Comparative study of the stability of edible oil by the utilization of various natural antioxidants

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ABSTRACT: The Present Investigation is to compare the effects of various natural antioxidants like \textit{Vitus vinifera} species and \textit{Tamarindus indica} species and also to evaluate its chemical characterization of pertinent properties in two varied edible oil. \textit{Vitus vinifera} species and \textit{Tamarindus indica} species and whose antioxidant activity measured by Totox assay (Total Oxidation Value) and DPPH scavenging assays. The quantitative amount results showed were 0.4\% w/w \textit{Tamarindus indica} species and 0.5\% w/w of \textit{Vitus vinifera} species were able to inhibit lipid oxidation throughout storage ($p < 0.04$). Quantitative results of the \textit{Vitus vinifera} species with 0.25\% (w/w) of Refined oil (RO) showed a good synergic effect, displayed radical scavenging activity and better antioxidant activity and acts as a better food ingredient for the healthier food commodities.

Keywords: Natural Antioxidant, Edible Oil, Rancimat analyzer, Totox value, DPPH

1. INTRODUCTION

The oil consumption has increased dramatically in last five years at CAGR of 1.2\%, which increase the production of oil. The oil is mainly extracted from the palm seed and soybean seed. The oil has limited application in unmodified from by their triacylglycerol (TAG) and fatty acids (FA). By changing the physical and chemical characteristics of oil, it makes the oil to produce many products. The changing the character of oil it causes rancidity phenomenon[1-3]. Rancidity is the phenomena when the oil is placed in the moisture it gets oxidized due to its high affinity to oxidation which the oil to produce unpleasant and cause the health issue in the humans when oil is refined. So that in the process of refining the antioxidant is added, antioxidant is the compound which controls the oxidizing property of the refined oil.

In general, the antioxidant is classified into natural and synthetic antioxidant. The synthetic antioxidant is added as chemical compound in oil industries. The most common antioxidant used are tetra-butyl hydroquinone (THBQ), butylated hydroxyl anisole (BHA), butylated hydroxyl toluene (BHT), propyl gallate (PG). These compounds lead to cause cancer and cardio-vascular disease. Here we are using the alternative method i.e., Despite of using the natural antioxidant are mainly consist of polyphenol, flavonoids, β-Carotene, vitamin C. The \textit{Tamarindus indica} species is a tree, 80-120 ft high,
of the family legumes, generally known as “tamarind”. The polyphenols of the tamarind have antioxidant and anti-inflammatory properties. The properties of tamarind have ability to protect against the diseases like cardiac disease, cancer, and diabetes[2-5]. The Vitus vinifera species is a vine, 80-115 ft high, of the family Vitaceae, generally known as “grape”. The antioxidant presents in grape such as resveratrol helps to reduce inflammation and protect against cancer and cardiac disease.

The oxidation process and the lipid oxidation in high fat-containing food is a prime cause of shelf of texture, shelf life, appearance, and nutritional qualities[5-7]. Effective models to examine the antioxidant property are a food model with natural plant extracts with lipids as oil in water emulsions (O/W). Several phases of decomposition of lipid oxidation starts were the first phase results in the origin of an unstable free radicals and the secondary products of decomposition is acids, ketones, aldehyde, and alcohols. In this research work, the main goal is go with quality traits of the primary oxidation and the secondary oxidation of both the extracts in specific comparison of results to evaluate the potential antioxidant activity of both the extracts by different methods Totox value and DPPH scavenging activity of the food ingredients.

2.MATERIAL AND METHODS:

2.1 Materials

The two different natural extracts such as Vitus vinifera species and Tamarindus indica species are mixed with the SFO (Sunflower oil) and RBO (Rice bran oil) in varying proportion[8-9]. The oil mixtures were mixed at 60°C in an oven prior to initial analysis. Lovibond tintometer is used to determine the color of the oil, where the mixed oil sample are placed into 1-inch cell and color was determined at 30°C thereby the best possible match with the standard color slides of red and yellow was observed.

2.2 Free fatty acid

The oil and fat are hydrolyzed to produces the free fatty acid (FFA) in consideration of environmental factors like time, temperature and moisture content are exposed to various condition of heating or firing[10-12]. Further the FFA is less stable in the natural oil and also high stable characteristics in edible oil like low flavor quality, undesirable saponification and low yield of products which have been attracted many researchers to influence the quality of edible oil product and their prices. In additional high FFA content in edible oil cause the oxidation in the unsaturated FFAs which may results in the rancidity of the oil and it was determined by the solvent agent by subsequent the neutralization of fatty acid is done by the caustic soda lye. The amount of lye for further neutralizing of the fatty acid is calculated by the titration basis of neutralized ethyl alcohol by using phenolphthalein as an indicator for the bath for 5 min to the sample. Then it was standardized by 0.1N of NaOH solution, where end point is the appearance of pink color.

2.3 Peroxide value

The shelf life and the stability of the sample is calculated by the peroxide value(PV) determination with the disagreeable odors of the liberated iodine. The standard titration of the sample is done by sodium thiosulfate in the weight range of 4.5 to 5.5gm of variable 3:2 ratio of acetic acid and chloroform. Thus, the added 0.5ml saturated KI solution is kept undisturbed for 29 minutes, cover with glass stopper and starch indicator as a resultant of pure state and the corresponding periodical measurement of the pH are examined in correlation with PV[12-16].

2.4 Rancimat Test

The accelerating aging process of the oil sample with two different natural extracts was determined by a viable factor of oxidative stability and together with constant evaluated temperature processes. By the continuous passing of stream of air in the Rancimat analyzer where the process fatty acids, test volatile,
secondary reaction products are generated continuously and it was recorded through the electrical conductivity of the measured dual sample oil solution in accurate value of more feed at the same time.[16-19] Refined Oil with antioxidants at room temperature can be measured directly by a disposable plastic Pasteur pipette placed in measuring vessel of heating block vessel is filled with 60 mL deionized water and also a new vessel is used to remove the particles the reaction vessel is air cleaned inside and outside by a sharp stream of nitrogen. Before the period of determination be started where the temperature of the heating block must be stable and interconnection of two tubing rancimat and reaction vessel with permissible sample size liquid sample 3.0 ± 0.1 gm, gas flow rate of 20 L/h and documented temperature is in between 80 and 160 °C is uncorrected one. Further both the P-Anisidine value and Totox value determinations is also examined in glacial acetic acid to make up a 0.25g/100 ml of solution by Isooctane as a solvent for oil samples. Around 0.5gm – 0.7gm of oil samples are measured in 25 ml volumetric flasks, noting down the mass of oil sample with viable diluted working solvent and the corresponding absorbance measurements are also recorded at 350 nm in a reagent blank of measured oil sample. The Comprehensive overview of both the PV and p-AV are mathematically predicted the oxidative stability and was correlated with the extended of oil deterioration.

2.5 DPPH Scavenging Activity

Both the Vitus vinifera species and Tamarindus indica species of different fractions were assessed with slight modifications for their DPPH radical scavenging activities by Schwarz et al. method. In covered vortex test tubes of three of each sample with 50 μL of the phenolic extracts were combined with methanolic DPPH (3.9 mL, 0.1 mM) and the tubes were placed exactly 10 min dark cabinet at the measured value of 600 nm[20-22]. The scavenging effect along the absorbance rate is recorded by the control absorbance(CA) and sample absorbance(CS) and to calculate 20,40,60,80 different concentrations of 100 μL sample in EC50 concentration.

3. RESULTS AND DISCUSSION

3.1 Effects Free Fatty Acid Test

The FFA content is analyzed with the 200ppm of the extract the Vitus vinifera has 0.045 and the Tamarindus indica has 0.048. Similarly, FFA content with 400ppm the Vitus vinifera has 0.041 and the Tamarindus indica has 0.044. The result was found that the Vitus vinifera is more effective than the Tamarindus indica[9-23]The Schematic representation of both the values of TSE and GSE are depicted in Fig 1 and it is measured by using the mathematical expression represented in equation 1

\[
FFA= (0.28\times V\times M) – W-------------------------\text{Equation 1}
\]

![Figure 1: The pictorial representation of GSE and TSE on FFA](image)
3.2 Effects of Peroxide Valve

The peroxide value is calculated with the extract with different ppm value in different time. The peroxide value of the sample with the 200ppm of the extract value is found that the *Vitis vinifera* has 1.99 and the *Tamarindus indica* has 2.01 at the initial day, the PV value at the 7th day of the *Vitis vinifera* has 2.86 and the *Tamarindus indica* has 2.92. similarly, for 400ppm the PV value at the initial day of the *Vitis vinifera* is 1.91 and the *Tamarindus indica* is 1.94, the value at the 7th day the *Vitis vinifera* has 2.84 and the *Tamarindus indica* has 2.87[23-26]. Thus, the result shows that the *Vitis vinifera* extract is most than the *Tamarindus indica* extract and the PV value is calculated from the formula stated in equation 2 and the observation are shown in figure 2 and 3.

\[ PV = \frac{(vol \times N \times 1000) - W}{W} \]  
**Equation 2**

![Figure 2: Initial effects of GSE and TSE on primary lipid oxidation](image)

![Figure 3: Effects of GSE and TSE on primary lipid oxidation after 7 days.](image)
3.3 Effects of Rancimat analyzer

The Rancimat analyzer results revealed that the oxidation stability of the oil in two different extract of are analyzed and the corresponding representation are illustrated in figure 4. But the concentration 200 ppm and 400 ppm are identified at 15 min are 3.06 and 3.1 of the Vitus vinifera and Tamarindus indica, respectively. Similarly, for subsequent concentration time 600 ppm of the extract are identified as 3.21 and 3.42 of the Vitus vinifera and Tamarindus indica respectively which indicates the maximum stability of the oil is conducted at constant temp 141°C [25-26] and the value is taken at different time with various ppm of the extract are shown in figure 4. The total oxidation value (TOTOX) is also calculated with different ppm level of the extract in different time. The value at initial time with the 600 ppm of the extract the values are 9.72 and 9.92 of the Vitus vinifera and Tamarindus indica, respectively. The value at the 7th day with same ppm the values are 17.8 and 18.4 of the Vitus vinifera and Tamarindus indica respectively and the corresponding results are incorporated in figure 6 and figure 7 by using the equation 4.

![Figure 4: Effects of Vitus vinifera and Tamarindus indica in Rancimat Analyzer](image)

3.4 Effects of p-Anisidine Analysis

The p-Anisidine value of the sample is analyzed with the extraction with different ppm. The p-AV of the sample with 600 ppm Vitus vinifera is 6.14 and Tamarindus indica is 6.54. similarly, at 800 ppm Vitus vinifera is 4.79 and Tamarindus indica is 5.19, then finally the sample is analyzed with 1000 ppm of Vitus vinifera and Tamarindus indica are 1.52 and 1.82 respectively[26-30] through an equation 3 as follows

\[
p-AV = (2.5 \times 1.2 \times A) – W \text{-------------------Equation 3}
\]
3.5 Effects of Totox Value

The Totox value is calculated in different day at different ppm of the sample. The 600ppm of the both samples analyzed at initial time the Vitus vinifera has 9.72 and the Tamarindus indica has 9.92, after in the 7th day the Vitus vinifera has the value of 17.8 and Tamarindus indica has the value of 18.4. then the sample with 800ppm is analyzed at the initial time the Vitus vinifera has 8.31 and the Tamarindus indica has 8.55, after in the 7th day the Vitus vinifera has the value of 8.31 and Tamarindus indica has the value of 8.55. then finally the sample with the 1000ppm is analyzed at the initial time the Vitus vinifera has 4.332 and the Tamarindus indica has 4.6, after in the 7th day the Vitus vinifera has the value of 4.34 and Tamarindus indica has the value of 4.64[28-32] by using the equation 4.

\[
\text{TOTOX value} = (2 \times PV) + \text{p-AV} \quad \text{-------------------Equation 4}
\]

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**Figure 5:** Effects of *Vitus vinifera* and *Tamarindus indica* on p-Anisidine

**Figure 6:** Initial Impact of GSE and TSE on TOTOX value.
4. CONCLUSION

The research work has been examined that the effects of natural antioxidant with sunflower oil and rice barn oil exhibits more significant values as compared with the effects of TBHQ of refined oil. Various analysis has been done such as FFA, peroxide value etc., and the corresponding results obtained was very low with the TBHQ addition. In this work, we reported the main factors for the deterioration of oxidant of oil is determined through p-Anisidine value. It shows the lesser effects for the natural antioxidants. The work also been focused in the shelf life of oil by the Rancimat analysis and yield. Rancimat analyze also predicted the shelf life oil has been more for the natural as in related with synthetic antioxidants.

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