

Data For Degree Of Rancidity Of Edible Oil With Respect To Different Induction Time And Induction Temperatures

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Abstract

This research was conducted to for study of trend of peroxide value change due to Thermal Oxidation of Blended Refined Edible Oil (80% sunflower and 20% Soya bean Oil) in respect to Induction Time at various different fixed Induction Temperatures. In this, data for the degree of rancidity have been presented after measured within the Temperature range of 120 – 200 °C with interval of 5 °C and and within the time range of 0-120 minutes.

Keywords: Peroxide value, Induction time, Induction temperature, Hot Oven, Hot Plate

1. Introduction

Thermal oxidation of edible oil is an important determination of the quality of edible oil. During processing of food stuffs involving the use of edible oils such as blended oil as a heat transfer medium, the oil owing to high temperature undergoes thermal oxidation over a period of time. Due to the thermal oxidation of edible oils, they become unfit for further use after a period of time. Hence proper control of processing condition is a desirable requirement in order to delay the onset of thermal oxidation of edible oil.

Heating is an important part of many food processing operations. Many desirable changes, as well as undesirable reactions, occur in vegetable oils when they are heated at elevated temperature. However, during heating, vegetable oils are very sensitive and susceptible to quality changes, caused by chemical instability, that are dependent on both chemical composition and environmental factors. Lipid oxidation is one of the major deleterious reactions during heating that markedly affects the quality of vegetable oils.

This chemical reaction is of primary concern to many researchers in the field of fats and oils. The extensive studies on lipid oxidation have spurred a vast array of findings in the field of fats and oils processing. Today, it is well known that this deleterious reaction leads to the formation of various oxidation products, which may result in the oil and fat products becoming unfit for human consumption. Compositional and/or environmental effects on lipid oxidation can be expressed by a mathematical relationship. However, this relationship applies only to several simple food systems and reactions. More often, oxidative reactions of vegetable oils are more complex and unique in their behavior, and the appropriate model must be derived individually for each product and oil system. Temperature is one of the main environmental factors that influence the rate of quality loss. The dependence on temperature of most reactions in foods can be expressed more precisely by the Arrhenius model.

The degree of rancidity of any edible oil is measure of peroxide value of the oil in given condition. By measuring the changes in peroxide value at different temperature for different time duration of induction one can decide the time and temperature of cook for minimum rancidity development and for longer preservation of food. One can measure the trend of change in peroxide value with respect to time and temperature.

Shahidi and Spurvey (1996) stated that Autoxidation of oils and the decomposition of hydroperoxides increase as the temperature increases. Velasco and Dobarganes (2002)

stated that the formation of autoxidation products during the induction period is slow at low temperature. The concentration of the hydroperoxides increases until the advanced stages of oxidation. Marquez-Ruiz *et al.* (1996) suggested that The content of polymerized compounds increases significantly at the end of the induction period of autoxidation. Yang and Min (1994); Rahmani and Saari Csallani (1998) suggested that temperature has little effect on oil oxidation due to the low activation energy of 0 to 6 kcal/mole. Sattar *et al.* (1976) stated that light is much more important than temperature in oil oxidation.

2. Materials and Methods

Oil was purchased from the market as refined blended oil (80% sunflower oil and 20% soyabean oil) of composition as shown in Table I.

TABLE I Approx. Composition of Oil.

Contents	Qty. per 100g
Energy	900
Carbohydrate (g)	0
Protein (g)	0
Fat (g)	100
- Saturated fatty acids (g)	10
- Monounsaturated fatty acid (g)	26
- Polyunsaturated fatty acid (g)	64
- Omega-6 [n-6] (g)	63
- Omega-3 [n-3] (g)	1
- Trans fatty acid (g)	0
Total Essential fatty acids (g)	53
Cholesterol (mg)	0
Vitamin E (mg/IU*)	50/50
Moisture (g)	0.987
Peroxide value (meq) at 28 °C	19.8
AntiOxidant TBHQ (mg)	12

2.1 Preparation of samples

The oil was first heated on hot plate in 500 ml beaker filled to 290ml, to reach the required temperature and then incubated in hot baking oven to maintain the temperature of the oil for required time intervals.

2.2 Sample Collection

2.2.1 Firstly, Samples (30 ml) were collected in the brown color bottle within the temperature range of 120-200 °C with interval of 10 °C for 0-120 minutes of induction time with the interval of 20 minute. And so the number of sample was $9 \times 7 = 63$. And there peroxide values were measured.

2.2.2 Secondly, Samples (30 ml) were collected in the brown color bottle within the temperature range of 125-195 °C with the interval of 10 °C for 0-60 minutes of induction time with the interval of 15 minute. And so the number of sample was $8 \times 5 = 40$. And there peroxide values were measured.

As such total number of samples collected was $(63+40)=103$.

*Assumptions

- Surface area exposed to atmosphere is constant or same.
- No mixing or agitation.

2.3 MEASUREMENT OF OXIDATION

2.3.1 Peroxide Value (PV) Analytical method.

2.3.1.1 Purpose and Scope

This method describes the determination of peroxides values for vegetable oils and fats. The peroxide value is a parameter specifying the content of oxygen as peroxide, especially hydro peroxides in a substance. The peroxide value is a measure of the oxidation present.

2.3.1.2 Principle

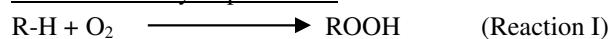
The sample treated in the solution with a mixture of acetic acid and a suitable organic solvent and then with a solution of potassium iodide. The liberated iodine is titrated with a standard solution of sodium thiosulphate.

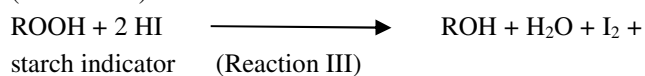
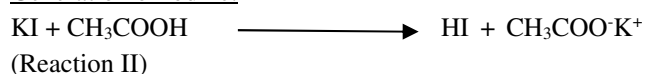
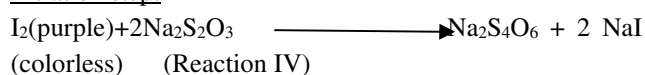
Peroxides and similar products which oxidize potassium iodide under the conditions of the test will contribute to the peroxide value. Variations in procedure may affect the results. Peroxide values are expressed either in milliequivalents of peroxide/kg or millimoles of peroxide/l.

Reaction scheme:

The peroxide value is determined by measuring the iodine liberated from potassium iodide by a peroxide, using sodium thiosulphate solution as the titrant. In the presence of acetic acid, the reaction scheme for hydroperoxides is as follows.

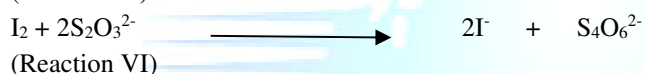
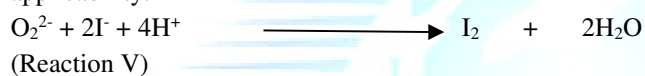
Generation of hydroperoxides:



Generation of iodine:Titration step:

Reaction of peroxides of the structures R-O-O-R' and R-CH-O-O-CH-R' follows an analogous pathway. Whilst cyclic peroxides do not react quantitatively under the conditions described here.

Alternatively, the ion reaction is of more of general applicability:



2.3.1.4 Procedure

- i) Approx. 3.0g of the sample was transferred, accurately weighed, into a 250 ml conical flask.
- ii) 25 ml of the appropriate solvent mixture (glacial acetic acid: chloroform, 1:2) and 1 ml saturated potassium iodide solution freshly prepared was added.
- iii) Was Allowed to react for 60 sec. and shaking thoroughly during this period. Then 35 ml of distilled water was added.
- iv) Then was titrated with 0.001 N sodium thiosulphate solution using 0.5 ml 1% starch solution as indicator.
- v) During the titration shaken until the blue color disappeared.
- vi) Blank titration was carried under the same conditions.

2.3.1.5 Calculations

S=titration of sample.

B=titration of blank.

SW=weight of sample taken.(gm)

N=normality of sodium thiosulphate used.(0.001)

PV=peroxide value (meq/kg)

$$\text{PV} = \frac{(S-B) \cdot N \cdot 1000}{SW}$$

3. Result

Below are the different peroxide values of Oil for various time and temperature of induction.

Peroxide Value (meq/kg)	Temp. (°C)	Time (minutes)
2.191	120	0
4.353	125	0
4.653	130	0
4.753	135	0
1.958	140	0
2.948	145	0
6.769	150	0
6.135	155	0
6.746	160	0
5.565	165	0
5.073	170	0
2.966	175	0
4.215	180	0
4.435	185	0
2.727	190	0
1.262	195	0
2.561	200	0
5.197	125	15
0.192	135	15
3.6	145	15
0.436	155	15
0.236	165	15
0.143	175	15
0.546	185	15
2.54	195	15
2.445	120	20
7.255	130	20
2.119	140	20
2.795	150	20
0.411	160	20
2.231	170	20
1.206	180	20
0.758	190	20
1.123	200	20

Peroxide Value (meq/kg)	Temp. (°C)	Time (minutes)
5.07	125	30
1.896	135	30
3.465	145	30
0.605	155	30
0.175	165	30
0.16	175	30
1.395	185	30
2.147	195	30
4.115	120	40
6.582	130	40
2.171	140	40
3.65	150	40
0.771	160	40
0.33	170	40
0.396	180	40
0.462	190	40
1.225	200	40
5.981	125	45
1.633	135	45
4.647	145	45
0.638	155	45
0.736	165	45
0.373	175	45
1.738	185	45
1.663	195	45
4.026	120	60
8.024	125	60
5.84	130	60
1.504	135	60
4.195	140	60
3.813	145	60
0.778	150	60
1.036	155	60
0.811	160	60

Peroxide Value (meq/kg)	Temp. (°C)	Time (minutes)
1.236	165	60
0.751	170	60
0.85	175	60
1.034	180	60

1.53	185	60
0.284	190	60
1.941	195	60
1.818	200	60
2.912	120	80
5.939	130	80
3.023	140	80
2.327	150	80
1.038	160	80
0.787	170	80
1.326	180	80
0.496	190	80
1.534	200	80

Peroxide Value (meq/kg)	Temp. (°C)	Time (minutes)
3.387	120	100
4.749	130	100
2.239	140	100
0.796	150	100
1.257	160	100
1.036	170	100
1.804	180	100
0.635	190	100
1.246	200	100
4.581	120	120
5.163	130	120
5.14	140	120
0.766	150	120
3.089	160	120
2.126	170	120
2.386	180	120
1.206	190	120
1.019	200	120

4. Discussion

These data can be used for the developing of models relating the degree of thermal oxidation of oil with induction time and induction temperature. So by the suggested models those best fit, one can easily determine

or predict the values of peroxide for different time and temperature of induction.

5. Conclusion

By thorough analysis of data for peroxide value one can easily decide the time and temperature of cook for extended self-life of the cooked products.

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References

- [1] Blaine, R. L., Lundgren, C. J. and Harris, M. B., "Oxidative Induction Time – A Review of DSC Experimental Effects," in this volume.
- [2] G. Litwinienko & T. Kasprzycka-Guttman, *Thermochim. Acta*, 1998, 319, 185.
- [3] Min D.B., Boff J.F., (2001). Lipid oxidation of edible oil. In: *Food lipids*, Akoh C., Min D.B. (Eds). New York: Marcel Dekker, pp 335-363.
- [4] P. Simon & L. Kolman, *J. Therm. Anal. Cal.*, **2001**, 64, 813.
- [5] Simon P., Kolman L. (2001) DSC study of oxidation induction periods, *Journal of thermal Analysis and Calorimetry*, 64, 813-820.

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