豆价格的溢价，以补偿为满足这些特性要求所增加的成本。

在美国，与豆农有生产合同的加工商及大豆出口商有责任管理好大豆交货的时间表，以满足压榨或大豆出口的要求。如果使用一些乡村收购站来集中储存不同的高油酸大豆货源，加工商或出口商则会制订需要达到的质量控制标准，以确保能够达到特性保护体系要求。这可能需要使用设备来对所有收来的大豆检测其脂肪酸成分及其它质量指标。

大豆加工商也在整个压榨流程中对大豆及豆油的特性进行保护，这包括使用专门的高油酸压榨操作规范、在满足特性保护要求的油罐中隔离储存高油酸豆油、对运输物流进行管理等。

同样，高油酸大豆出口商也严格执行特性保护体系程序来避免同商品大豆掺混，这包括对运输船只进行管理及隔离，直到向客户交货。

可追溯性及可持续价值:

除了能够保护高油酸豆油成分的纯度及价值之外，由于所有的生产工作都由签约的豆农来做，这一闭环型的特性保护体系也能够让食品企业获得产品追溯性方面的益处。美国大豆行业的美国大豆可持续保障计划（SSAP）确立了美国大豆生产在可持续发展方面的积极做法，从而进一步提升了产品可追溯价值。随着高油酸豆油煎炸和货架期的延长，从而减少了包装、运输及其它成本，其可持续性优势进一步得到体现。

六、为何需要提前签订合同

由于高油酸大豆还处在进入市场的初期阶段，大豆加工商及出口商还没有大量未签约的高油酸大豆及高油酸豆油现货来满足更大量的现货市场需求。订单体系有助于确保高油酸大豆产量满足客户的需求。

高油酸产品合约同时也有助于供应链各方协调彼此的工作，这些重要的工作包括种子供应、作物生产、产品储存运输、加工或出口等等。

美国高油酸大豆的供应链在下图中进行了展示。

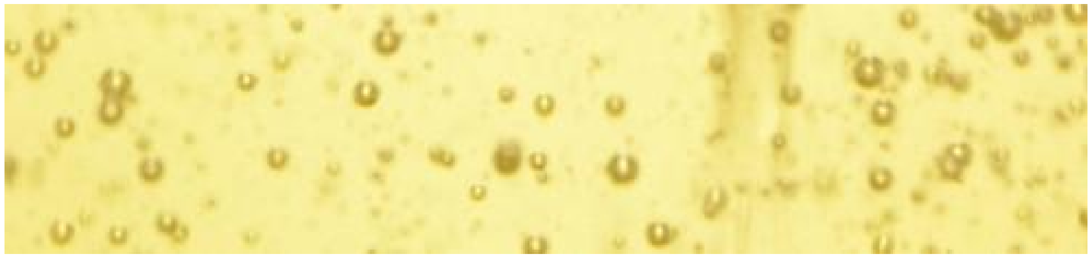


图 5: 美国高油酸大豆供应链

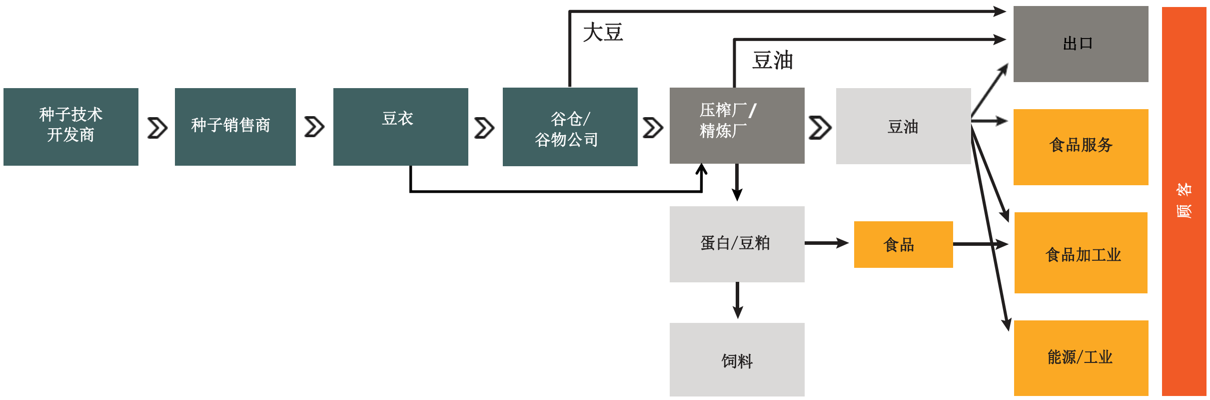


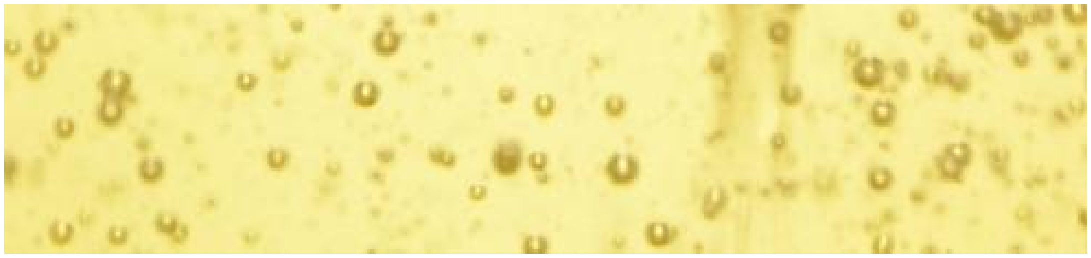
图 6: 高油酸大豆供应链中各参与方的主要职责

种子公司

1. 适应特定产区的高产种子产品
2. 跨多个种植季节仍能保持一致的脂肪酸含量
3. 大豆中的蛋白质与油分含量保持良好平衡
4. 获得所需的法规批准
5. 向签约豆农供应及销售种子以满足需求

豆农

1. 同美国加工商或出口商签约，合约中注明特性保护要求、交付交货条款及谷物质量标准
2. 评估高油酸种子品种的性能数据以满足产量及农艺要求
3. 通常在播种前6个月下单订购种子
4. 清洁播种机以避免同商品大豆种子掺混，在特定的土壤中种植以优化种子的特性
5. 清洁收割及大豆运输设备
6. 收割后安排专用且清洁的粮仓进行储存，或者向专用的谷仓运营商或加工商进行交付
7. 高油酸大豆在交付地点进行检测以保证达到脂肪酸要求（油酸与亚麻酸）以及其它质量要求，未达标的大豆以无溢价的商品大豆价格售出
8. 完成交货交付后从加工商或出口商处获得高油酸大豆溢价



加工商
出口商

1. 在不迟于商业生产前一年的九月份锁定客户的需求量，以便同豆农签约
2. 决定合约生产的地点及种植面积
3. 决定所需的高油酸种子特性以确定豆油质量要求，同种子公司协调以保证种子供应
4. 招募种植者，确定溢价及特性保护要求，与豆农签订合同
5. 安排乡村收购站网络来对特性保护大豆进行集中收货，为豆农交货提供便利
6. 管理交付大豆交货、压榨及出口的时间表
7. 对收进的大豆脂肪酸成分及其它质量指标进行检测
8. 管理豆油及大豆在运输和处理上的特性保护要求

进口商
精炼商

1. 取得高油酸产品样品，同终端客户评估其功能性价值指标，然后进行合约协商
2. 根据终端客户的功能性需求来确定脂肪酸及豆油质量要求
3. 根据特性保护生产要求来规划交付交货时间表
4. 对备选的美国种子开发商、加工商及大豆出口商进行评估并选择供应商，确定满足规格要求的高油酸大豆种子品种
5. 同供应商确认价格、交付交货时间表及脂肪酸规格等条款
6. 确定收货处理及加工中的特性保护要求，向员工提供特性保护执行方面的培训
7. 接收大豆及/或豆油的交货，在处理及加工过程中遵循特性保护规范

七、采购高油酸大豆或高油酸豆油的关键步骤

采购高油酸大豆或高油酸豆油涉及到几个同采购商品豆油或商品大豆有所不同的步骤，重要的不同之处包括：

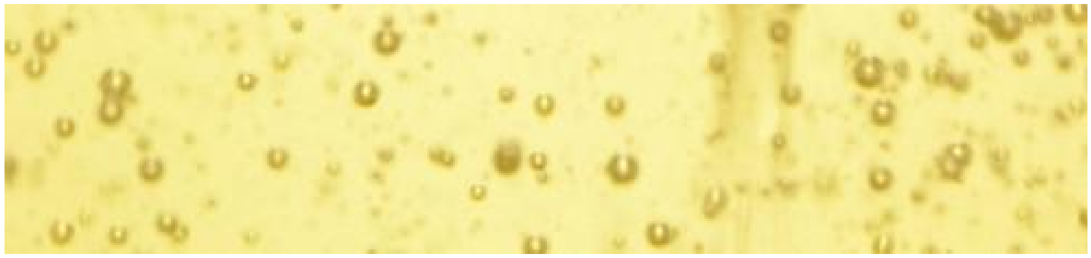
1. **确定能够为您所在市场供应高油酸大豆或高油酸豆油的供应商。**并不是所有的美国大豆出口商或者大豆加工商都参与高油酸大豆的订单生产，美国大豆出口协会（USSEC）的职员及顾问可以指导您找到现有的供应商并协助获得其样品。
2. **根据目标用途来确定所需的高油酸大豆或高油酸豆油的具体规格，不管该用途是餐饮行业、包装食品生产或其它最终用途。**除了商品大豆或豆油所使用的质量规格以外，脂肪酸方面的要求还可以包括油酸、亚油酸、亚麻酸及饱和脂肪酸成分。如有必要，供应商还应确认法规审批的状态。
3. **向特定的供应商索取高油酸大豆及豆油样品。**由于不同的高油酸大豆产品可能会有着不同的脂肪酸含量，获得所选供应商商品化高油酸产品的代表性样品非常重要，这可以保证所采购的高油酸产品的功能能够满足未来应用中的要求。
4. **同潜在的供应商讨论供货及价格。**由于高油酸大豆生产的特定时间线，交付交货所必要留出的前置时间是其中一个关键的讨论点，而供应商是否能够可靠地达到脂肪酸规格要求是另外一个关键因素。还有一个需考虑到的重要情况是高油酸大豆供应商所使用的高油酸种子来源，因为不同的高油酸种子品种会有着不同的脂肪酸含量，从而会影响到其功能性。此外，评估高油酸供货商在协助豆油应用测试及市场开发方面所提供的技术支持水平也很有必要。
5. **协商高油酸大豆及豆油的最终合约。**除了价格、交付交货时间期限及方式外，买方和卖方还应就合同中所包括的最终脂肪酸含量指标以及其它常用的商品合约条款达成协议。合同中应注明官方样品分析所使用的分析方法，如果买方意图在其收货设施使用NIR（近红外线）快速检测，应要求供应商提供合适的NIR校准指标来准确界定脂肪酸含量水平（油酸及亚麻酸含量）。

八、高油酸大豆采购同商品大豆采购的异同

下表对高油酸大豆/豆油同商品大豆/豆油在采购流程上的异同进行了总结。

表格 2: 采购上的异同

<table>
<tr><th colspan="2">高油酸大豆及高油酸豆油同商品大豆及豆油相比在采购时需考虑的要素</th></tr>
<tr><th>同</th><th>异</th></tr>
<tr><td>
• 按照正常的大豆/豆油合约条款（NEAGA, GAFTA, NOPA, NIOP 或 FOSFA）以及USSEC采购客户手册[1]进行交易
• 参考CME（芝加哥商业交易所）期货价格进行定价
• 适用USDA（美国农业部） GIPSA/FGIS 大豆标准:
  ○ 容重
  ○ 水分
  ○ 损坏率
  ○ 杂质
  ○ 破裂率
  ○ 异色率
• 适用AOCS（美国油脂化学家学会）精炼油规格测试方法
  ○ 风味
  ○ 色泽
  ○ 游离脂肪酸
  ○ 过氧化值
  ○ 水分
  ○ 碘值
  ○ 冷试
  ○ 稳定性/OSI（油脂氧化稳定指数）
• 大宗的高油酸大豆或豆油产品可使用现有的货运渠道
• 适用同样的海关申报统一系统编码（HS code）[3]:
  ○ 大豆 - 1201
  ○ 豆油 - 1507
• 可使用同样的CME大豆及豆油期货及期权市场风险管理工具
</td><td>
• 在处理、运输及收货流程中对高油酸大豆/高油酸豆油进行隔离
• 针对高油酸产品更为详细的合同条款及指标
• 根据特性保护体系（IP）成本确定高油酸产品超出商品大豆/豆油价格部分的溢价
• 确定脂肪酸含量指标
• 由于缺少能够满足大宗商业订单需求的现货市场供应，有必要进行订单生产安排
• 更长的交付交货时间线
• 高油酸豆油特有的化学文摘社（CAS）编码（1280732-24-2）
• 高油酸豆油的碘值（IV）[2]:
  ○ 商品大豆碘值幅度 120 - 143
  ○ 高油酸大豆碘值幅度 75 – 105
• 对高油酸产品的低温特性可能需要进行管理
</td></tr>
</table>



九、高油酸大豆及豆油的采购时间安排

短期少量采购的时间安排：

在过去几年中，已有一些高油酸大豆产品投入初期生产，对于少量的尝试性高油酸大豆及高油酸豆油的订单，美国加工商及出口商可能目前有可供的存货。感兴趣的国际加工商或精炼商可联络美国供应商以查询库存情况。

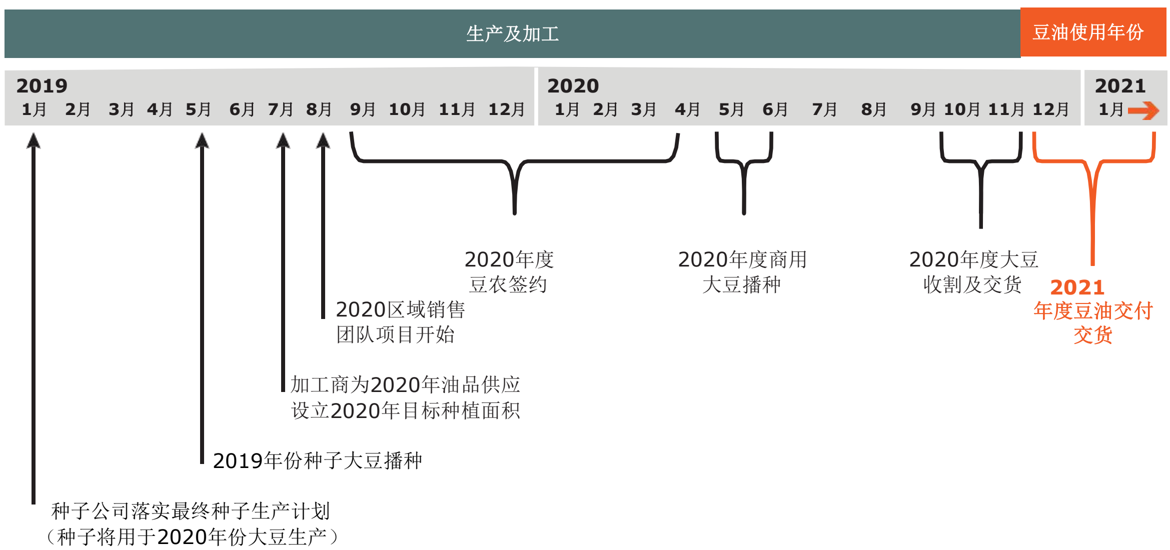
用于持续性商业用途的长期大宗采购：

对于大宗的持续性的供货需求，需要规划一个长期的时间线来把高油酸豆油客户同高油酸大豆或豆油的供应渠道连接起来。同商品大豆不同，高油酸大豆是在特性保护体系中生产出来的，需要协调种子生产并提供种子给豆农，安排商用高油酸大豆的种植及收割，并协调加工商及出口商供应链物流。此外，由于高油酸大豆目前尚处在市场推出的早期阶段，只有少量订单外的产品可以供应现货市场。

考虑到这些因素，最好提前18至24个月提出大宗商用高油酸大豆或豆油产品的采购意向。这种做法可以帮助保证供货量并获得最低的采购成本。

高油酸产品生产时间线中的重要步骤在下图中进行了展示，以2020作物年份为例。

图 7: 高油酸大豆的扩展规划时间线

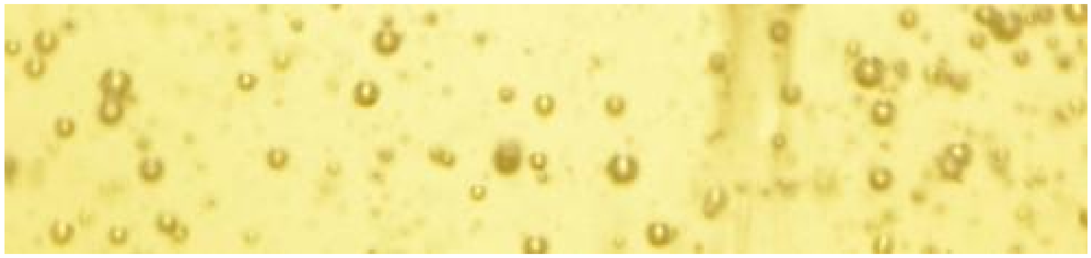


十、高油酸大豆及豆油的成本价值量化分析

为给成本/效益分析提供基础，准确量化高油酸豆油对比商品豆油或者其它油品所具有的改良功能性效益所体现的价值非常重要。

应考虑、评估及量化的且能带来额外价值的主要特征包括:

1. **健康效益：**0克反式脂肪、饱和脂肪降低超过20%、可媲美橄榄油的对心脏健康有益的高油酸含量
2. **更清爽/清淡的口味：**降低油腻口感，可以作为理想的混合物
3. **高OSI** （氧化稳定指数）：处于25至30小时区间
4. **高达2至3倍的更长煎炸使用期限：**同传统豆油相比换油次数更少、包装浪费更低
5. **长达3倍的货架期：**用于包装食品时，同传统大豆相比



6. **更高的烟点：**比商品大豆豆油、高油酸菜籽油或高油酸葵花籽油的烟点高出约10度
7. **炊具表面清洁更加容易：**更少聚合物形成，减少炊具表面油污
8. **更少添加物：**去除了人工合成抗氧化剂 （TBHQ、EDTA）

   **每份食用量低于0.5克的反式脂肪*

十一、高油酸大豆和豆油溢价加价的定价体系

除了额外的溢价这一点之外，高油酸大豆及高油酸豆油的交易方式同商品大豆及豆油相同，高油酸的特殊供需因素以及供应链的特性保护要求导致了额外的溢价。高油酸豆油的固有价值体现在其相对于商品豆油更优的功能性效益，包括其更高的热稳定性和氧化稳定性，因为高油酸豆油的油酸含量更高、多不饱和脂肪酸含量更低。为了将这些效益传递给终端客户，很重要的一点是要保证整个高油酸供应链尽量不要同商品大豆或豆油发生掺混，因为掺混会改变最终的脂肪酸含量，导致性能下降。

大豆及豆油的溢价由以下几个主要因素推动：

- 为了最大程度避免同商品大豆发生掺混而需要向美国豆农支付溢价，以让他们能够根据特性保护规范种植及交付高油酸大豆。向豆农支付的溢价可能会根据种子的产量表现而有所不同。
- 由于豆农需要将高油酸大豆运输至符合特性保护规范的谷仓，这些谷仓可能距离豆农通常交货的地点更远，从而需要向豆农支付更高的运输成本。
- 为最大程度避免同商品大豆掺混而向收购站、加工商、运输商等其它供应链各方支付隔离成本。
- 在收货地点及关键的处理点上设置检测脂肪酸的技术手段以保证符合要求。
- 竞争性油籽及其它油脂的供需状况。
- 同商品大豆相比，供应链各方需要管理一个更为复杂的系统，从而会有相应的利润率要求。

同商品大豆一样，高油酸大豆的基础溢价是动态多变的。但是，由于其闭环的供应链结构（以保持特定的高油酸大豆特性的纯度），美国大豆行业内目前并没有大量的高油酸大豆或豆油产品的公开交易。供应商的高油酸溢价取决于其所处的特定的终端客户需求状况及/或其接受新的销售订单的能力。

高油酸大豆及豆油可以使用同样的CME大豆及豆油期货与期权市场风险管理工具，但高油酸溢价则不可以。

高油酸大豆溢价可以表述为:

- 高油酸大豆溢价 —— 高出2号商品黄大豆基础价格之上的部分
- 高油酸豆油溢价 —— 高出相应的商品豆油价格之上的部分

大豆或者豆油的高油酸溢价可以通过与卖方根据实际装运时间签订基础合约的方式提前进行锁定，最终的净价可以通过CME的期货市场进行确定，直到交货期开始。

<u>高油酸大豆溢价举例</u>:

- 目前豆农的特性保护溢价幅度通常为每蒲式耳40美分至50美分
  - 按照每蒲式耳大豆11.4磅豆油的产量，该溢价等同于每磅高油酸豆油3.5美分至4.4美分的溢价
  - 随着时间推移规模效益的提高，高油酸大豆溢价预计将逐渐下降

目前美国市场上的高油酸豆油高出精炼的商品豆油的溢价幅度为每磅8至12美分。

- 该溢价幅度适用于与商品大豆单产大致相同的高油酸大豆
- 单产低于商品大豆的高油酸品种会有更高的溢价

十二、美国用于出口的高油酸大豆及豆油的主要来源

表格 3: 目前美国高油酸大豆供应商及其所使用的种子品牌

高油酸产品供应商*	现有高油酸种子品牌
ADM	Plenish®
拜耳作物科学	Vistive® Gold
邦基集团	Plenish®
Catania油品公司	Plenish®
CHS	Plenish®
科迪华农业科技	Plenish®
密苏里大豆销售委员会	Soyleic™
普渡农商	Plenish®
Stratas食品有限责任公司	Plenish®

******附件中有每一高油酸产品供应商的联系信息*

十三、宽松特性保护体系下的文件记录及检查要求

特性保护的目标：通过避免高油酸大豆及豆油渗漏并掺混进入低价值的商品大豆来保护价值并使其最大化。

对于商品大豆或商品豆油同高油酸大豆或高油酸豆油可被允许的具体掺混水平没有标准的界定，因此采购合同应含有用于生产高油酸豆油的高油酸大豆应达到的特定脂肪酸含量标准，而不是掺混比例的标准。这一点很重要，因为所增加的价值取决于比照商品大豆而言更高的脂肪酸含量。对于相应的产品交付，买方也会希望收到合适的含量分析认证。

对于高油酸大豆，检测油酸、亚麻酸、蛋白质、油分含量等的最快速及可靠的方法是使用近红外（NIR）光谱检测。虽然NIR技术在整个大豆供应链中相对来说比较新，尚未广泛使用，但很多其它谷物产品以及食品行业中的一些其它检测应用已经获准使用NIR。

如果使用NIR，很重要的一点是要同高油酸供应商确认已经开发出能够对所检测的特定高油酸种子及性状进行精确测量的NIR校准软件。目前尚无一个单一的高油酸产品NIR校准软件可以使用在不同的高油酸供应链中。

对于高油酸豆油来说，最为准确的测定其脂肪酸成分（FAC）的方式是使用气液色谱检测（GLC）。这一检测流程由美国油脂化学家学会（AOCS）设立，是一种成熟的检测方法，大多数的美国豆油企业及独立分析实验室都用它来在分析证书上记录实际的脂肪酸组分结果。

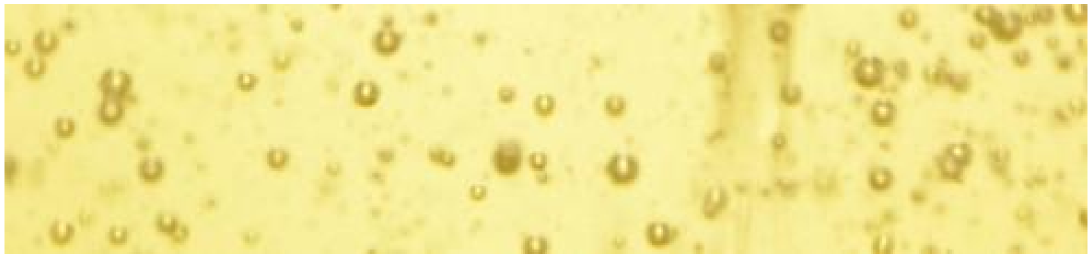
十四、高油酸大豆或豆油的交付交货方式

无论是高油酸大豆还是高油酸豆油，交付其交货方式与国际买家通常用于进口至其特定目的地时所使用的方式相似，但是由于高油酸大豆市场不像商品大豆那么发达，最初的交付交货方式可能需要适用于比商品大豆或豆油交付更小的量。此外，考虑到买方现场隔离仓储设施有限，精炼后的最终高油酸豆油产品的初期市场需求也有限，可能需要签订比较小量的合同。

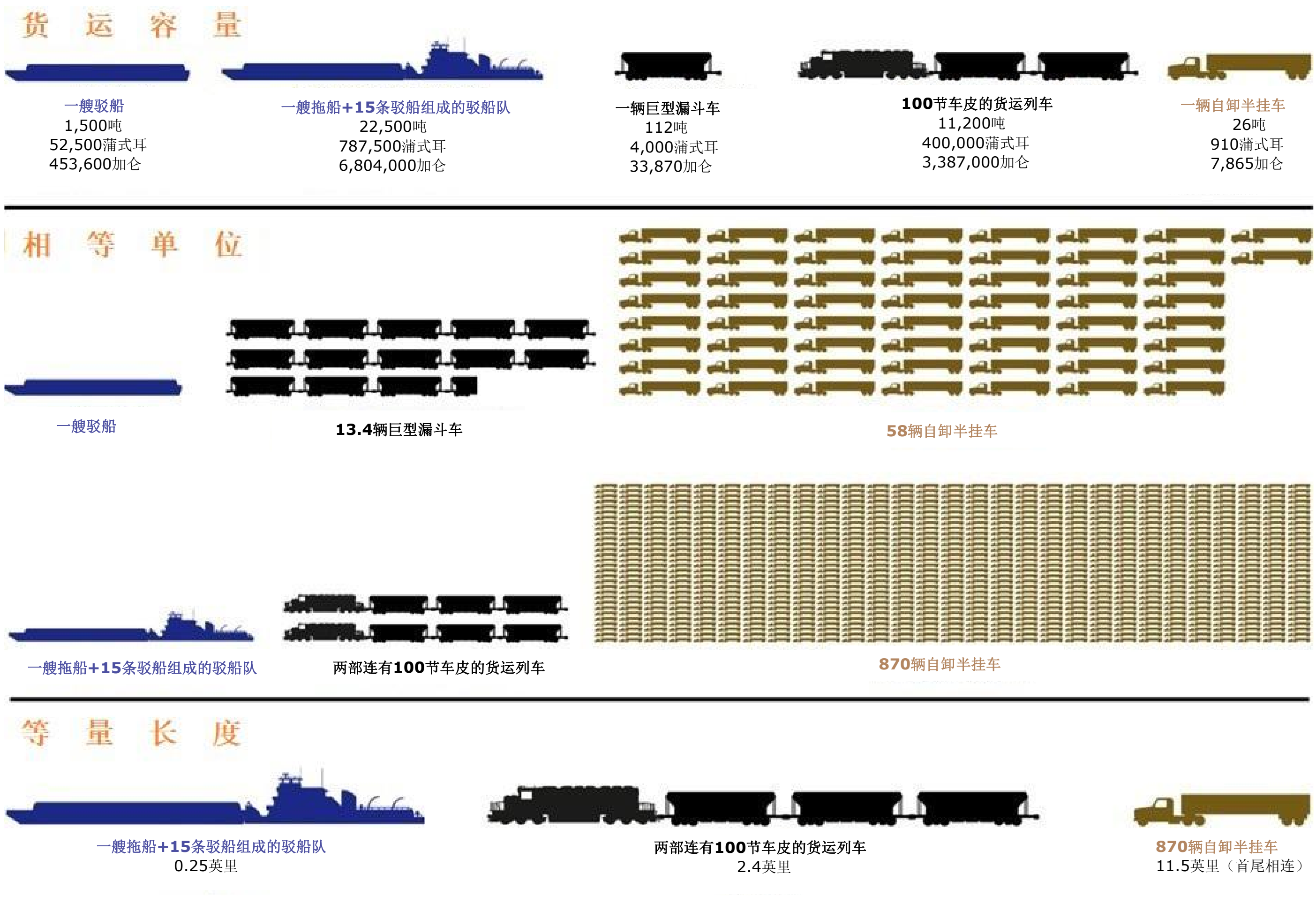
买方也需要尽早同潜在的供货商讨论其供应链能够承担的物流能力，以及可到达的出口目的地。交货运输方式可能包括：

- 二十英尺标准集装箱（TEU）
- 二十英尺集装箱内使用Flexitanks塑料包装袋（油品）
- ISO罐式集装箱（油品）
- 巨型漏斗车或油罐车
- 驳船
- 船舶货舱

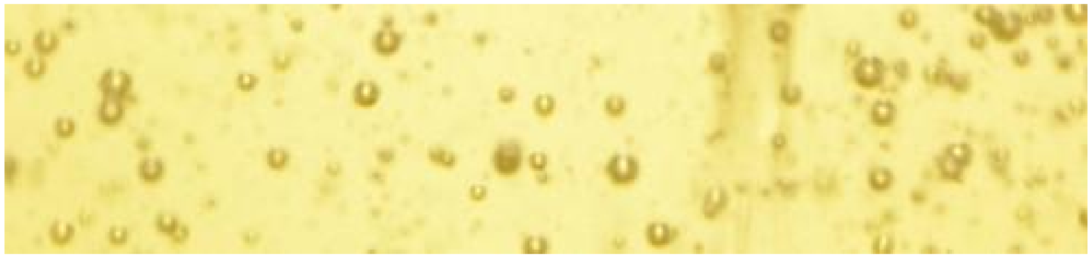
其它掺混在有可能与商品大豆、豆油或其它以前处理过的物品混在一起的每个转运点，都需要考虑特定货物的隔离措施。虽然隔离的水平要求并不像非转基因谷物那么严格（不需PCR检测），买方仍需遵循基本的“宽松的”特性保护体系以在最终交货前尽量不发生掺混。



表格 **8:** 散装谷物运输



资料来源：艾奥瓦州交通厅

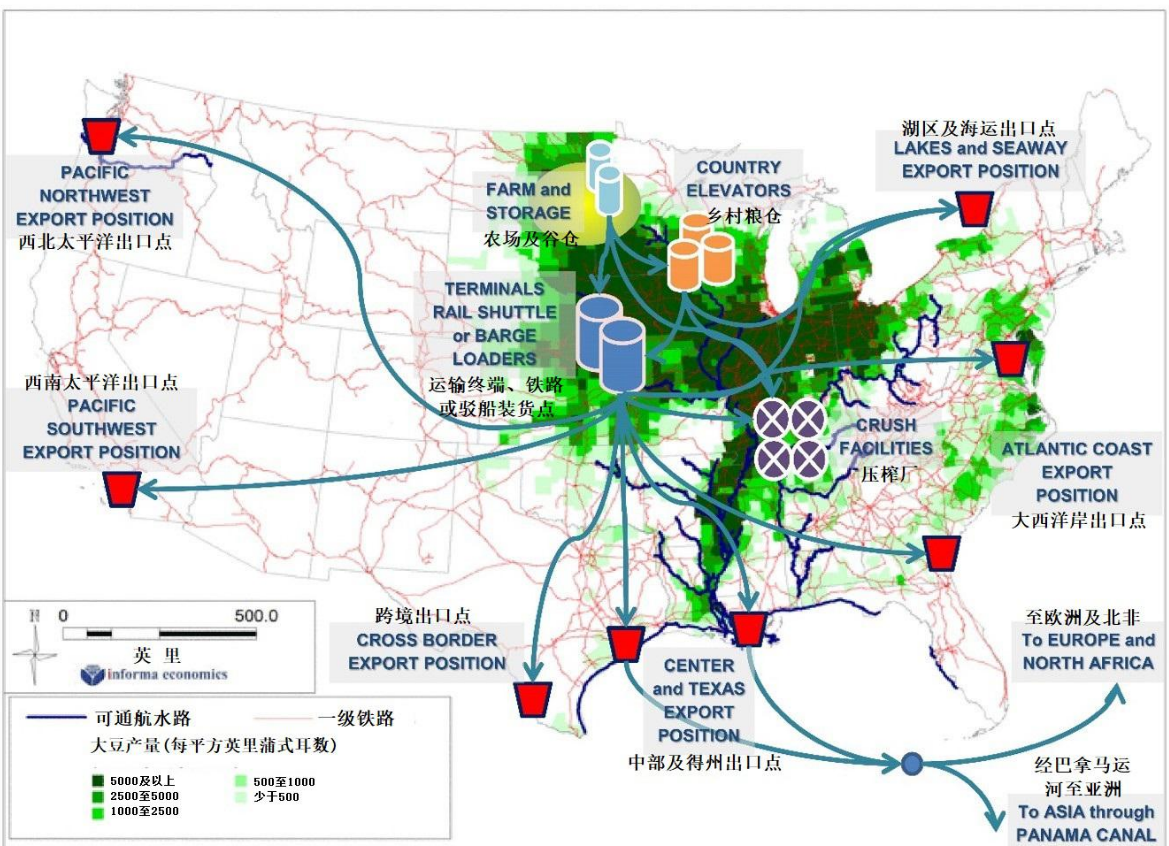


表格 4: 散装植物油运输

运输方式	大约容量 / 净重*
钢桶	420 磅
中型散装袋 （IBC） – 硬质	275 加仑 / 2,100 磅
IBC 瓦楞袋 – 可折叠	275 加仑 / 2,100 磅
用于ISO TEU集装箱的Flexitank塑料包装袋	48,000 磅 / 22,000 公斤 / 6,300 加仑 / 24,000 公升
ISO罐式集装箱	48,000 磅
巨型油罐车	25,500 加仑 / 185,000 磅 ***或***
• *可用外部线圈进行隔热处理*	28,000 加仑 / 205,000 磅
油罐运货卡车	48,000 磅
液体运输驳船	3,000,000 磅
散装液体货船	根据租船订单而不同

***** *买方卖方彼此同意*

图表 9: 大豆的物流流程图



资料来源: 美国大豆基金会

十五、高油酸大豆及豆油的储存细节

在储存高油酸大豆或高油酸豆油时，最重要的一个考虑是要尽量降低同商品大豆或豆油的掺混。对于任何高油酸大豆掺混的要求要比非转基因谷物的要求宽松，后者需要通过PCR检测每百万单位内的掺混物数量。

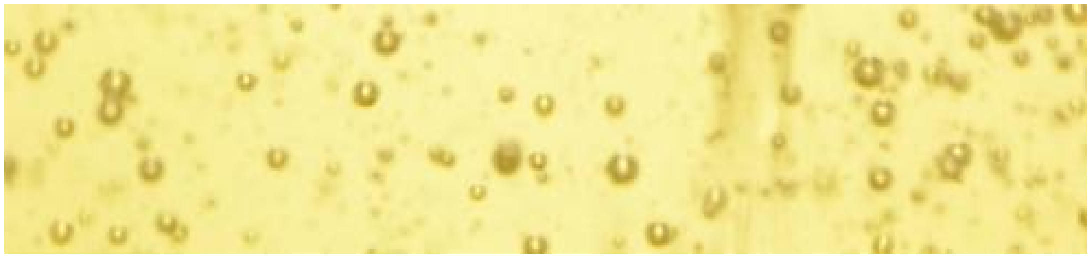
由于这个原因，高油酸大豆及高油酸豆油所使用的特性保护体系经常被称为“宽松”特性保护体系。但是，保持高油酸产品的纯度仍然是将最终精炼高油酸豆油通过性能提升而获得价值进行最大化的一个关键因素。

举例来说，如果23%油酸含量的商品大豆掺混入75%油酸含量的高油酸大豆的比例达到百分之一，那么掺混后生产出来的豆油的油酸含量就会下降至74.5%。因此，如果商品大豆与高油酸大豆的掺混比例达到10%，则掺混后生产出来的豆油的油酸含量就会下降至70%。这种水平的变化，伴随着相应的多不饱和脂肪酸含量的上升，会对高油酸豆油在食品应用上的性能表现起到严重的负面影响。

高油酸豆油的储存同商品豆油储存方式相似，不过高油酸豆油的储存期限更长，而且高油酸豆油也有着不同的低温属性。同商品豆油（23-%油酸含量, 62%多不饱和物含量）相比，高油酸豆油在不饱和脂肪酸含量上也有着很大的不同（70-80%油酸含量, 5-17%多不饱和物含量）。

因此，高油酸豆油在低温状况下的处理方式与商品豆油不同，更类似于橄榄油的处理方式。橄榄油在温度下降到2-4摄氏度（35-40华氏度）时会自然凝固，从室温下的液态缓慢凝结，直到在温度达到零下12至18摄氏度（10至0华氏度）时变为固态。

冻结及凝固的情况可能会在高油酸豆油在处于低温天气下的散装运输过程中、储藏罐中或在冷藏状态下使用高油酸豆油时发生。瓶装的零售沙拉油产品一般需要进行5.5小时的低温测试，虽然大多数高油酸豆油会满足这个测试要求，但长期处于冰点或以下温度的状况会使得高油酸豆油粘度增加，并在温度足够低的时候最终发生凝固。



对高油酸豆油进行的实验检测发现，粘度增加在温度达到约零下10摄氏度的时候开始发生，并在温度达到零下16至零下23摄氏度时开始凝固。但是需要注意的是，油品体量及其它物理因素也会影响到其物理形态时改变时的实际温度。

油品凝固的状态并不会损害油品质量，而且油品会在温度回升到冰点以上之后恢复到液体状态。如果买方预计高油酸豆油会在散装运输或储存时经受低温的状况，建议使用保温的运输容器及/或油罐，也可以通过跟踪伴热隔温管道进行温和加热。除了蒸汽盘管之外，带有搅拌功能的散装油罐也有助于保持油的循环，使油均匀地暴露在热源下。

十六、保证高油酸大豆及豆油的宽松特性保护体系

收货及处理

处理高油酸大豆时的一些常规性特性保护流程包括:

1) 对员工进行高油酸特性保护规范方面的培训。
2) 如果可能的话，高油酸大豆交货时使用的储存设施不要同其它谷物共享卸货区及装卸设备。
3) 清洁或者使用专用的谷物卸货区、装卸设备、传送带等来尽量避免高油酸大豆同其它谷物或商品大豆发生掺混。
4) 交货之前，所有需要用于储存高油酸大豆的谷仓都应进行清洁（谷仓清扫）并经目视检查确认不再含有其它谷物。
5) 目视检查卡车在运输高油酸大豆前无其它谷物残留。
6) 对每一批接收的高油酸大豆进行NIR检测，确定油酸及/或亚麻酸含量。

压榨

高油酸大豆压榨的常规性特性保护流程包括:

1) 对压榨厂的员工进行高油酸特性保护规范方面的培训。
2) 应用上述相同的特性保护规范来处理高油酸大豆，直到压榨开始。
3) 确认压榨厂是否需要:
    a. 在开始高油酸大豆压榨之前停工进行清洁，或者
    b. 不停工而直接开始高油酸大豆压榨，并对出油口提取器进行测试，从而确定是否需要开始分离至专用的高油酸大豆原油罐。

c. 不同的加工厂需要根据自身情况决定哪种方法可以最大程度避免商品豆油和高油酸豆油发生掺混及降低相应的冲刷费用。成本方面的因素还包括停工时间、清洁费用以及由于高油酸大豆及高油酸豆油进入低价值商品流中所造成的损失。

4) 在整个压榨及精炼过程中，高油酸大豆及豆油应定期进行采样来记录油品纯度。

5) 在高油酸压榨流程中产生的豆粕不需遵循特性保护或其它特殊的处理规范。

精炼

隔离流程同买方精炼厂在精炼其它植物油时采用的流程极为相似。

高油酸豆油精炼的常规特性保护规范包括:

1) 对精炼厂员工进行高油酸产品特性保护规范的培训。

2) 如果可能的话，清洗高油酸豆油传输管道之前的所有油品加工管线来最大程度避免同之前所加工油品发生掺混。

3) 在精炼流程中使用合适的方法来让高油酸豆油脱臭。

4) 在使用专用的高油酸豆油油罐之前确认其清洁状态。

5) 确认从精炼豆油罐到装车区之间的管线均已进行清洗。

6) 在所有散装精炼成品油运往最终用户之前，确认每一油罐车或其它运输工具均已出具清洗证明文件，并已经过目视检查。

十七、附件：联系方式、术语及定义

美国高油酸供应商联系信息：

ADM
联系人：Jake McCammack
地　址：4666 Faries Parkwa
　　　　Decatur, IL 62525
电　话： 1-217-451-3791
网　站：www.adm.com
电　邮：jake.mccammack@adm.com

拜耳作物科学
联系人：Ernesto La Red
地　址：800 N. Lindbergh Blvd.
　　　　St. Louis, MO 63167
电　话：1-314-694-4673
网　站：www.vistivegold.com
电　邮：ernesto.lared@bayer.com

邦基集团
联系人：Rodrigo Vasconcelos
地　址：1391 Timberlake Manor Parkway
　　　　Chesterfield, MO 63017
电　话： 1-905-825-7962
网　站：www.bungenorthamerica.com
电　邮：Rodrigo.vasconcelos@bunge.com

Catania油品公司*
地　址：3 Nemco Way
　　　　Ayer, MA 01432
电　话：(978)772-7900
网　站：www.cataniaoils.com

CHS
联系人：Todd Biedenfeld
地　址：5500 Cenex Drive
　　　　Inver Heights, MN 55077
电　话： 1-651-355-6414
网　站：www.chsinc.com
电　邮：todd.biedenfeld@chsinc.com

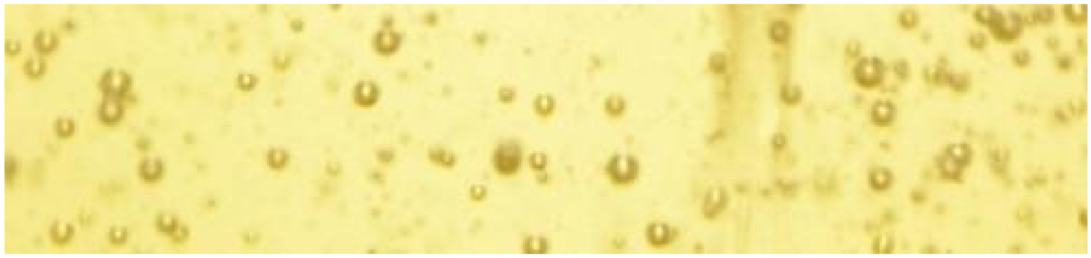
科迪华农业科技
联系人：Susan Knowlton
地　　址：974 Centre Road
Chestnut Run Plaza, Bldg. 735
Wilmington, DE 19805
电　　话：1-302-299-5283
网　　站：www.plenish.com
电　　邮：susan.knowlton@corteva.com

密苏里大豆销售委员会
联系人：Bryan Stobaugh
地　　址：3337 Emerald Lane
Jefferson City, MO 65109
电　　话：1-573-635-3819
网　　站：www.mosoy.org
电　　邮：bstobaugh@mosoy.org

普渡农商
联系人：Matt Porter
地　　址：6906 Zion Church Road
Salisbury, MD 21804
电　　话：1-410-341-2004
网　　站：www.perduefarms.com/agribusiness/
e-电　　邮：matt.porter@perdue.com

Stratas食品有限责任公司*
联系人：Jonathan Gilbert
地　　址：7130 Goodlett Farms Parkway
Suite #200
Memphis, TN 38016
电　　话：(901) 387-2224
网　　站：www.stratasfoods.com
电　　邮：jonathan.gilbert@stratasfoods.com

**为餐饮业提供包装后的高油酸豆油产品，批次供货量少于卡车整车容量（桶装/袋装）*



<u>高油酸大豆及/或豆油的行业信息来源:</u>

- **拜耳** （Vistive®Gold 高油酸大豆）
  https://www.vistivegold.com/

- **科迪华农业科技** （Plenish® 高油酸大豆）
  https://www.plenish.com/

- **密苏里大豆销售委员会** （Soyleic™ 高油酸大豆）
  https://mosoy.org/

- Qualisoy
  https://www.qualisoy.com/food-industry-solutions/high-oleic-soybean-oil

- **美国大豆基金会**
  https://unitedsoybean.org/topics/high-oleic-soy/

<u>术语表:</u>

生物技术/基因改造生物 （GMO）: 通过基因工程培育出来的作物。基因工程是一项更为精准的作物培育方法，也称为生物科技，让作物培育者在自然界找到优秀的生物特性，将其DNA从一个植物或生物转移到需改进的另一植物或生物上，同时也对所培育植物的现有生物特性进行改变。

闭环供应链: 一个明确的质量保证控制程序，涉及到供应链的所有方面。高油酸大豆在一个协调的闭环供应链中进行种植，涉及到种子供应商、商用大豆豆农、大豆加工商及出口商。高油酸大豆及豆油出口商同国际客户之间的谷物及油产品供应渠道中也需执行特性保护体系。

高油酸大豆: 同商品大豆相比，高油酸大豆的油分含有极高的单不饱和油脂肪酸（18:1）。虽然对于脂肪酸含量没有一个官方标准，美国行业内的常规共识是高油酸大豆应达到70%或以上的油酸含量，而商品大豆的油酸含量则只有22-25%。高油酸大豆中其它的脂肪酸也会有一些不同，比如多不饱和物（亚油酸和亚麻酸）含量极大降低，饱和脂肪（棕榈酸和硬脂肪）含量也有降低。

高油酸定价溢价: 高油酸大豆及/或豆油的递增价格，表述为超出商品大豆/豆油现货价格或基础价格之上的溢价。不同的高油酸供应商会有不同的溢价，主要取决于由于高油酸供应链采用特性保护而导致的成本的增加。

碘值: 脂肪饱和程度的表现值，通过衡量特定情况下同自然或加工过的脂肪发生反应的碘元素量获得，也可以使用美国油脂化学家学会提供的数学公式（AOCS method Cd 1c-85）对已知的脂肪酸成分来直接进行计算。

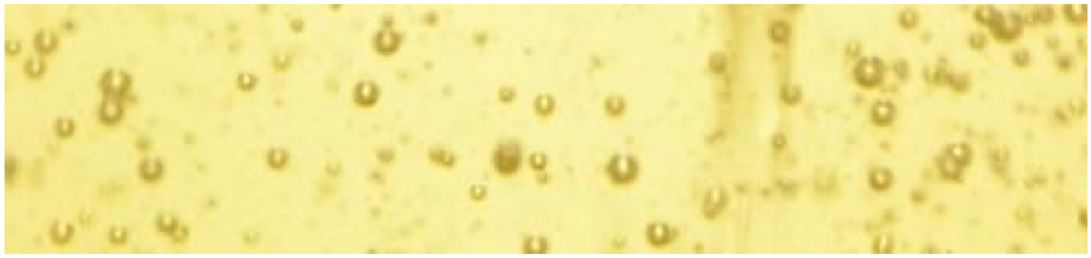
特性保护（IP）： 该流程涉及高油酸大豆供应链的所有步骤，避免将高油酸大豆或豆油同商品大豆或豆油掺混在一起。该流程保护高油酸成分不会被稀释。

- **宽松IP:** 一种较为简单且成本较低的特性保护规范，在供应链容忍度不像非转基因认证那样严格、但仍有必要来保持价值及较高的谷物质量的情况下使用。为监控合同指标的合格情况，仍需使用质量检测，但对于豆农的达标要求要较宽松，更多时候是用百分比整数进行表述，而不使用百万分比。
- **严格IP:** 一个更为复杂的流程，涉及到大量检测，比如测试转基因成分的PCR检测。此外，对于豆农、谷物处理商及加工商也有着更为严格的谷物生产及处理程序要求。合同规格及杂质检测容忍度经常以百万分比进行定义。

近红外(NIR)检测: 对样品的化学成分进行的光谱光度测量分析。除了可以衡量高油酸大豆的蛋白及油分含量之外，NIR快测也是油酸及亚麻酸含量的主要商业检测方法。

氧化稳定性指数(OSI): 一个广泛应用的衡量油脂抗氧化度的指标，所代表的油脂稳定度可以导致更长的煎炸使用期限及包装食品的储存期限。

聚合作用: 在有氧状态下脂肪酸内由于热能而加速发生的碳-碳双键交叉连接形成长链，多不饱和脂肪比例较高的油脂(多双键)更易出现聚合作用，从而导致在设备表面积累形成油腻且具光泽的涂层。



TEU海运集装箱: 二十英尺标准集装箱。一个二十英尺的标准集装箱(TEU)内部空间约为20英尺长、8英尺宽、8英尺高。

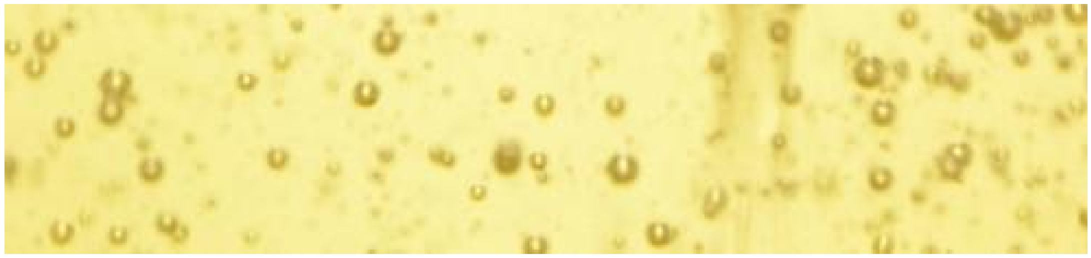
传统/常规作物育种: 在多个作物植株中找到并选择优质特性，将其整合植入在一个单一作物植株上。最为常用的作物培育技术是杂交，杂交的目的是将不同株系内发现的优质特性通过异体授粉集合植入单一株系。通过这个流程生产出来的谷物不需要法规特批，也被认作是非转基因作物。

单位换算及基础假定:

a) 一蒲式耳大豆 = 60磅
b) 一公吨大豆 = 36.74蒲式耳
c) 一短吨大豆 = 33.33蒲式耳
d) 一磅 = 2.2046公斤
e) 一加仑植物油 = 7.65磅
f) 一公吨 = 2,204.6磅
g) 一公吨 = 1.2204短吨
h) 一英亩 = 0.4046公顷
i) 一公顷 = 2.471英亩
j) 每蒲式耳大豆的估计豆油产量 = 每蒲式耳11.4磅
k) 美国大豆平均每英亩产量 (2018): 每英亩51.6蒲式耳
l) 按照美国大豆2018年平均产量计算每英亩平均豆油产量: 588磅

缩写

FAC (脂肪酸成分)
FFA (游离脂肪酸)
FGIS (联邦谷物检验局)
GC (气相色谱分析)
GIPSA (谷物检验、肉品加工及活畜市场管理局)
HO (高油酸)
HOS (高油酸大豆)
IBC (中型散装集装箱)
IP (特性保护)
ISO (国际标准组织)
NIR (近红外)
PCR (聚合酶链式反应)
TEU (二十英尺标准集装箱)



<u>美国行业机构联系方式</u>

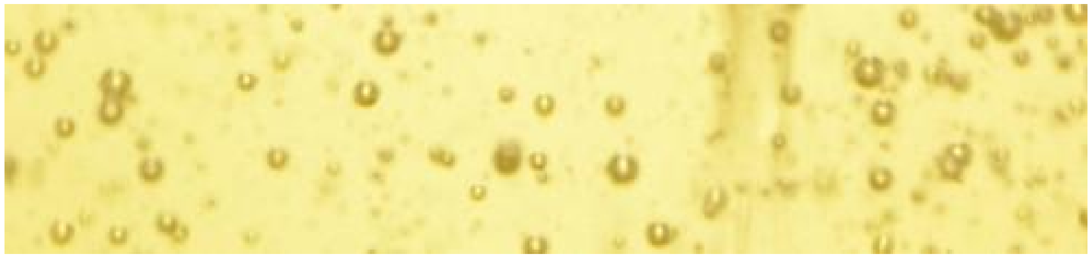
美国油脂化学家学会 (AOCS)
地址：2710 S. Boulder, Urbana, IL 61802-6996
电话：(217)359-2344
传真：(217)351-8091
电邮：general@aocs.org
网站：www.aocs.org

起酥油及食用油学会（ISEO）
地址：1319 F Street NW, Suite 600
Washington, DC 20004
电话：(202)783-7960
电邮：contactus@iseo.org
网站：www.iseo.org

全国油籽产品学会（NIOP）
地址：750 National Press Building, 529 14th St NW Washington, D.C. 20045
电话：(202) 591-2438
传真：(202) 591-2445
电邮：niop@kellencompany.com
网站：www.niop.org

北美谷物出口商协会（NAEGA）
地址：1400 Crystal Drive; Suite 260
Arlington, VA 22202
电话：202-682-4030
传真：202-682-4033
电邮：info@naega.org
网站：www.naega.org

全国油籽加工商协会（NOPA）
地址：1300 L Street, NW
Suite 1020
Washington, DC 20005
电话：(202) 842-0463
传真：(202) 842-9126
网站：www.nopa.org



特种大豆及谷物联盟（SSGA）
地址：151 Saint Andrews Court, Suite 710
Mankato, MN, 56001
电话：(507) 385-7557
网站：www.soyagrainsalliance.org

美国大豆委员会基金会
地址：16305 Swingley Ridge Road
Suite 150
Chesterfield, MO 63017
电话：(800) 989-8721
网站：www.unitedsoybean.org

注释
1 *《美国大豆：国际采购客户手册》， 美国大豆出口协会*
2 *《食物化学法典，第七版》及业界资料*
3 *美国人口统计局, Schedule B 出口类别表，2019年，第七版*

致谢

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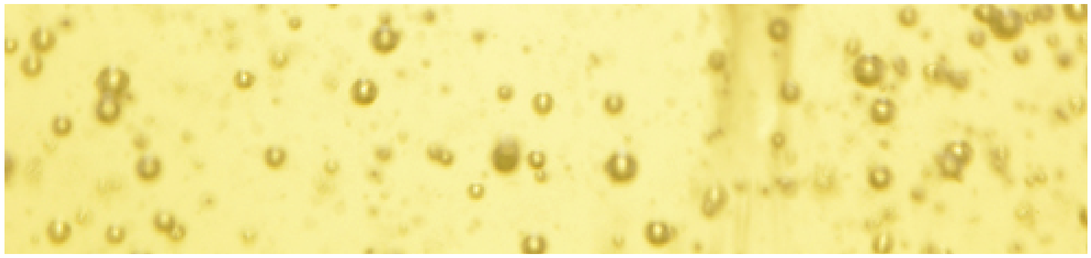
- 科迪华农业科技™ Susan Knowlton
- CHS有限公司 Todd Biedenfeld
- 美国大豆出口协会 Will McNair



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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.

Introduction and Sourcing Manual Purpose

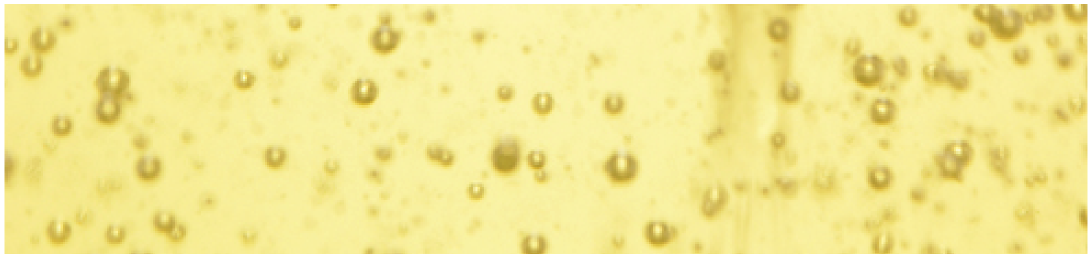
This sourcing manual is intended to provide international customers with basic background information to facilitate the sourcing of U.S. produced High Oleic (HO) Soybeans and HO Soybean Oil.

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 very high 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 U.S. soybean farmers. Working with leading soybean processors and soybean exporters, the U.S. 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 in order 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 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 on handling and transport.



This manual has been produced for the U.S. 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 U.S. soybean farmers and the U.S. soybean industry

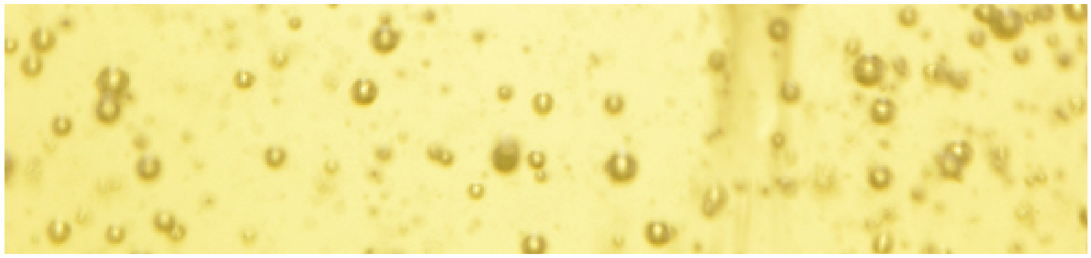
Executive Summary

The U.S. soybean industry is committed to continuous improvement in the quality and value of U.S. 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, soft identity preservation (IP) of HO Soybeans and HO 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 level of oleic fatty acid comparable to 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 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



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.

Food companies may also find value in the product traceability benefits that are possible with the closed loop, identity preserved High Oleic Soybean supply chain. And as part of the U.S. soybean industry's U.S. Soy Sustainability Assurance Protocol (SSAP), High Oleic Soybeans have a positive sustainability story at the farm level. This sustainability advantage is improved even further with the increased frying and shelf life benefits of High Oleic Soybean Oil.

Opportunities in non-food applications are also attractive, based on the very high 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 IP supply chains that first-time HO 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.

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 U.S. and therefore differences in the fatty acid profiles of the various seed products.

While HO Soybean Oil is generally defined as having 70% or greater oleic content, there is not a standard fatty acid profile across the industry. For this reason, it is important to coordinate with suppliers on the specific seed product used and the resulting fatty acid profile that is desired. Specific fatty acids with the greatest impact on HO Soybean Oil functionality include oleic, linoleic, linolenic, stearic and palmitic.

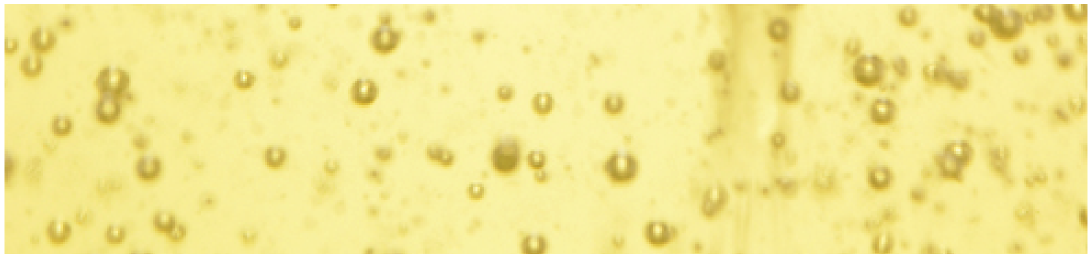
Because HO Soybean Oil represents a major change from commodity soybean oil, functionality testing in specific food applications is important to fully quantify the value benefits. HO Soybean Oil samples can be obtained from participating U.S. suppliers to begin the process. USSEC staff and consultants 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 U.S. through a collaboration between soybean farmers, seed companies and the soybean processing industry. Partial hydrogenation was widely used in the U.S. 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 U.S. soybean oil was partially hydrogenated, oil demand risk was high for the U.S. industry.

With the availability of new seed development technology and the commitment by the entire U.S. 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 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%**	**22%**	**55%**	**8%**
Relative rate of oxidation*			***1***	***40***	***98***
High Oleic Soybean Oil**	**6.5%**	**4%**	**76%**	**7.5%**	**2%**
Olive Oil	**12%**	**3%**	**75%**	**9%**	**1%**

* ***Lipid Oxidation**, E. N. Frankel, 2005*
** *Profile for Plenish® High Oleic Soybean Oil courtesy of Corteva™Agriscience*

While no <u>official</u> fatty acid profile standard exists for HO Soybeans, general U.S. industry consensus is that an oleic level of 70% 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 (palmitic and stearic).

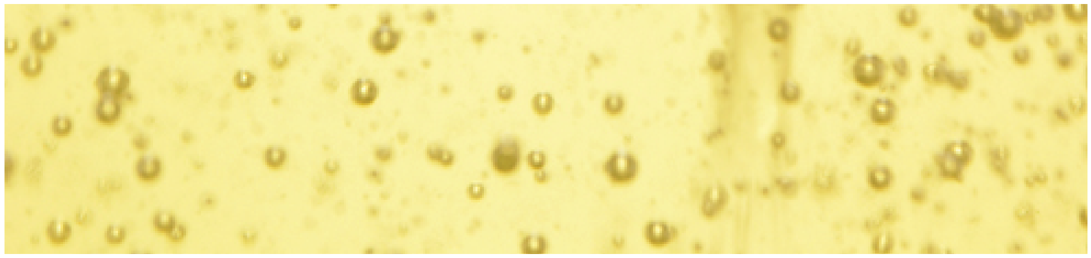
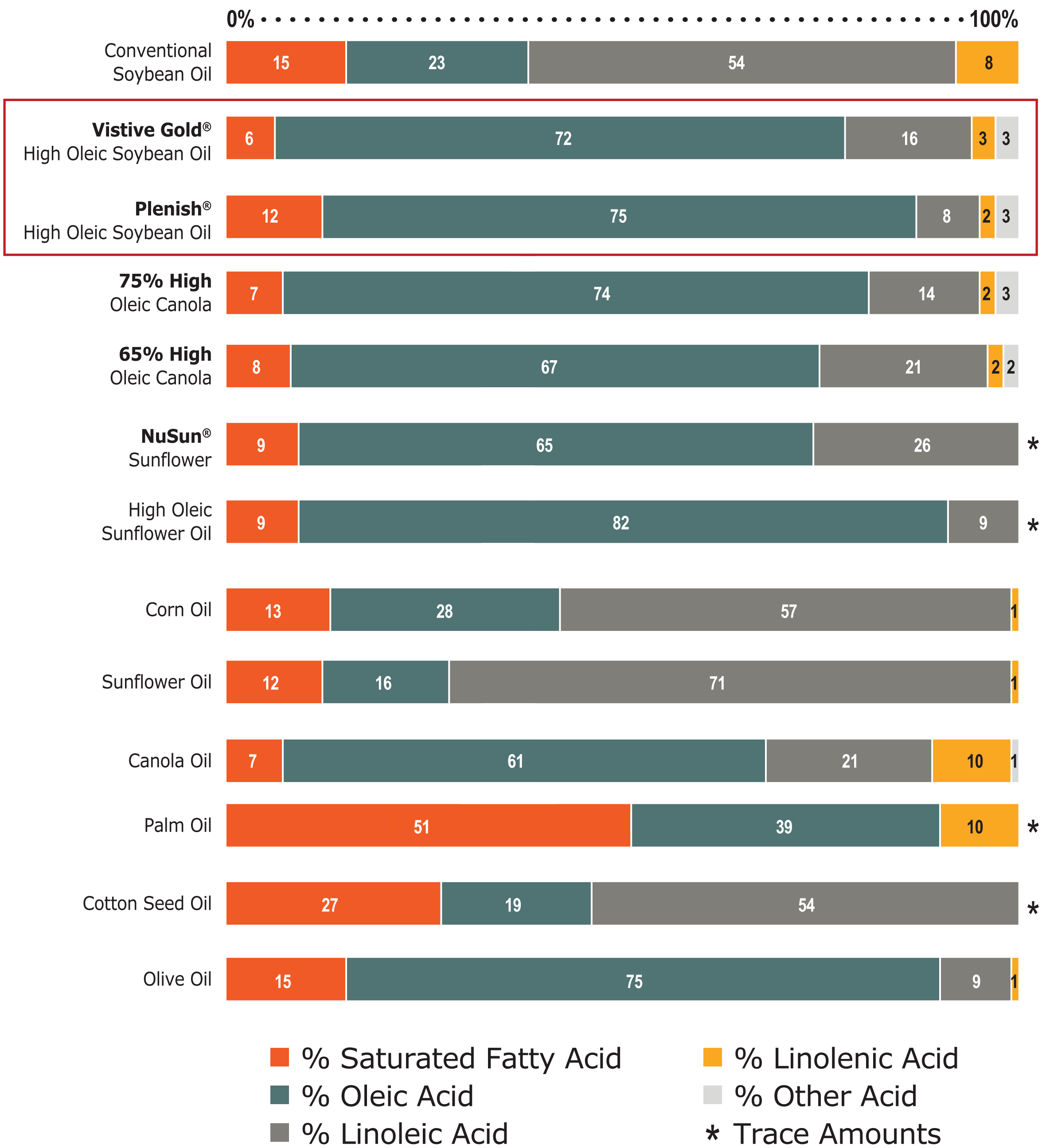
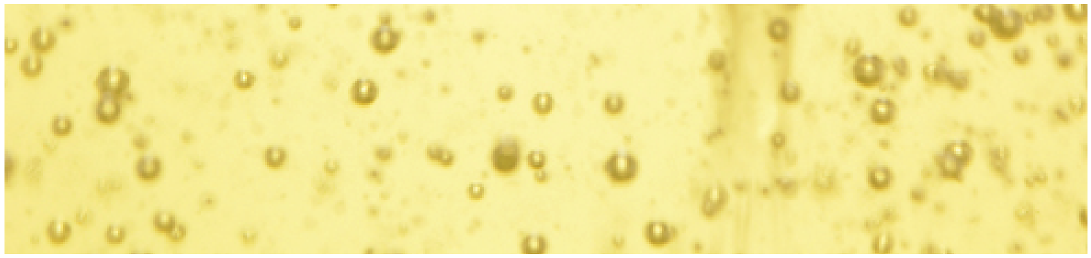


Figure 2: Comparison of Fatty Acid Profiles

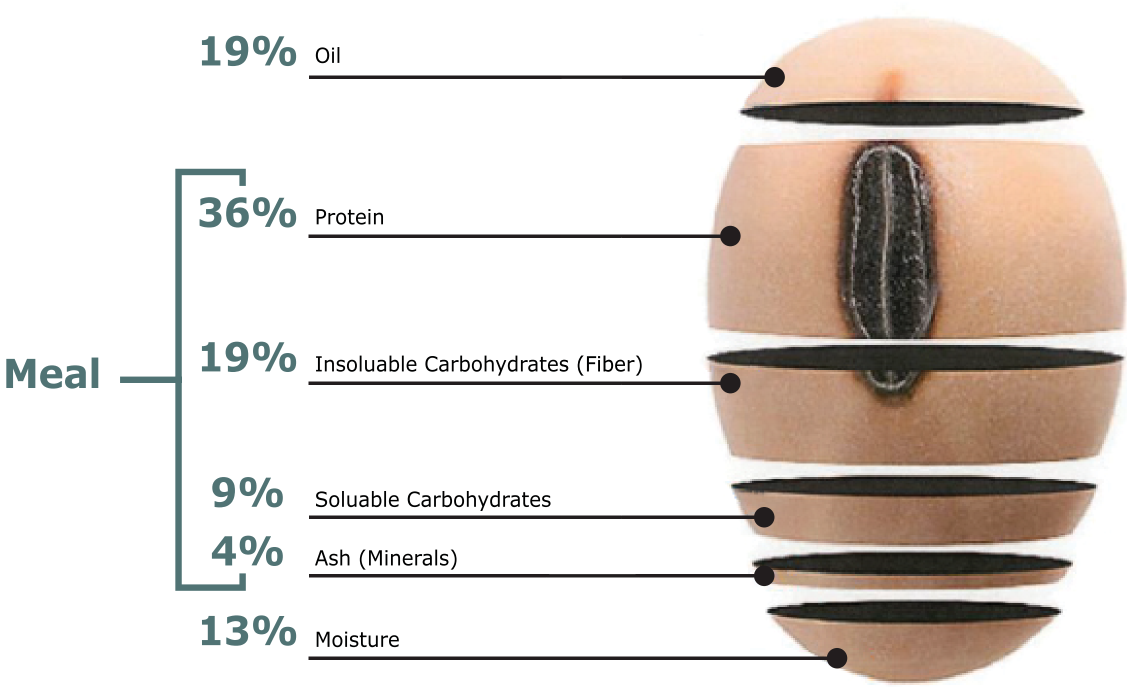


Source: Qualisoy



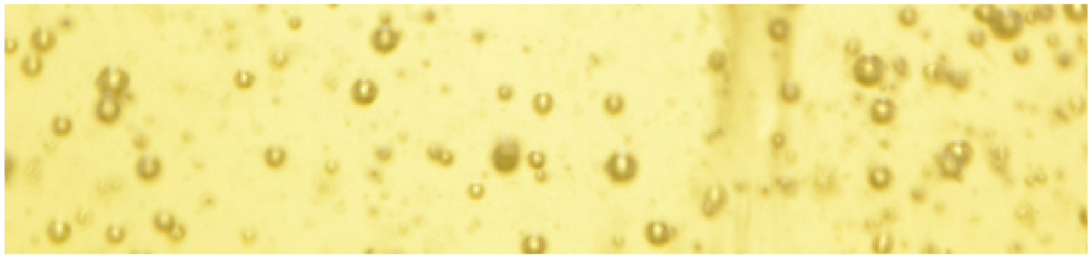
In addition to the improvement that was achieved in modifying the profile of the oil, researchers have also worked to keep the traditional balance between oil and protein content in the HO soybean in order to maintain crush economics. Amino acid content of the HO soybean meal was also not affected in order to allow blending with commodity soybean meal and to eliminate the need for identity preservation of the meal. Other HO similarities to commodity soybeans include such factors as test weight and oil extraction characteristics.

Figure 3: Soybean Composition Profile



Source: United Soybean Board

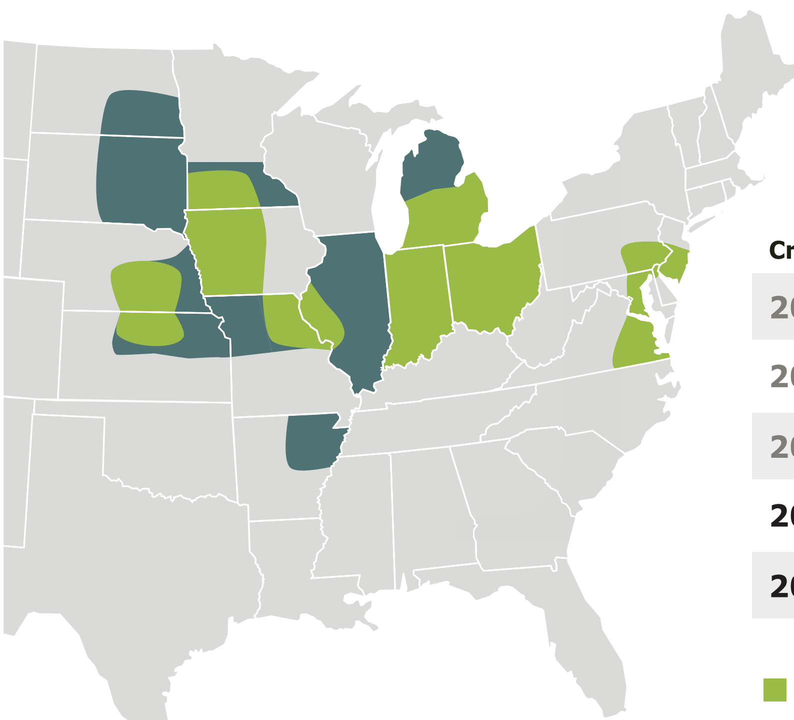
For farmers, it is essential that HO seed products also have the same high grain yields and necessary agronomic traits as current high-performance commodity seed products. This is necessary to assure that production costs are comparable to commodity soybeans and that HO premiums needed to cover added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



With over 5 years of HO 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 in widely diverse 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 High Oleic Soybean growing geography in the U.S. is diverse and the commercialization ramp-up plan is aggressive, as shown by the following chart.

Figure 4: Production Geographies and Growth Projections



Crop Year	Planted Acreage
2012	50,000
2015	275,000
2018	400,000
2021	**3,750,000**
2026	**14,850,000**

Established Regions
Projected Projected

Source: Qualisoy

IV. Current U.S. High Oleic Soybean Seed Developers & Trait Characteristics

Table 1: Current U.S. HO Seed Technology Developers and Product Information*

Seed Technology Developer	Product Name	Seed Development Technology	Oleic Range (%)	Linoleic Range (%)	Linolenic Range (%)	Saturates Range (%)
Bayer Crop Science	Vistive® Gold	Biotechnology	74	17	3	6
Corteva™Agriscience	Plenish®	Biotechnology	75 – 80	5 – 10	2	12
Missouri Soy	Soyleic™	Non-GMO	79 – 85	2.8 – 10.8	0.8 – 4.5	5.6 – 12.2

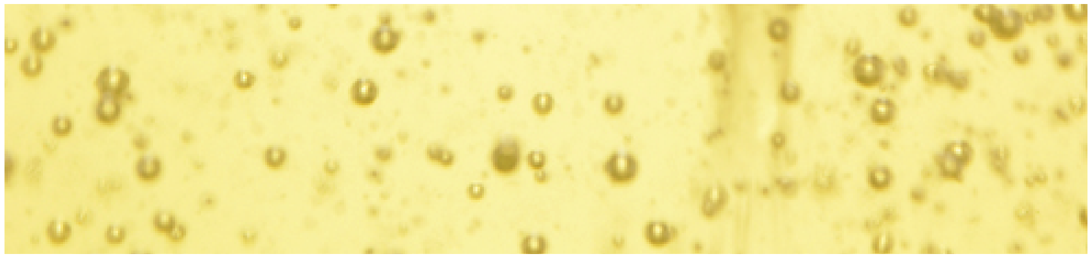
**Information provided by HO Seed Technology Developers*

- ***The fatty acid profiles in the above table represent what the seed trait has been shown to produce using whole soybean GC analysis.***
- ***The final oil profile may be different from the above due to comingling with commodity soybeans or oil in specific supply chains.***
- ***Production location of the crop may also impact the profile.***

V. Identity Preservation (IP) in the High Oleic Soybean Supply Chain

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 are more often expressed in whole percentages rather than parts per million.
- **Hard IP:** A more complex process involving extensive quality testing such as PCR assays for GMO presence along with more stringent grain production and handling protocols for farmers, grain handlers and processors. Specifications and contamination detection tolerances are often defined in parts per million.



High Oleic Soybeans are produced 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 specification requirements.

The commercial production guidelines of the IP system are 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.

U.S. 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.

Traceability and Sustainability Values:

In addition to preserving the purity and value of the high oleic oil profile, the closed loop IP system provides food companies with product traceability benefits, since all production takes place under contracts with farmers. This value is further enhanced with the positive sustainability story of U.S. soybean production as a result of the U.S. soybean industry's U.S. 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 can result in reduced packaging, transportation and other costs.

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 from seed companies, production of commercial soybeans by the farmer, soybean storage and transport, and processing or exporting of soybeans.

The U.S. High Oleic Soybean supply chain is shown in the following graphic.

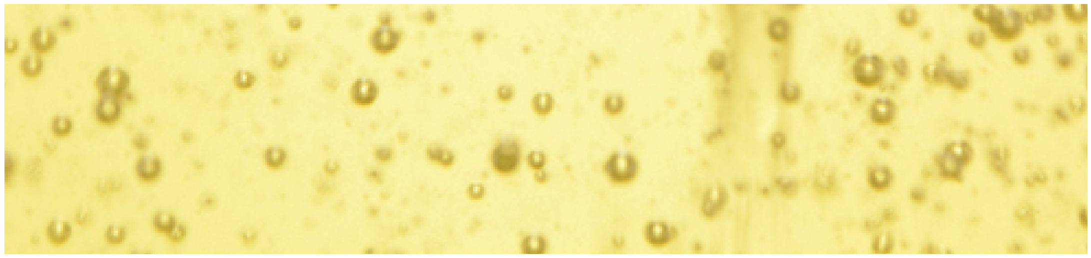


Figure 5: U.S. High Oleic Soybean Supply Chain

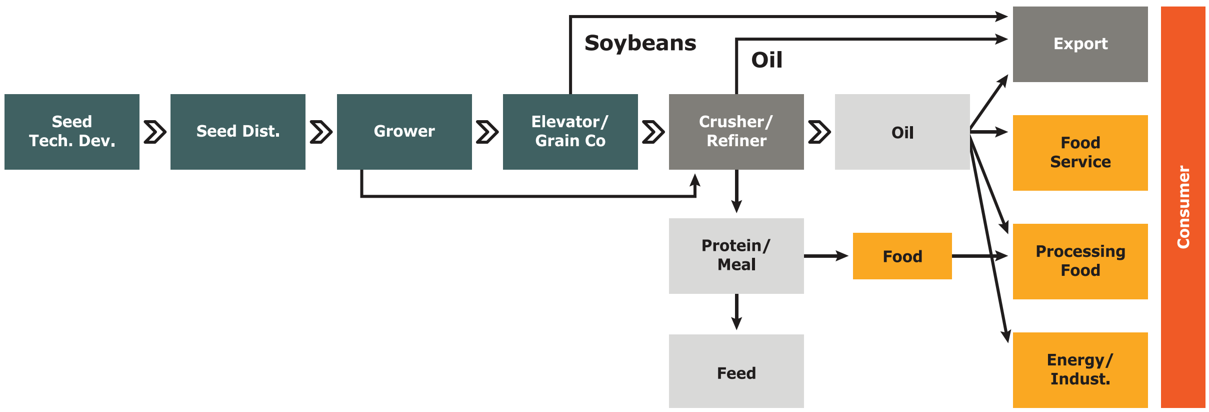


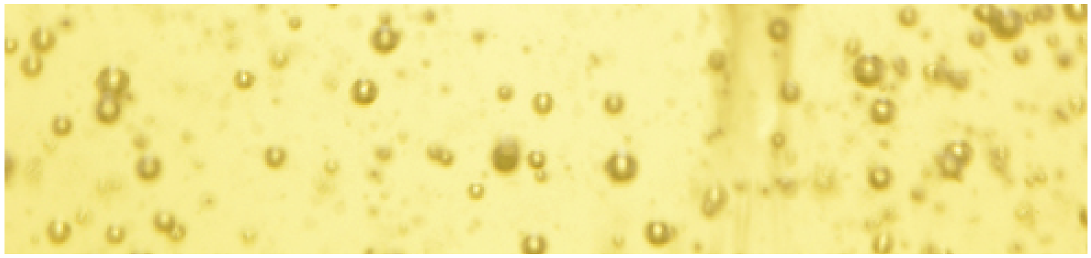
Figure 6: Primary Responsibilities of High Oleic Supply Chain Participants

Seed Companies

1. High yielding seed products, adapted to specific production areas
2. Consistent fatty acid profile over multiple growing seasons
3. Good protein and oil content balance in the soybean
4. Obtaining regulatory approvals as needed
5. Seed supply and distribution to contract growers to meet demand

Farmers

1. Commit to a contract with U.S. processor or exporter that specifies 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. HO soybeans are tested at delivery locations to assure fatty acid specifications (oleic and linolenic) and other quality factors are met. Rejected loads are sold as commodity at no premium
8. Receive HO grain premium from the processor or exporter at completion

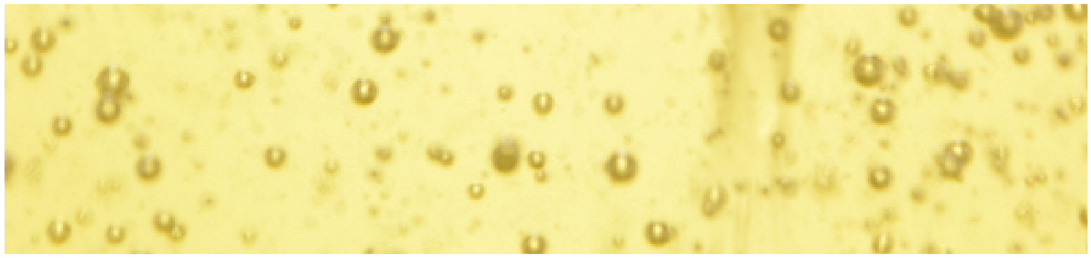


Processors/ Exporters

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 seed trait to establish oil specification, coordinate with seed company to assure 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

Importers and Refiners

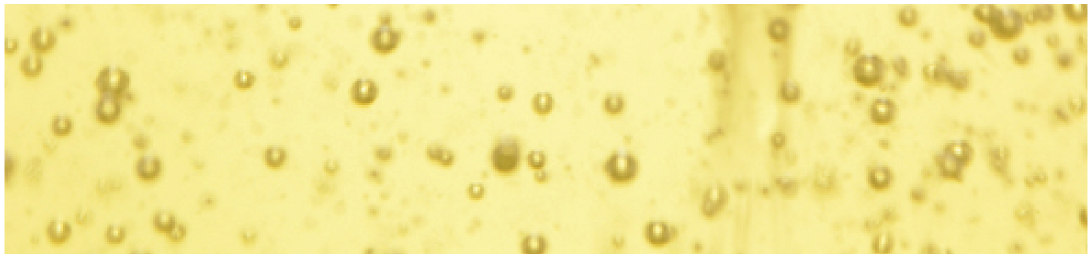
1. Secure HO product samples, evaluate functionality values with end use customers prior to entering into contract negotiations
2. Determine fatty acid and oil quality specification requirements based on functionality needs of end use customers
3. Plan for delivery timelines, based on IP production requirements
4. Evaluate and select suppliers from participating U.S. 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 U.S. soybean exporters or soybean processors are engaged in contract production of 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, linoleic, linolenic and saturate content. Suppliers should also verify 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 discussion area will involve lead times necessary for 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 traits have some variation in fatty acid profile that can impact functionality. It is also helpful to assess the level of technical support that the HO 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).



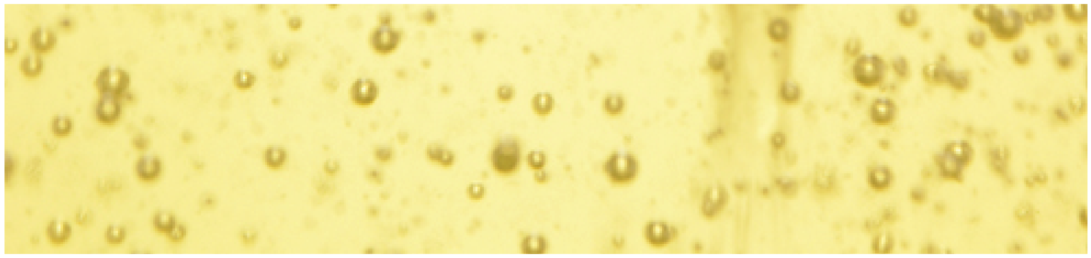
VIII. High Oleic Purchasing Similarities and Differences to Commodity

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

Table 2: 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
• 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
• Can utilize same CME soybeans and soybean oil futures & options market risk management tools
	• 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



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, U.S. processors and exporters may have available supplies now, considering that several HO soybean products have been in early stage production for the last few years. Interested international processors or refiners should contact U.S. suppliers for availability.

Longer-term, higher volumes for ongoing commercial usage:

For larger, ongoing supplies there is a needed for longer term timeline planning to connect High Oleic Soybean oil customers with a supply of HO Soybeans or Soybean Oil. Unlike commodity soybeans, HO Soybeans are produced in an identity preserved 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 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 up to 18-24 months. This lead time helps provide greatest assurance of supply and lowest cost of procurement.

The key steps in the High Oleic production timeline are shown in the diagram below, using the 2020 crop year as an example.

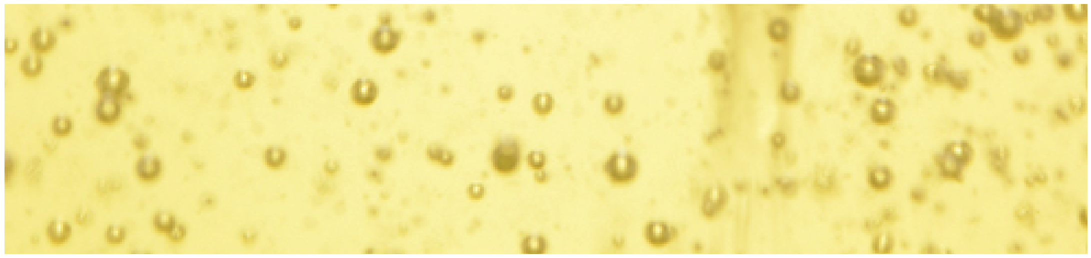
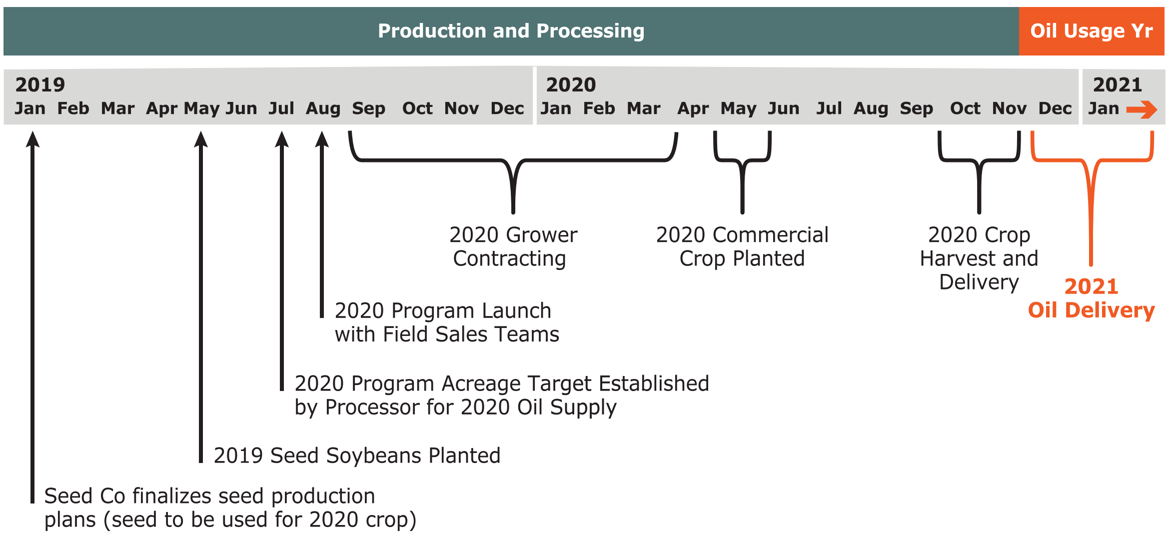


Figure 7: High Oleic Soy Extended Planning Timeline



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*, more than 20% reduction in saturated fats, high level of heart-healthy oleic fatty acid comparable to olive oil
2. **Cleaner / lighter flavor** with less oily taste, also provides a good blending opportunity
3. **High OSI** (Oxidative Stability Index) in the 25-30 hour range
4. **Up to 2-3X longer fry Life** than conventional soy for fewer oil changes, less packaging waste
5. **Up 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 sun
7. **Easier cleaning of cooking surfaces** from reduced polymer formation, with less greasy, varnish-like coatings on equipment surfaces
8. **Cleaner ingredient labels** with the removal of synthetic antioxidants (TBHQ, EDTA)

**Less than 0.5g trans fat per serving*

XI. Pricing Factors for HO Soybeans or Oil on a Premium Plus Board Basis

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.

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 in order to minimize cross-mixing with commodity soybeans. Premiums paid to farmers may vary depending upon seed yield performance.
- 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 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 U.S. 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 premium.

Except for the High Oleic 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 Oil – premium over the appropriate commodity soybean oil basis

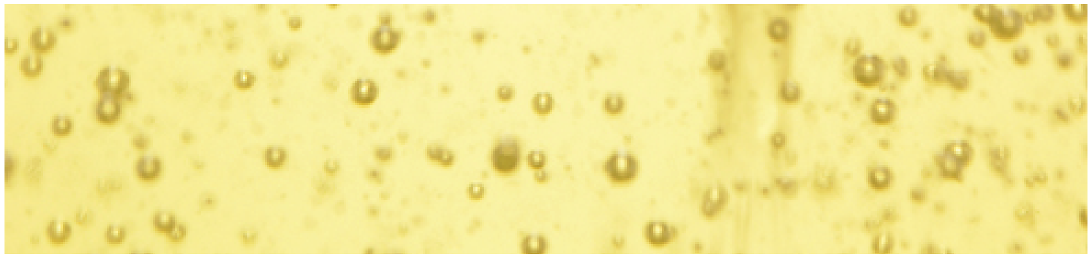
The High Oleic Soy premium for either whole Soybeans or Oil can be contracted in advance to the actual shipment position by establishing a basis contract with the seller. The final flat price can then be established through the CME futures market up to commencement of the delivery period.

<u>High Oleic Soy Premium Example</u>:

- Current farmer IP premiums generally range from $.40 to $.50 per bushel
  - At 11.4 pounds of oil /bushel, this equals $0.035 to $0.044 per pound of HO Oil
  - HO Soy premiums are expected to decline over time with economies of scale

Current estimated U.S. market High Oleic Soybean Oil Premium Range is +$.08 to +$.12 per pound over commodity RBD soybean oil.

- This premium range is based on High Oleic seed varieties that are generally yield equivalent to high yielding commodity soybean seed varieties
- High Oleic seed varieties with lower soybean yield per acre compared to high yielding commodity varieties may have a higher premium



XII. U.S. Sources of High Oleic Soybeans and Oil for Export

Table 3: Current U.S. High Oleic Soy Suppliers and Seed Traits Offered

High Oleic Supplier*	Current HO Seed Trait
ADM	Plenish®
Bayer Crop Science	Vistive® Gold
Bunge	Plenish®
Catania Oils	Plenish®
CHS	Plenish®
Corteva Agriscience	Plenish®
Missouri Soybean Merchandising Council	Soyleic™
Perdue Agribusiness	Plenish®
Stratas Foods	Plenish®

**Contact information for each HO supplier is included in the Appendix*

XIII. Documentation and Inspection Requirements Under Soft IP Systems

Identity Preservation Goal: Protect the value and maximize the volume of HO soybeans and oil by avoiding leakage into and mixing with lower value commodity soybeans.

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 suppliers that the NIR calibration software was developed to accurately measure the specific HO seed and trait source being tested. There currently is no single HO NIR calibration being used across the various HO 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 U.S. soybean oil companies and referee analytical laboratories to report actual FAC results for certificates of analysis.

XIV. Delivery Options for HO Soybeans or Oil

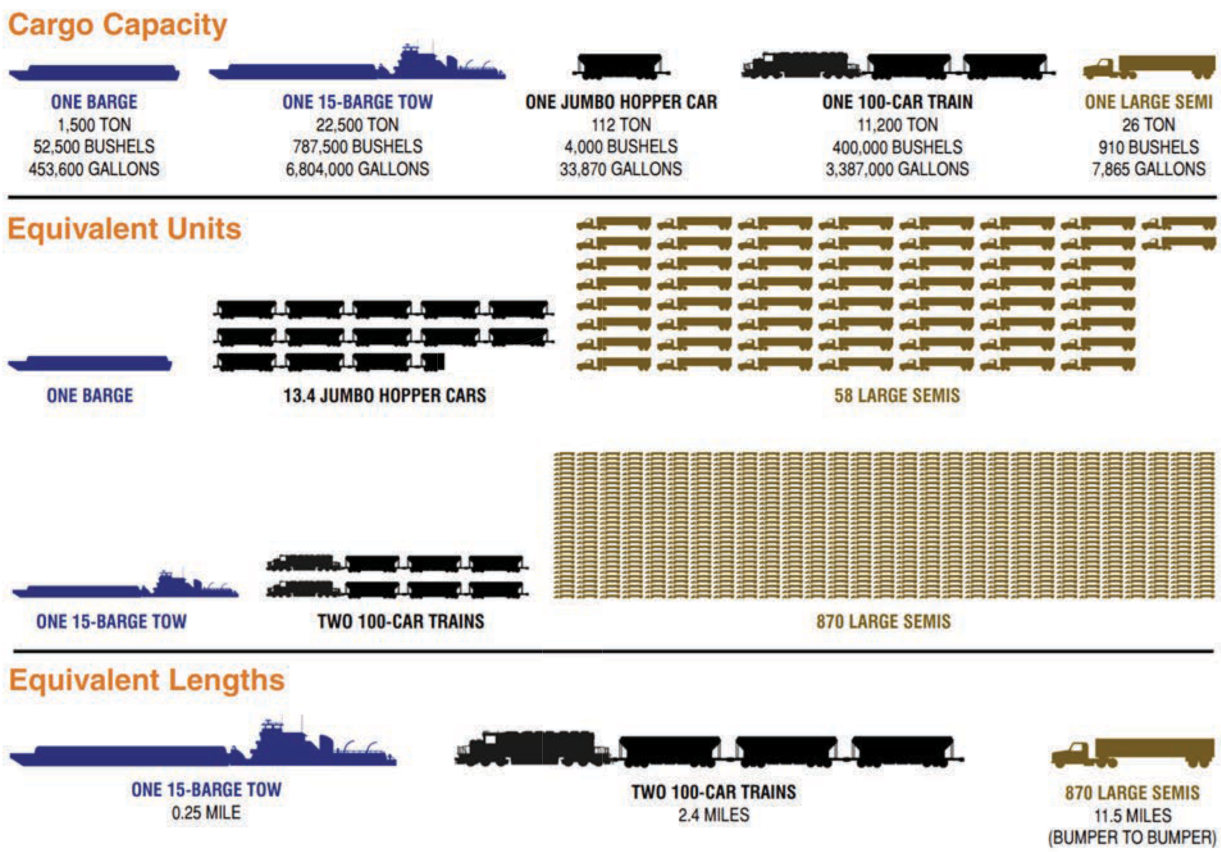
Delivery options for either HO Soybeans or HO Oil are similar to what international buyers often use for importing to their specific destinations. However, as the HO soy market is not nearly as advanced as that for commodity soy, the initial delivery modes might need to accommodate smaller quantities 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:

- Twenty Food Equivalent (TEU) containers
- Flexitanks in 20-foot containers (oil)
- ISO tanks (oil)
- Jumbo hopper or tank cars
- Barges
- 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. While this degree of segregation is less stringent than for non-GMO grains (no PCR testing needed), a buyer will want to follow basic "soft" IP guidelines in order to minimize any comingling prior to final delivery.

Figure 8: Bulk Grain Transport



Source: Iowa Department of Transportation

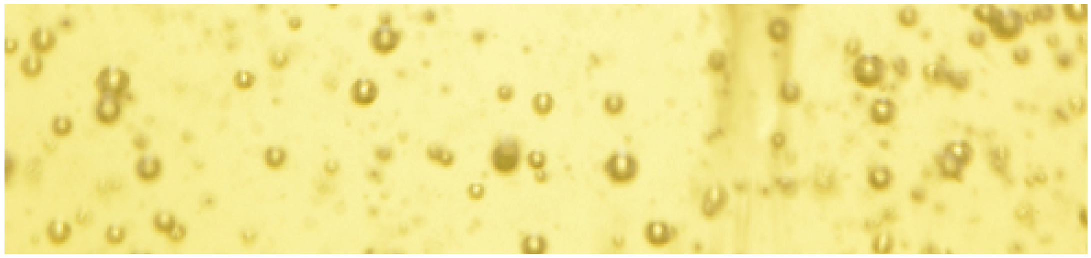
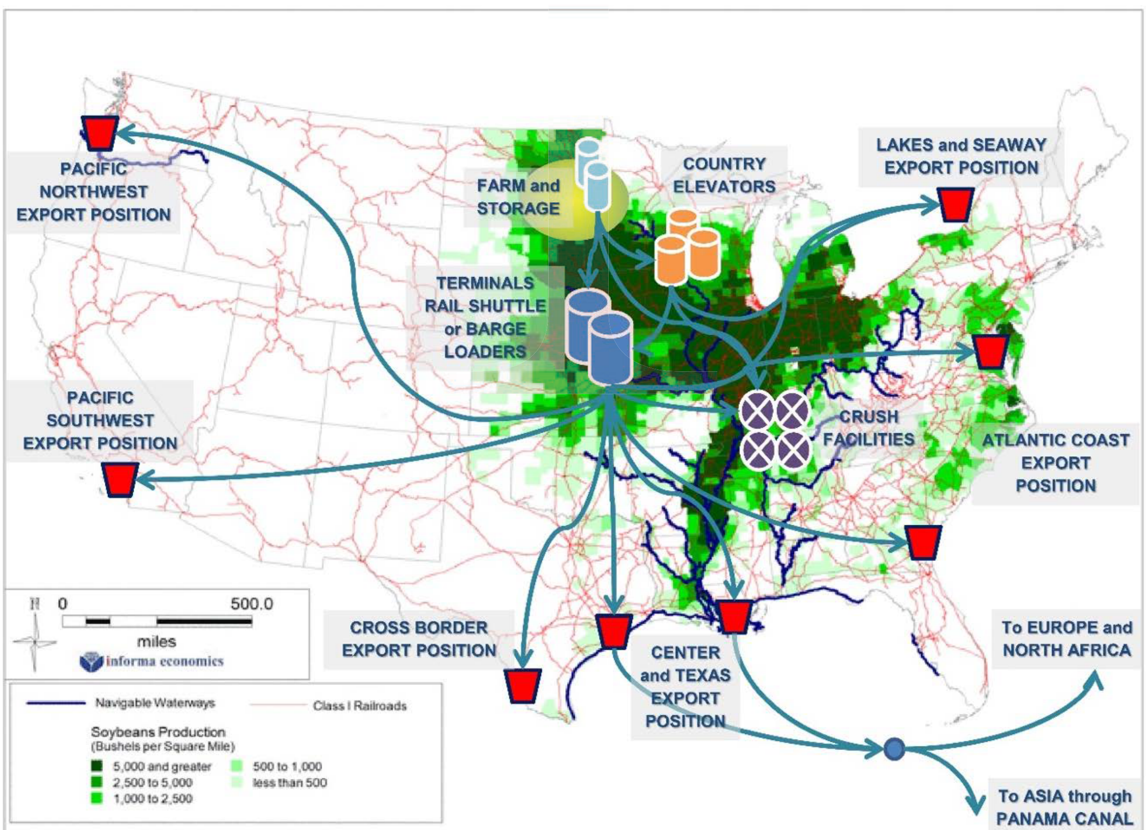


Table 4: Bulk Vegetable Oil Transport

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 any HO Soy comingling is significantly higher than for non-GMO specifications where contamination can be measured in the parts per million by PCR testing.

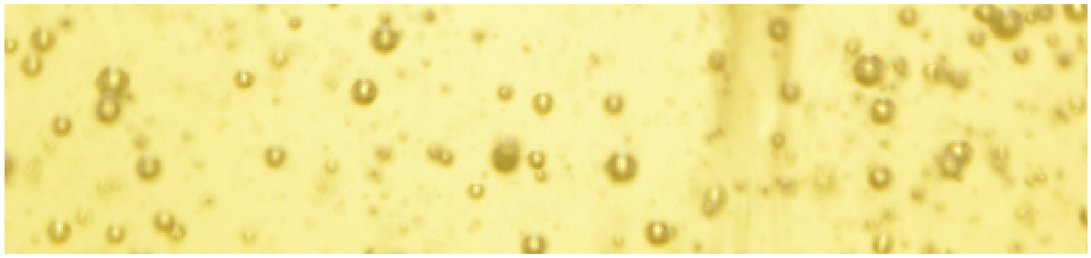
For this reason, the IP system used for HO Soybeans and HO Oil is often referred to as a "soft" IP system. However, maintaining HO product purity is still a critical factor to maximize value capture from the increased functionality of the final refined HO Oil.

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 (70-80% oleic, 5-17% 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.

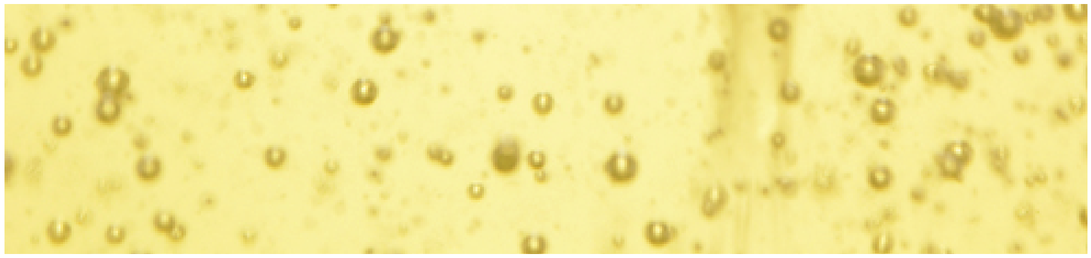
XVI. Maintaining a Soft IP for HO Soybeans and Oil

Receiving and Handling
Typical IP guidelines for handling HO Soybeans would include:

1) Conduct employee training on High Oleic 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 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 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 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 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.

XVII. Appendix with Contacts, Terms & Definitions

U.S. High Oleic Suppliers Contact Information:

ADM
Jake McCammack
4666 Faries Parkway
Decatur, IL 62525
Phone: 1-217-451-3791
Website: www.adm.com
e-mail: jake.mccammack@adm.com

Bayer Crop Science
Ernesto La Red
800 N. Lindbergh Blvd.
St. Louis, MO 63167
Phone: 1-314-694-4673
Website: www.vistivegold.com
e-mail: ernesto.lared@bayer.com

Bunge
Rodrigo Vasconcelos
1391 Timberlake Manor Parkway
Chesterfield, MO 63017
Phone: 1-905-825-7962
Website: www.bungenorthamerica.com
e-mail: Rodrigo.vasconcelos@bunge.com

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

CHS
Todd Biedenfeld
5500 Cenex Drive
Inver Heights, MN 55077
Phone: 1-651-355-6414
Web site: www.chsinc.com
e-mail: todd.biedenfeld@chsinc.com

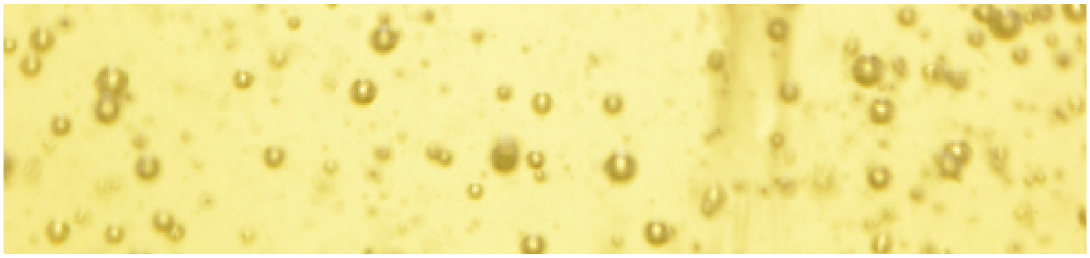
Corteva Agriscience
Susan Knowlton
974 Centre Road
Chestnut Run Plaza, Bldg. 735
Wilmington, DE 19805
Phone: 1-302-299-5283
Web site: www.plenish.com
e-mail: susan.knowlton@corteva.com

Missouri Soybean Merchandising Council
Bryan Stobaugh
3337 Emerald Lane
Jefferson City, MO 65109
Phone: 1- 573-635-3819
Website: www.mosoy.org
e-mail: bstobaugh@mosoy.org

Perdue Agribusiness
Matt Porter
6906 Zion Church Road
Salisbury, MD 21804
Phone: 1-410-341-2004
Website: www.perduefarms.com/agribusiness/
e-mail: matt.porter@perdue.com

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

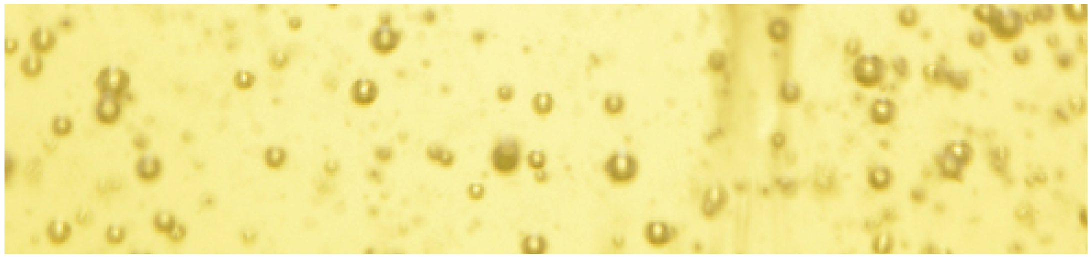
- **Bayer** (Vistive®Gold High Oleic Soybeans)
  https://www.vistivegold.com/
- **Corteva Agriscience** (Plenish® High Oleic Soybeans)
  https://www.plenish.com/
- **Missouri Soybean Merchandising Council** (Soyleic™ High Oleic Soybeans)
  https://mosoy.org/
- **Qualisoy**
  https://www.qualisoy.com/food-industry-solutions/high-oleic-soybean-oil
- **United Soybean Board**
  https://unitedsoybean.org/topics/high-oleic-soy/

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.

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 U.S. industry consensus is that an oleic level of 70% 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 (palmitic and stearic).



High Oleic 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 suppliers and is primarily determined by the added cost of identity preservation across the HO 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).

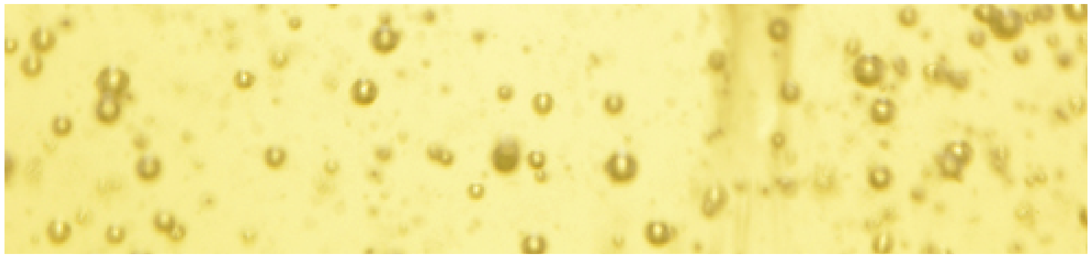
Identity Preservation (IP): The process involved in all phases of the High Oleic Soybean supply chain that prevents the mixing of High Oleic Soybeans or oil with commodity soybeans or oil. This process protects the High Oleic fatty acid profile from being diluted.

- **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 more complex process involving extensive testing such as PCR assays for GMO presence along with more stringent grain production and handling protocols for the farmer, grain handlers and processors. Specifications and contamination detection tolerances are often defined in parts per million

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.

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.

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 polyunsaturated fats (multiple double bonds) are more prone to polymerize and lead to a buildup of greasy, varnish-like coatings on equipment surfaces.



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:

a) Bushel of Soybeans = 60 pounds
b) Metric Ton of Soybeans = 36.74 bushels
c) Short Ton of Soybeans = 33.33 bushels
d) One Pound = 2.2046 kilograms
e) One Veg Oil Gallon = 7.65 pounds
f) Metric Ton = 2,204.6 pounds
g) Metric Ton = 1.2204 short tons
h) Acre = 0.4046 hectares
i) Hectare = 2.471 acres
j) Soybean oil yield per bushel estimate = 11.4 pounds per bushel
k) Average U.S. soybean yield per acre (2018): 51.6 bushels per acre
l) Average pounds of oil produced per acre at U.S. 2018 average yield: 588 pounds

Acronyms

FAC (Fatty Acid Composition)
FFA (Free Fatty Acids)
FGIS (Federal Grain Inspection Service)
GC (Gas Chromatography)
GIPSA (Grain Inspection, Packers and Stockyards Administration)
HO (High Oleic)
HOS (High Oleic Soybean)
IBC (Intermediate Bulk Container)
IP (Identity Preservation)
ISO (International Organization for Standardization)
NIR (Near Infrared)
PCR (Polymerase Chain Reaction)
TEU (Twenty Foot Equivalent Unit)

U.S. Industry Organizations Contact Information

American Oil Chemists' Society (AOCS)
2710 S. Boulder, Urbana, IL 61802-6996
Telephone: (217) 359-2344
Fax: (217) 351-8091
e-mail: general@aocs.org
Website: www.aocs.org

Institute of Shortening & Edible Oils (ISEO)
1319 F Street NW, Suite 600
Washington, DC 20004
Telephone: (202) 783-7960
e-mail: contactus@iseo.org
Website: www.iseo.org

National Institute of Oilseed Products (NIOP)
750 National Press Building, 529 14th St NW Washington, D.C. 20045
Telephone: (202) 591-2438
FAX: (202) 591-2445
e-mail: niop@kellencompany.com
Website: www.niop.org

North American Export Grain Association, Inc. (NAEGA)
1400 Crystal Drive; Suite 260
Arlington, VA 22202
Telephone: 202-682-4030
Fax: 202-682-4033
e-mail: info@naega.org
Website: www.naega.org

National Oilseeds Processors Association (NOPA)
1300 L Street, NW
Suite 1020
Washington, DC 20005
Telephone: (202) 842-0463
Fax: (202) 842-9126
Website: www.nopa.org

Specialty Soya and Grains Alliance (SSGA)
151 Saint Andrews Court, Suite 710
Mankato, MN, 56001
Telephone: (507) 385-7557
Website: www.soyagrainsalliance.org

United Soybean Board
16305 Swingley Ridge Road
Suite 150
Chesterfield, MO 63017
Telephone: (800) 989-8721
Website: www.unitedsoybean.org

Footnotes

[1] *U.S. Soy: International Buyers' Guide, USSEC*
[2] *Food Chemicals Codex, Seventh Addition and industry sources*
[3] *U.S. Census Bureau, Schedule B Classification of Exports, 2019, Seventh Edition*

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