Hurricane Ivan Causes Problems in South

Halts Mississippi and Gulf Traffic; Barge Rates at Record Highs

Mississippi River pilots closed all traffic along the river as Hurricane Ivan hit land in mid-September. The storm made landfall along the Gulf Coast of Florida, Alabama, Mississippi, and Louisiana. The Port of South Louisiana closed seven terminals under its jurisdiction. Thousands of barges and other vessels were at various docks at the port, and authorities advised them to take necessary precautions.

Dow Jones newswires reported that an estimated $5 billion worth of U.S. grain and oilseeds were in fields awaiting harvest when Hurricane Ivan made its landfall. At risk were virtually all of the nation's 2004 peanut crop, plus more than significant quantities of corn and soybeans, in addition to smaller amounts of rice, grain sorghum, fruit, vegetables, and tobacco.

Export elevators in the New Orleans area also shut down for Hurricane Ivan to let employees evacuate with their families. Vessels that were at the berth were moved to the middle of the river to ride out the storm. Luckily, not many soybeans were moving down the river at this time even though the week of September 10 showed export inspections were as strong as they have been since March, at more than 10.5 million bushels (286,000 metric tons).

NOAA/NATIONAL CLIMATIC DATA CENTER

This September 15, 2004, satellite image shows Hurricane Ivan in the Gulf of Mexico, 12 hours from reaching shore. From here, the storm's eye traveled directly north and made landfall near Gulf Shores, Alabama.

ALABAMA COOPERATIVE EXTENSION SYSTEM

Hurricane Ivan caused severe damage to the cotton crop in the southern United States. This field in Alabama shows the extensive damage. Early information from Alabama agriculture officials estimate that Alabama farmers lost approximately 390,000 bales of cotton, with an economic value of about $127 million.

Barge freight rates from nearly all locations on the inland river system jumped to record levels a week after Hurricane Ivan. The rate from Memphis to New Orleans jumped to an all-time high of 535% of tariff. Barge operators moved barges away from New Orleans or held barges from moving toward New Orleans. This in effect tightened barge capacity considerably for almost two weeks until the logistics smoothed out into a more normal pattern.

Soybean exports through the Center Gulf typically begin to move toward seasonal highs during early October, peaking during mid-November and then peaking again in January and February of the new calendar year.

Southern Crops Take a Hit

Hurricane Ivan hit the Gulf Coast region September 16 and left a mark in some areas that will take some time to erase. The effects on this year's peanut crop for Alabama vary in location, but no doubt put a halt to peanut harvesting for a while. Reports from near the Robertsdale, Alabama, area indicated that the peanuts took a beating and have a wilted look, but the leaves did remain on the plants. That area received up to 14 inches of rain during the storm.

Across the peanut areas in Alabama and Florida, trees were downed across roads, bridges washed away, and metal roof panels and other debris scattered across fields.

According to Dallas Hartzog, Alabama Extension Peanut Agronomist, areas near Headland, Alabama, did not receive the heavy winds and torrential rains that were documented farther west. In fact, Hartzog said only about 2 inches of rain was received in his area with about 40 mph winds.

"Most of our peanuts probably haven't been extraordinarily damaged, so far," Hartzog said. "A lot, of course, depends on how good a grower's disease control program was and where peanuts were on the maturity curve at the time of all the rain. As soon as the soil dries up, farmers will start harvesting peanuts."

It looks like peanuts withstood the hurricane better than cotton. William Birdsong, of the Alabama Cooperative Extension System, said that southern Alabama could lose more than 50% of the cotton crop because of Ivan. The storm came at a bad time for the state's cotton farmers—just after some of the bolls had started to open. "It's very unfortunate," Birdsong said, "because we were looking at a good cotton crop, from 800–1000 pounds per acre."

Losing so much of the crop also means that less seed will be available for processors, and there may be quality concerns also. Ben Morgan, executive vice president of the National Cottonseed Products Association in Cordova, Tennessee, said that it's "too early" to tell the extent of the damage to the cotton crop, but that the amount of moisture that was received could definitely affect the quality of the seed.

Although not a major crop in Florida, cotton was hit hard by Ivan in that state also, which, at the time of this report, is being ravaged by hurricane Jeanne. The Associated Press quoted a USDA Farm Services Agency representative saying in reference to counties in the northwestern part of Florida "We have lost 100 percent of the cotton crop."

Portions of this article were provided by The American Soybean Association Weekly Update *and also the Alabama Peanut Producers Association.* ■

Quality Assurance of Fats and Oils

Fereidoon Shahidi

Quality of fats and oils is dictated by a number of physical and chemical parameters that are dependent on the source of oil, geographic, climatic, and agronomic variables of growth in the case of plant oils, as well as processing and storage conditions. Thus, quality-assurance criteria may depend partly on the type of oil under investigation as well as other factors that may vary depending on the intended use and regulations that vary from country to country (1–3).

Edible oils may originate from animal, both land-based and aquatic, higher plants, and algal sources. Regardless of the source, the extraneous matters such as large pieces of wood, metal pieces, soil, etc. should be eliminated. For oilseeds, these are usually passed through a magnetized sieve. However, this does not eliminate environmental pollutants that might exist endogenously or have been introduced into the raw material. Thus, special attention must be paid to PCBs (polychlorinated biphenyls), dioxins and other pollutants, such as polycyclic aromatic hydrocarbons, as their presence or level may render the material unfit for edible purposes. The physical state of food lipids, mainly their crystallinity and whether they exist in the liquid or solid form, is dictated primarily by the degree of saturation/unsaturation of the oil/fat. In this, the approximate composition of the source material must be determined. For example, solid fat content may be estimated by low-resolution nuclear magnetic resonance spectroscopy. Near infrared spectroscopy allows determination of fat content and other components of oilseeds.

The color of the oil, which is dependent on a number of factors, may be determined visually or using a Lovibond tintometer or other hand-held color-measuring devices (4). The color may be due to carotenoids, chlorophylls, or other components. When the harvested seeds are immature, often chlorophyll content of the resultant oil is high, and this affects the stability of products (5). Chlorophylls are photosensitizers; hence their presence leads to enhanced photo-oxidation of the oil. Obviously, agronomic conditions, season of the harvest, and many other related factors affect the quality of the resultant oil. In this regard, soil may affect the content of certain unwanted minerals, such as cadmium, in the seeds, but these do not usually end up in the oil. Furthermore, as explained earlier, other contaminants may be introduced into the raw material during harvest, processing, and transport. Thus, fats and oils and their source material have to be tested for the presence and level of contaminants. In addition, diseases and pests always lead to decreased quality of oils, as reflected in their high acid values (6). In the case of animal fat, every effort should be made to process the raw material in the fresh state or use fresh-frozen material to ensure premium quality of the product.

In the extraction of edible oil from seeds, cleaning and subsequent conditioning of the seeds followed by heating during or immediately after crushing are needed as these deactivate the endogenous enzymes and help in releasing the oil. After expelling part of the oil, the resultant left-over material may be flaked and then extracted with hexanes. The expelled and solvent-extracted oils are then combined and desolventized to afford crude oil.

The edible oils, following rendering or extraction from source material, may be subjected to degumming, refining, bleaching, deodorization, possibly winterization and blending, and perhaps hydrogenation and/or addition of stabilizers/antioxidants. Discussion of these steps in any detail is beyond the scope of this overview. However, each processing step carries with it many advantages and some disadvantages. To explain these briefly, it is essential to first examine the constituents of fats and oils in a cursory manner.

Edible oils are composed of triacylglycerols (triglycerides) as their main components. However, the presence of diacylglycerols (diglycerides), monoacylglycerols (monoglycerides), and free fatty acids (FFA) is not uncommon. As an example, these latter constituents are present at about 10% in cottonseed oil. In addition to acylglycerols and FFA, edible oils often contain phospholipids (PL) and, to a lesser extent, glycolipids. The PL are generally removed during the degumming process (7). The recovered PL, often called lecithin, may possibly be used as dietary supplements. FFA are then eliminated during the refining process, and bleaching of the oil leads to the removal of colored materials as well as decomposition of hydroperoxides to secondary oxidation products. The deodorization step is then designed to remove the odorous secondary oxidation products from the oil. However, many of the useful minor components present in the oils are also removed during the deodorization process. Of particular interest to this article are tocopherols and tocotrienols as well as phytosterols. If the concentration of the latter components in the deodorizer-distillate is high enough, these can be removed, purified, and sold as dietary supplements or used in specialty applications. The final oil following refining, bleaching, and deodorizing (RBD) may further be subjected to winterization, a cooling process that allows the removal of more saturated fats, as well as possible blending. Some oils also may be subjected to hydrogenation to enhance their oxidative stability. However, hydrogenation often leads to the production of 30–50% *trans* fats that are of health concern because of their potential harmful effect on the cardiovascular system (8). Therefore, novel formulations using more saturated oils in the mix have become popular (9).

Among the parameters often checked or evaluated for quality assurance of edible oils are those related to the make-up of the oil or their properties. Table 1 summarizes a list of parameters usually employed to assess quality of edible fats and oil. However, not all parameters listed may be evaluated for each oil.

In addition to parameters listed in Table 1 that dictate the quality of fats and oils, storage and transport conditions are also considerably important as these factors determine the final quality of the oil. Obviously of the above parameters, fatty acid composition and oxidative stability are of utmost importance, both from nutritional and sensory quality viewpoints. In general, intake of omega-3 fatty acids (FA) in the Western world is much less than desired. Nutritionally, one would like to have a ratio of 1:2–1:5 for omega-3 to omega-6 FA in the diet. However, a high content of omega-3 FA in edible oils is responsible for their rapid quality deterioration. Hence, much effort has been made to eliminate the omega-3 FA, mainly linolenic acid, from vegetable oils. However, recent trends have reflected the concern about low intake of omega-3 FA and its deleterious effects.

Table 1. Quality Parameters of Fats and Oils[a]

Parameter	Details
Fatty acid composition and distribution	Percentage of total; depends on the type of material
Relative density	At 20 or 40°C relative to water at 20°C (<1)
Refractive index	At 40°C
Viscosity	At 20°C
Color	Visual, Lovibond, or Colormet
Turbidity	Visual or instrumental
Solidification point, solid fat content, and cooling curve	For water-insoluble fatty acids
Odor and taste	Sensory evaluation
Saponification value	mg KOH/g
Iodine value (IV)	g iodine/100 g sample (WIJS method)
Unsaponifiable matter	g/kg
Acid value (AV)	mg KOH/g
Smoke, flash, and fire points	°C
Oxidative state	
Peroxide value (PV)	Meq oxygen/100 g sample
Thiobarbituric acid reactive substances (TBARS)	Mol/g
para-Anisidine value (*p*-Anv)	mg/kg
TOTOX	2 PV + *p*-AnV
OSI, Rancimat, and AOM value	—
Polar lipids	Percentage
Polymers	Percentage
Volatile matter (%)	At 105°C
Phosphorus	mg/kg
Iron, copper, lead, and arsenic	mg/kg
Cadmium	g/kg
Trans fatty acids	Percentage; measured at ~10:
Cholesterol content	Percentage, mainly for animal fat
Contaminants and foreign matter, including Plasticizers (%)	—
Carotenoids and chlorophylls	mg/kg
Squalene	$C_{30}H_{50}$
Sterols	GC determination
Tocols	HPLC determination
Synthetic antioxidants	BHA, BHT, TBHQ, PG
Anti-foaming agents	Dimethyl polysiloxane, singly or with silicon dioxide
Metal chelators	Citric acid or citrates, phosphoric acid
Crystallization inhibitor	Oxystearin
Adulterants	Finger-printing using sterols or other minor components

[a]Abbreviations are: BHA, butylated hydroxyanisole; BHT, butylated hydroxytoluene; TBHQ, *tert*-butylhydroquinone; and PG, propyl gallate.

Adulteration of fats and oils is another matter of concern. This might occur accidentally or deliberately. Rendering of pork fat and beef tallow in the same equipment without proper washing is an example of accidental and unintended contamination/adulturation. However, often cheaper oils have been sold in place of or mixed with more expensive oils. Thus, prior to the recognition of health benefits of hazelnut oil, this oil was used as an adulterant in olive oil (10). As mentioned earlier, different oils have considerably different sterol compositions. Thus, sterols could be used as a means of identifying adulterants because often FAcompositions of the adulterant and the original oils are very similar (11–13).

In addition to the above, depending on the intended use, the quality of oil during storage and use must be monitored. The oils may undergo hydrolytic rancidity, autoxidation, photo-oxidation, and thermal oxidation. The latter type of oxidation is observed primarily in the frying oil and causes quality deterioration that must be monitored using different parameters such as color, viscosity, polar components and polymers, among others (14,15). Obviously, oils that are highly unsaturated are not suitable for frying purposes. On the contrary, autoxidation is a process that proceeds rather slowly for properly stored oils. However, if the oil is kept in clear bottles, photooxidation may occur, especially when photosensitizer chlorophyll is present. Thus, parameters of interest for quality assurance of fats and oils begin at the farm gate and continue up to the dinner table. This includes proper holding and use of oil at home after purchase, which despite their importance, are often ignored by most consumers. A thorough discussion of these and other matters related to fats and oils quality is provided in the *Sixth Edition of Bailey's Industrial Oils and Fats*.

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