Oil Selection: Cause for concern

Oil used for frying is a critical component in food operations and processors have discovered just how much this cooking medium can drive profits up or quickly increase costs.

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The oil selection process is a multi facetted activity and must take into account factors such as market preference, operational needs, continued supply, product compliance and cost.

An effective oil specification document should state what the processor needs, and take into consideration the attributes that are most important for the quality of the end product. An oil specification list should address all aspects of the product and not be limited to information on Free Fatty Acids (FFA) content, iodine value and melting points.

Inconsistent Quality?

Frying oil comes from natural feedstock, be it palm fruit (palm oils and their derivatives) or seed stock. Due to this natural origin, the quality level of the original feedstock may differ from crop to crop. This can lead to variability of the refined oil's attributes and quality.

From this and even worse could be variability occurring from shipment to shipment with one consignment of oil delivering good processing/product results, and the next delivering a noticeably different outcome. In this scenario, it is extremely difficult for any processor to maintain consistency in their end product and their production process.

Consumer complaint and excessive production costs can be overwhelming. In order to avoid this scenario, specifications is key in helping to address variability and increase confidence in oil attributes and quality. After establishing the criteria for oil attributes and quality, an oil specification given to a supplier should state exactly what is expected, followed by monitoring each delivery to ensure that the standard is maintained.

Defining The Specifics

The level of details in an oil specification is a corporate decision, taking into account the company's expectations (process and product), and the ability of the supplier to consistently meet their needs. There is no standard specification that suits all and every situation.

Processors who have developed their specifications may have used FFA as their key oil quality measurement; since it is the index they are most familiar with and is the only test they conduct. While the level of FFA is important, there are other oil attributes that are just as, and some say, more important.

Oil specification can be a complex process. When the scope of oil specification is minimal, there is a possibility that even though the oil supply falls within the parameters specified, the desired end product result is not obtained due to varying overall quality. In the case of comprehensive specification, the more stringent the criteria, the harder it will be for oil suppliers to deliver inconsistent quality.

Keeping Up The Quality

Clear criteria should be set to eliminate miscommunication. The processor determines exactly what is needed, and includes it in the specification. This enables suppliers to work with the processor in providing the right solution for every situation.

When determining physio-chemical attributes, FFA appears to be a relatively common item in oil specifications, and helps to address the hydrolysis effect. However, it does little against the oxidation and polymerisation activities. The oxidation is an area of growing concern to processors as this one delivers the undesirable rancid off odours and flavours.

The Oily Issue

Frying oil deteriorates predominantly in three ways: oxidation, hydrolysis and polymerisation. Understanding these means of deterioration should allow the processor to understand what characteristics their oil should contain, to help control what happens to oil and extend its usage levels.

Hydrolysis

This reaction is generally caused by water reacting with the oil molecule and causing the bond between the glycerol and fatty acid chain to be broken. After the fatty acid chain is removed from the glycerol backbone, the molecule produced is called a Free Fatty Acid (FFA). Although FFAs do not contribute to increasing the level of oxidation or rancidity, they will increase the acidity of the oil and cause the fried product to have a tainted or acidic flavour.

This reaction rate increases in the presence of acids, high temperatures, high oil turnover rate, increasing number of heating and cooling cycles of the oil, high pressures, products of oxidation, some emulsifiers, caustic soda and metal alloys.

Oxidation

Oxidation generally occurs with the oil's fatty acid chain where a double bond is located. The more double bonds located within a single fatty acid, the more reactive the molecule would be to oxidative deterioration.

Atmospheric air coming into contact with frying oil generally causes oxygen atoms to attach to the fatty acid chain at the point of unsaturation, and form a peroxide molecule. These peroxides react to produce hydro peroxides, and it is this molecule that further deteriorates into volatile and non-volatile compounds.

The compounds are responsible for the rancid odours present in oxidised food. The oxidation reaction is catalysed by high temperatures, metal alloys, large surface exposure of oil to atmospheric air, high oil turnover time and UV light.

Polymerisation

When frying, oil deteriorates as they breakdown products of both volatile and non-volatile compounds. Non-volatile compounds remain within the frying oil and can produce polymerisation at frying oil temperatures above 200 deg C, or in isolated hot spots within the frying system.

These molecules bond together with oxidised or hydrolysed fragments that have already reacted to produce free radicals or molecules that are very reactive and join together to produce a very large molecule. Due to its large molecular weight, it is generally insoluble in frying oil and tends to accumulate at the top of the oil and along the sides of the fryer pan.

As different size molecules bond together, it causes variations in molecular weights. It is this variation that causes frying oil to foam. This reaction also causes an increase in the level of hydrolysis by trapping steam bubble under the oil and causing the oil to foam.

The Quality Test

The following two examples show just how little or how much can be specified. Companies are advised to develop their own standards that will satisfy their needs, policies and requirements.

Example 1:

A typical specification of refined, bleached and deodorised palmolein is shown in Table 1. It can be assumed that in actual commercial specifications, other points can be included; such as description, physio-chemical attributes, packaging, delivery, and contaminants.

From the table, it could be inferred that it could result with inconsistent oil, even though it complies with the specification. This is due to the minimal criteria and parameters stated.

Table 1: Example 1

Refined, Bleached & Deodorised (RBD) / Neutralised, Bleached & Deodorised (NBD) Palm Olein	
FFA (As Palmitic)	0.1% max
M&I	0.1% max
I.V (Wijs)	56 min
M.Pt °C (AOCS Cc 3-25)	24 max.
Colour (5 ¼" Lovibond cell)	3 Red max

Example 2:

In contrast to Example 1, this extract of a palmolein oil specification is much more in-depth, and details more items of concern than the previous specification.

Table 2: *Example 2*

Palmolein Oil Specification

Description:
Palmolein Oil is the liquid fraction of Palm Oil, yellow in colour, free of any foreign materials with a bland taste, no 'off' odours and with a melting point of around 23 deg C.

Physio - Chemical Attributes:

Attribute	*Target*	*Maximum*	*AOCS Test*
Colour	1	3	Cc-13a-43
Flavour	8	-	Cg-2-83
Foreign material	Nil	-	-
FFA%	0.03	0.05	Ca-5a-40
Peroxide Value (meqltr)	<0.5	1.0	Cd-8b-90
p_Anisidine	<4	6	Cd-18-90
Polar Compounds (%)	<2.0	4.0	Cd-20-91
Polymers (%)	<0.5	<1.0	Cd-22-91
Phosphorous (ppm)	<0.5	<1.0	Ca-12b-92
Iron (ppm)	<0.2	<1.0	Ca-17-01
Magnesium (ppm)	<0.2	<0.5	Ca-17-01
Calcium (ppm)	<0.2	<0.5	Ca-17-01
Iodine Value (Wijs)	>56	-	Cd-1-25
∑ Tocopherols	>700ppm	-	CE-8
Refractive index at 40◦C	1.4586	-	Cc-7-25

Fatty Acid profile			
Saturated	C12.0	Lauric	0.1 – 0.5
	C14.0	Myrstic	0.9 – 1.4
	C16.0	Palmitic	38.2 – 42.9
	C18.0	Stearic	3.7 – 4.8
	C20.0	Arachdic	0.2 – 0.6
	C16.1	Palmitoleic	0.1 – 0.3
Mono-unsaturated	C18.1	Oleic	39.8 – 43.9
	C20.1	Gadoleic	-
Poly-unsaturated	C18.2	Linoleic	10.4 – 13.4
	C18.3	Linolenic	0.1 – 0.6

Pesticides:
Compliant with the relevant Codex Alimentarius.

Shipping and Packaging:
Each delivery should be accompanied with an accredited Certificate of Analysis with the following information:

1. *Net Content*
2. *Date produced / Expiry date*
3. *Lot / batch No.*
4. *Date shipped / Delivered*
5. *Results as per Specification Sensory-Physical requirements*

- *Oil is to be delivered in bulk in a clean tanker of hygienic design and maintenance dedicated purely for the transport / delivery of frying oil.*
- *Delivered oil is not to be adulterated / contaminated by the cartage of any previous oil.*