Optimization of Oxidative Stress Indicator Workflows for Enhanced Quality Control of Rendered Meals and Fats Utilizing the CDR FoodLab® Analyzer: Peroxide Value and Free Fatty Acids

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Introduction

In the United States, over 56 billion pounds of raw materials derived from animals are converted to approximately 9 and 10 billion pounds of rendered fats and protein meal, respectively.[1] With this size and scope, it is a necessity quality control teams have access to methods that are reliable, accurate, intuitive, robust, and rapid are a necessity to keep up with the ever-growing demands and ensure finished product quality.

Background

Two primary indicators to evaluate oxidative stress of protein meals and fats are peroxide value (PV) and free fatty acid (FFA).[2] Industry estimations due to no standardization of oxidative test methods costs the ingredient and food industries millions of dollars.

Recently, industry leaders have come together to tackle these challenges through evaluating and validating new platforms. One recognized platform is the CDR FoodLab® analyzer, a pre-calibrated, easy to use photometer that can perform multiple oxidative stress analyses including PV and FFA in a variety of products. The rendering industry recognized the potential for this and industry leaders in conjunction with CDR FoodLab® validated the equipment against the AOCS official methods Cd 8b-90 and Ca 5a-40, for PV and FFA, respectively.

Methods

75 meat meal samples of various types were analyzed over 3 days, at 25 samples per day. Samples were run side-by-side in using the AOCS Official Method Cd 8b-90 with ether extraction and the CDR FoodLab® flours calibration and n-propanol as the extraction fluid.

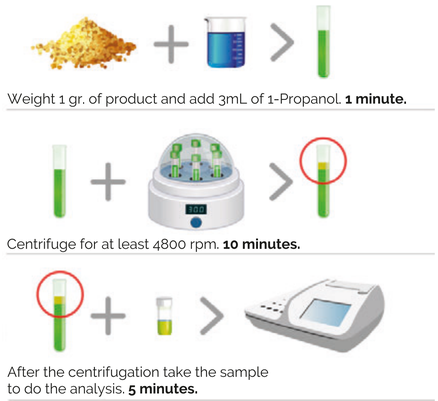

Figure 1. Extraction method to prepare meat meals to test on the CDR FoodLab®.

The CDR FoodLab® and its accompanying test kit for peroxide value utilizes the fact that R-O-O-R peroxides oxidize Fe2+ ions. The Fe3+ ions resulting from oxidation are grouped and form a complex. Its colorimetric intensity, measured at 505nm, is directly proportional to the concentration of peroxides in the sample. Results are expressed as meqO2/Kg.

Results

Sample Number	AOCS Official Method	CDR FoodLab	Sample Number	AOCS Official Method	CDR FoodLab
1	5.90	18.64	39	5.11	6.72
2	3.65	2.88	40	6.80	5.36
3	3.21	1.50	41	3.24	1.48
4	8.03	10.04	43	5.27	0.19
5	22.30	29.73	45	2.99	2.57
6	0.20	0.19	47	4.43	3.83
7	3.48	1.88	48	8.02	8.57
8	13.69	14.41	49	4.40	5.50
9	2.11	2.17	51	3.87	1.77
10	3.58	1.72	52	2.48	1.78
11	4.30	3.20	54	1.17	4.53
12	3.43	2.41	55	8.31	7.25
13	5.03	7.42	56	13.21	12.77
14	7.77	7.75	58	8.79	4.11
17	7.04	14.50	59	0.69	0.97
18	4.85	2.60	60	4.44	11.59
19	14.56	12.26	61	1.62	2.33
20	6.18	1.76	62	5.43	1.68
22	11.94	16.07	63	3.06	1.30
23	5.71	1.57	64	20.14	23.75
24	4.21	4.46	65	6.15	7.51
26	11.01	15.04	66	5.18	6.01
27	4.53	4.05	67	8.41	1.66
29	21.80	22.72	68	3.36	5.05
30	11.73	13.72	69	3.32	2.12
31	16.23	19.67	70	5.21	14.59
35	21.88	28.84	72	15.46	20.32
36	6.41	2.84	73	6.22	5.44
37	5.77	8.26	74	3.76	4.06
38	9.06	14.75	75	4.63	13.23

Table 1. Results of the peroxide value of various meat meal samples tested on the CDR FoodLab® flour curve and AOCS Official Method Cd 8b-90. Samples that did not have results or results exceeded 30 meqO_2/Kg are not listed.

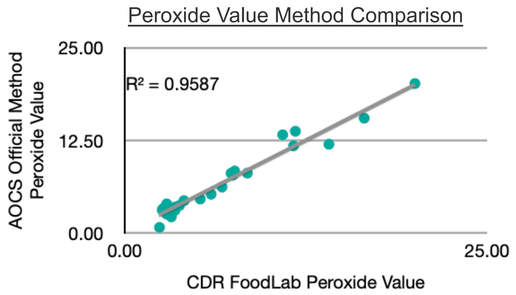

Figure 2. Comparison of CDR FoodLab® peroxide value results to AOCS Official Method Cd 8b-90, with outliers removed.

Conclusion

When comparing the results of the AOCS Official Method Cd 8b-90 to the CDR FoodLab®, there was a clear correlation between the results, indicating that the CDR FoodLab® may be the answer the industry needs in order to tackle challenges regarding oxidation. Using the results from this study, a new calibration curve was created in correlation to the AOCS Official Method Cd 8b-90 for the peroxide value on meat meals for the CDR FoodLab®. This allows meat meals to be tested for peroxide value more easily and efficiently than the official method while maintaining accurate results.

Since the CDR FoodLab® has been found to be such a valuable tool, further studies are being conducted using the technology for analyzing FFA's in addition to PV.

References

1. Meeker, D. (2006). Essential Rendering: All About The Animal By-Products Industry. Arlington, VA. Kirby Lithographic Company, Inc.
2. Frankel, E. (2012). Methods to Determine Extent of Oxidation, p.99-127. Edwin N. Frankel, Lipid Oxidation, 2nd ed, Woodhead Publishing.

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