



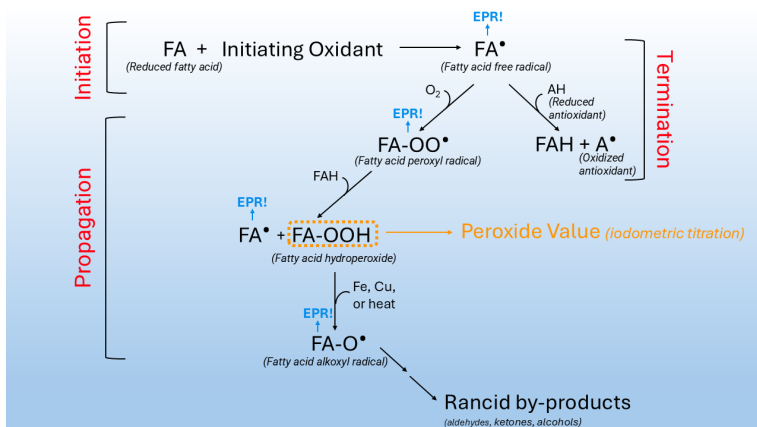
## EPR Shelf Life Analysis by ESR

### Magnettech ESR5000 for Oxidative Resistance in Edible Oils

Innovation with Integrity

#### Oxidation and Shelf-Life Challenges in Vegetable Oils

Rancidity in vegetable oils poses a significant challenge for the food industry, primarily occurring during storage due to the oxidation of unsaturated fatty acids. This process leads to unpleasant odors and flavors, compromising product quality. Several factors influence oxidative stability, including exposure to oxygen, temperature, light, and the presence of metal ions. While oxidation is inevitable over time, its impact can be mitigated through the use of natural or added antioxidants and by optimizing processing and storage conditions to extend shelf life.



#### Accelerating Data Collection for Process Control

Rapid and precise assessment of oxidative resistance enables manufacturers to make timely, informed decisions in process control, directly influencing the final quality of food products. To support this need, Bruker has introduced the Magnettech ESR5000 benchtop spectrometer along with a dedicated software suite for evaluating oxidation and shelf-life in liquid samples. Essential parameters, such as peak-to-peak amplitudes, are automatically computed, while endpoint free radical concentrations can be determined using either the SpinCount module or a calibration curve. The ESRStudio software offers an intuitive interface for seamless data acquisition and post-processing.

Figure 1: Simplified scheme for the free radical formation in edible oils.

## EPR-Based Forced Oxidation Assay

This assay employs the ESR5000 spectrometer to monitor free radical formation in oil samples undergoing forced oxidation. During the test, the oil is heated, and a spin trap reagent is added to capture unstable free radicals as they form. Initially, antioxidants in the oil neutralize these radicals, preventing their detection. As the antioxidants are gradually depleted, a sharp increase in free radical formation reveals the oil's oxidation profile. Accurate quantification of free radicals is achieved through calibration with known nitroxide reference standards or by using the reference-free SpinCount module integrated in the software.

The resulting oxidation profile and end-point radical concentration offer a reliable measure of oxidative resistance at various stages of production. This data enables manufacturers to assess shelf life and optimize processing and storage conditions for enhanced product stability.

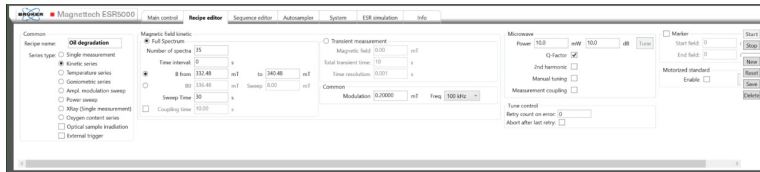


Figure 2: Recipe Editor

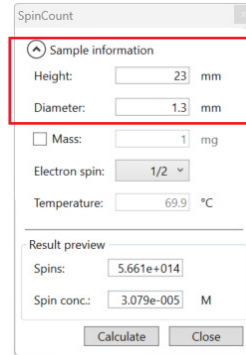


Figure 5: Providing sample size for quantitative analysis using SpinCount.

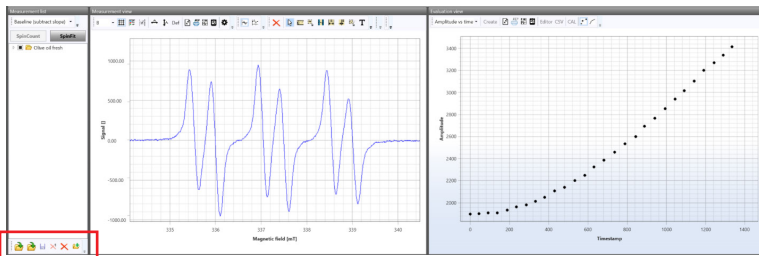


Figure 3: Evaluation View automatically generate an oxidation profile.

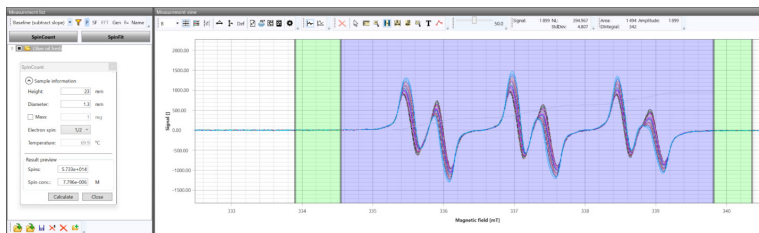


Figure 4: SpinCount module allows to integrate the entire EPR spectrum for quantitative analysis.

report									
05	Time [s]	Height [mm]	Diameter [mm]	Volume [ml]	X start [mT]	X end [mT]	Spins	Spin conc. [M]	
05	0.000	23	1.3	0.031	334.546	339.822	5.661e+014	3.079e-005	
06	45.177	23	1.3	0.031	334.546	339.822	5.767e+014	3.137e-005	
07	91.414	23	1.3	0.031	334.546	339.822	5.838e+014	3.175e-005	
08	137.554	23	1.3	0.031	334.546	339.822	5.951e+014	3.237e-005	
09	188.733	23	1.3	0.031	334.546	339.822	5.884e+014	3.200e-005	
10	234.826	23	1.3	0.031	334.546	339.822	5.963e+014	3.243e-005	
11	285.899	23	1.3	0.031	334.546	339.822	6.181e+014	3.362e-005	
12	332.024	23	1.3	0.031	334.546	339.822	6.303e+014	3.429e-005	
13	378.089	23	1.3	0.031	334.546	339.822	6.486e+014	3.528e-005	
14	429.154	23	1.3	0.031	334.546	339.822	6.701e+014	3.645e-005	
15	480.199	23	1.3	0.031	334.546	339.822	6.820e+014	3.710e-005	
16	532.305	23	1.3	0.031	334.546	339.822	7.120e+014	3.873e-005	
17	584.357	23	1.3	0.031	334.546	339.822	7.347e+014	3.997e-005	
18	630.385	23	1.3	0.031	334.546	339.822	7.520e+014	4.090e-005	
19	681.465	23	1.3	0.031	334.546	339.822	7.707e+014	4.192e-005	
20	736.531	23	1.3	0.031	334.546	339.822	8.126e+014	4.420e-005	
21	788.584	23	1.3	0.031	334.546	339.822	8.334e+014	4.533e-005	
22	842.656	23	1.3	0.031	334.546	339.822	8.542e+014	4.646e-005	
23	888.721	23	1.3	0.031	334.546	339.822	8.837e+014	4.807e-005	
24	940.776	23	1.3	0.031	334.546	339.822	9.027e+014	4.910e-005	
25	993.904	23	1.3	0.031	334.546	339.822	9.307e+014	5.062e-005	
26	1043.871	23	1.3	0.031	334.546	339.822	9.609e+014	5.227e-005	
27	1089.924	23	1.3	0.031	334.546	339.822	9.901e+014	5.385e-005	
28	1140.996	23	1.3	0.031	334.546	339.822	1.007e+015	5.479e-005	
29	1191.107	23	1.3	0.031	334.546	339.822	1.027e+015	5.588e-005	
30	1243.136	23	1.3	0.031	334.546	339.822	1.052e+015	5.723e-005	
31	1289.204	23	1.3	0.031	334.546	339.822	1.068e+015	5.810e-005	
32	1334.184	23	1.3	0.031	334.546	339.822	1.066e+015	5.797e-005	

Figure 6: SpinCount report with molarity and total number of radicals per time point

### Key Features of the System:

- More reliable and accurate than the Peroxide value test
- Faster result for oxidative resistance than Rancimat
- Oxidative resistance results in as little as 30 minutes
- Compact, lightweight and portable instrument
- Complete system includes PC, software, and set of sample capillaries



The Magnettech ESR5000 benchtop system

### References:

1. Fadda A. et al., *ACS Food Sci. Technol.* 2021, 1, 1294
2. Musakhanian J. et al., *AAPS PharmSciTech.* 2022, 23, 151
3. Di Prima G. et al., *Appl. Sci.* 2024, 14, 10766
4. Sanna D. and Fadda A., *Antioxidants* 2025, 14, 300
5. Jiang S. et al., *Food Chem.* 2020, 309, 125714
6. Velasco J. et al. *Food Chem.* 2004, 85, 623

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