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Statistical Analysis Determination on Cooking Oils Stability by Using Selected Quality Parameters Like Peroxide Value, Iodine Value & Melting Point

Sridevi Motupalli[1],Arunakumari Nekkella[2], Sivanath Musunuri[3],Venkateswara Rao CH.[4]

[1]Department of chemistry, S.K.S.D.Mahila Kalasala, UG & PG(A), Tanuku, Andhra Pradesh, India[2]Department of Engineering chemistry, B.R.Ambedkar University, Etcherla, Srikakulam,A.P.,India[3]Department of chemistry, A.N. R College(A), Gudivada, Andhra Pradesh, India
[4]Department of chemistry, Y.N.College (A), Narasapuram, Andhra Pradesh, India

ABSTRACT
Cooking vegetable oils are prone to quality deterioration through oxidation and microbial degradationresulting in nutritional loss and off-flavours. Quality deterioration may contribute in the formation of oxidation productsthat are reactive and toxic, which ultimately pose health risks including cancer and inflammation. The objective of thisstudy was to assess quality of both imported and locally made edible vegetable oils accessed in and around Tanuku town, WestGodavari district,Andhra Pradesh, India.

Cooking oil quality is related not only to humanhealth but also to the economic development of the country and social stability. High stability oils are in great demand. For this reason research on edible oil quality is very important. In this study we present the best ways to determine the natural stability of cooking oils. Peroxide value indicates the rancidity of oil, lower the peroxide value better will be the sample Peroxide value,inanoilis usefulforassessingtheextenttowhichspoilageadvanced. The most important application of the iodine value is to determine the amount of unsaturationcontained in the form of double bonds which react with iodinecompounds.Thehighertheiodinevalue,themoreunsaturatedoils. Different cooking oils were analysed using standardized methods. The evaluated parameterswere peroxide value, Iodine value and melting point for different cooking oil samples collected from different houses present in and around Tanuku. Sample size is small (n=50). The obtained data was tabulated and applied statistical parameters like mean, variance, standard deviation etc. In this analysis it is shownthat stability of cooking oil decreases with increase in the peroxide value and Iodine value.

Keywords : determination, cooking oils, peroxide value, Iodine value

Introduction

Cookingvegetable oils are triglycerides of plant origin thatinclude olive, palm, soybean, canola, and sunflower oil[1, 2]. Oil and fat are important nutritional componentswith variety of functions in our body [3, 4].Vegetable oils may rancid and hence lose its nutritionalvalues and flavor upon improperhandling and storage [5, 6]. Moisture, microbes, air,anti-oxidants and exposure to sunlight are among factorsdetermining the oils rancidity or deterioration time[7–9].
In quality control, parameters such as iodinevalue (degree of unsaturation), peroxide value (formationof primary oxidation products), melting point,are key parameters ofinterest as they determine the shelf-life quality and hencethe economicvalue of oils [3, 10]. Rancidity of vegetableoils may pose health risks including cancer and inflammationbecause of the formation of toxic and reactiveoxidation products [2, 11, 12]. For healthy consumption,unsaturated oils are better than the saturated. Consumptionof palmitic oil (highly saturated) is associated withan increased risk of developingcardiovascular diseases[12, 13]. In contrast, edible vegetable oils such as sunflower,olive, canola and Niger- seed oils contains highlevels of polyunsaturated fats [2, 14] which make themsusceptible for rancidity.

Unlike in the developed countries, developing countries like India doesn't have a strict food safety regulation. Studies showed that developed countries society have greater awareness compared to developing countries in edible oil purchasing choice [15-17]. WHO/FAO has outlined quality standards for various edible vegetable oils constituents; heavy metals, fatty acids composition, antioxidants, micronutrients and other physicochemical parameters [18]. The WHO/FAO guideline sets the maximum allowable limit for edible oils quality parameters including moisture (0.2%), acid value (0.6 mg potassium hydroxide/g oil) and peroxide value (10 mill-equivalents oxygen/kg oil) [19].

Due to the availability of limited published research and importance of publichealth, periodic oil quality analysis isrequired. Therefore, the aim of the study was to assessquality of edible vegetable oils accessed in and around Tanuku town, West Godavari District, Andhra Pradesh, India regarding rancidity and level of unsaturation.

Materials &Methods

A study was conducted in the research laboratory of S.K.S.D.Mahila Kalasala, UG & PG (A), Tanuku on collected cooking oils from the students in 2022. 10 samples of various brands (sunflower oil, groundnut oils from local mills etc) used by students at their homes were taken

Experimental Procedure

Collected samples by our students were transferred to the Department of Organic Chemistry Laboratory, S.K.S.D.Mahila Kalasala, UG & PG (A), Tanuku for analysis.Care was taken toavoid air contact during analysis to keep-away oxidation reactions.

All the quality parameters analysis was conducted using the Paquot Standard methods of oilanalysis[20].

Moisture content

10 gmsof oil sample was placed in a weighed crucible.The samples were dried for 1hr to constant weights in an oven set at 105^0C and then allowed to cool in desiccators for 15 minand finally the difference was calculated using the following equation.

$$\%\text{Moisture} = \frac{W1 \times 100}{W2}$$

Where, W1= weight loss (g) upon drying, W2 = weight (g) of the oil sample.

Peroxide Value

Ten mL of oil sample was dissolved in acetic-acid/chloroform (3: 2 ratios) solvents. This solution was furtherreacted with 0.5 mL of 15% potassium iodide (KI). Theliberated iodinewas titrated with 0.1 N sodium-thiosulphate using 0.5 mL starch as indicator. Blank titration was performed. The peroxide value was calculated asfollows:

Peroxide value = $(B - S) \times W \times N$

where, S=volume of sodium-thiosulphate consumed bythe oil sample, B=volume of sodium- thiosulphate usedfor blank, W=weight of oil sample, N=the normality ofsodium-thiosulphate.

Acid value

Mixture of 10 mL of oil sample and 100 mL of ethyl-alcohol was heated until the contentstarted boiling. The hotcontent was cooled and titrated with 15% KOH solutionusing phenolphthalein as endpoint indicator. Acid

valuewas calculated as follows:

$$Acid\ value = \frac{V \times N \times M.wt}{W}$$

where,V=volumeofstandardKOHsolutioninmL, N=normalityofstandardKOHsolution,W=weight ofoilsampleingrams,M.wt(molecularweight)of KOH=56.1 g/mol.

Iodinevalue

Mixtureof0.5mLofoilsampleand10mLchloroform was added into 25 ml of iodine solution, stayed for 30 min for a complete reaction between iodine and the unsaturatedbondsofoils.Theflaskwascoveredbyaluminum foil to avoid light exposure. Then, 20 mL of 15% aqueousKIand100mLofwaterwasaddedtotransformleftover odinetoiodide.Thefinalcontentwastitratedwith0.1N sodium- thiosulphate($Na_2S_2O_3$)solutionsusingstarchas anindicator.Iodinevaluewascalculatedasfollows:

$$\textbf{Iodine value} = \frac{(A - B) \times N \times 0.127 \times 100}{W}$$

where,A=mLof 0.1 N $Na_2S_2O_3$ required by oil sample, B=mLof0.1N$Na_2S_2O_3$ required by the blank, N=normalityof $Na_2S_2O_3$, W=weight of oil in gram, 1 mL 1 N $Na_2S_2O_3$=0.127 g I_2.

Quality, Data processing and Analysis

Instrument calibration and pretest for functionality of instruments were conducted before the laboratory analysis to maintain quality. Analysis involved blank measurements and all the measurements were done triplicate wise. Standard analysis methods were followed. Data were entered for statistical analysis. Mean values and standard deviations were calculated. ANOVA was used for the analysis of variance among the oil brands for the respective parameters, and independent t-test was used for comparison between locally made and imported oils.

Results& Discussion

Fromthe10samples analyzed, moisture content, peroxide value, acid value and iodinevalue were within the limits of WHO/FAO standards for locally made and imported edible vegetable oils.

The mean moisture value for locally made and branded oils were found to be

0.333±0.08 and 0.089±0.11,respectively.There is a significant difference in moisturecontent between local made and branded edible vegetable oils having p-value 0.016 of95% confidence interval (CI). However, there is no significant difference within oil
brands.

The mean peroxide value for the local products and branded oils were 15.09±1.61 and 7.05±0.102, respectively. There is a significant difference being local and Branded edible oil with p-value<0.003 of 95% CI.

The mean acid value for the locally made and branded oils were 2.43±0.9 and 0.98±0.23, respectively. The acid value between the locally made and branded edible oils significantly differ with p-value<0.001 of 95% of the CI. The locally made edible
oils have shown a greater deviation from the WHO/FAO standardvalue.

The iodine value was significantly differ between locally made and branded edible oils with p-value<0.001 of 95% CI. The iodine value for the local products and brandedwere115.63±6.77and21.8±3.4,respectively. It was observed that the iodine value significantly different among the brands.

Conclusions

The results showed that locally made edible oils displayed higher degree of rancidity compared to the imported. The higher iodine value in the locally made oils indicated that these oil types are better for public consumption with respect to health risks.

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