

Reading Palms: A Palm Oil Primer

By R.J. Foster, Contributing Editor

Since the year 2000, palm oil imports into the United States have increased from around 200 million pounds per year to more than 2 billion pounds per year. Reasons for this growth include improvements in perception, advances in production and expansion of product application. Results of this growth can be seen worldwide, providing opportunities for market and product development.

Market *trans*-formation

"This significant increase in demand has largely been fueled by the efforts of food manufacturers to remove *trans* fat from their products," says Bob Wainwright, technical service director, dressings, sauces and oils, Cargill, Minneapolis.

In the late 1950s, consumers were told that saturated fats should be avoided in order to reduce the risk of heart disease, and "tropical fats"—palm, palm kernel and coconut oils—eventually fell out of favor in the United States. Manufacturers seeking saturated fats' functionality and stability turned to oils modified by hydrogenation. Through the 1990s, a growing number of studies indicated a connection between these *trans* fats and increased LDL (low-density lipoprotein), or "bad" cholesterol. In 2003, FDA finalized the *Trans* Fatty Acids in Nutrition Labeling rule, requiring manufacturers to declare *trans* fats in their nutritional information by 2006. Wainwright recalls how manufacturers quickly began seeking means to redevelop their products as *trans*-fat-free. "Palm was leveraged in many reformulations because its melting properties and stability align well with demands imposed upon partially hydrogenated shortenings for a variety of product executions," he says.

Pressing matters

Originally discovered in Western Africa, the oil palm tree's ideal growing conditions are found in Indonesia and Malaysia. Gerald McNeill, PhD, vice president of research and development, Loders Croklaan, Channahon, IL, suggests the agronomics of palm plantations differs from typical annual crops. "The lifetime of a palm plantation is about 20 years, until the yield of fruit is too low to be commercially viable. The plantation is then cut down and replanted with new seedlings and the 20-year cycle starts again." Young trees bear fruit within 30 months.

"A major advantage of palm-oil production is the very high yield of palm oil per acre of planted trees," McNeill adds. "A palm plantation produces almost 10 times more oil per acre than soybean oil." With global demand for palm oil surpassing that of soybean oil, growers are not relying entirely on high yields to meet future needs. "Longer-term research in Malaysia has identified new varieties of palm trees that have the potential to produce up to 50% more oil than currently possible using the best current agronomic practices," he says. "This process could take up to 20 years to fully convert existing plantations completely with new varieties."

Oil palms produce small, typically 1-in. to 1.5-in., fruits with a small kernel inside. The "fruitlets" grow in groups sometimes referred to as "fresh fruit bunches," or FFBS. "On the average, FFBS weigh around 45 to 65 lbs. and contain 1,500 to 2,000 fruitlets," Wainwright says. "The fleshy mesocarp of the fruitlets is filled with palm oil; hence, some manufacturers label palm oil as 'palm fruit oil' on their ingredient legends."

Palm-oil processing begins with steam sterilization of FFBS. Not only does it help preserve the oil's quality by inactivating naturally occurring lipases, this initial steam treatment facilitates separation of fruitlets from the stalks, softens the fruits to ease digestion and oil removal, and conditions the kernels to minimize fracturing. Once stripped from their stalks, fruitlets are reheated and pressed. The expelled oil/water mixture is clarified by gravitational or centrifugal separation or decanting, and then dried and cooled to yield crude palm oil.

Fiber and kernels left after pressing are separated from the palm oil, but not discarded. "Kernels are separated from the fiber, cracked to remove shells, winnowed and dried, flaked, conditioned, and then either mechanically pressed or solvent extracted to recover crude palm kernel oil," Wainwright says. "Palm kernel oil, chemically and physically distinct from palm oil, represents about 10% of the total oil yield from the oil palm."

Naturally occurring carotenes, at a level of approximately 700 to 800ppm, give crude palm oil a bright-red color. Conventional refining processes remove the carotenes (and their red coloration), free fatty acids and volatiles that could impart off flavors, resulting in a pale-yellow, bland tasting, odor-free material. McNeill says removal of vitamin A and other naturally occurring antioxidants does not affect stability. "Palm oil is naturally very stable due its low content of polyunsaturated fat, the main cause of instability in vegetable oils," he says. "It contains a natural balance of saturated and unsaturated fat, making it one of the most stable frying oils available in the industry today." According to the American Palm Oil Council (APOC), Washington, DC, evolving refining technologies will allow greater than 90% of the natural carotenes and vitamin E to be retained.

That's what fronds are for

Palm oil contains 50% saturated and 50% unsaturated fats: 44% palmitic acid, 5% stearic acid, 39% oleic acid, 10% linoleic acid, and negligible amounts of myristic and lauric acids, according to APOC. It exhibits a melting point around 35°C. Palm oil can be fractionated to tailor the physical properties of the oil. "In very general terms, palm oil is crystallized under a specified protocol to develop the desired solid/liquid matrix," Wainwright says. "This matrix is then partitioned to recover both a lower-melting (olein) and higher-melting (stearin) fraction."

Palm olein is approximately 45% saturated fat and 55% unsaturated fat, with a slip melting point around 23C. The main saturated fatty acids are 40% palmitic acid and 5% stearic acid, while the unsaturated fatty acids are 43% oleic acid (monounsaturates) and 12% linoleic acid (polyunsaturates). Palm stearin is approximately 60% saturated fat and 40% unsaturated fat, and exhibits a slip melting temperature of approximately 53C. The main saturated fatty acids are 54% palmitic acid, 5% stearic acid, and 1% myristic acid, while the main unsaturated fatty acids are 33% oleic acid (monounsaturates) and 7% linoleic acid (polyunsaturates).

"A variety of crystallization protocols can be coupled with multiple fractionations and refractionations to yield a wide array of functional products that range from liquids to high-melting solids to steep-melting fractions suitable as alternatives to cocoa butter," Wainwright notes.

Since palm oil was introduced to the United States in 2005, "almost every partially hydrogenated product has been matched and replaced," McNeill says. "Application of functional solid fats based on palm oil in food categories include all-purpose shortenings for use in a wide variety of baked goods, including cookies, cakes and muffins. More challenging applications using palm oil blends include: chocolate coatings, laminating fats (croissants, puff pastry and Danish), pies, ice cream, whipped toppings, fillings, icings, margarine, processed cheese, doughnut frying, peanut-butter stabilizers, binding fats, spray oils, frying oils and more."

R.J. Foster is a Wordsmith with a B.S. in food science from the University of Wisconsin-Madison and over 15 years of experience in the food industry. He can be reached through his website, wordsmithingbyfoster.com.