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A Study on Smoke Point and Peroxide Values of different widely used Edible Oils

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ABSTRACT

Edible oils are used in frying, baking, and other types of cooking. They are also used in food preparation and flavoring not involving heat, such as salad dressings and bread dips. Various Physicochemical parameters of an oil depends upon its origin and chemical composition. Oils with high degree of unsaturation are susceptible to oxidation. Oxidation of oils leads to its rancidity. Rancidity of oil produces potentially toxic compounds associated with long-term health disorders. The peroxide value (PV), which depends on temperature, storage time and light measures the extent of rancidification of oils. Greater peroxide value indicates high rate of oxidation of oils. The temperature limit up to which oil can be used is given by smoke point . Heating oil until it gives smoke produces harmful free radicals. An attempt was made to suggest that selection of particular oil for different types of cooking is important to match oils heat tolerance with cooking method. In the present study smoke point and peroxide values of different widely used edible oils was determined.

Key words: rancidity, physicochemical parameters, free radicals, peroxide value, smoke point

1. INTRODUCTION

Edible oils are used in frying, baking and other types of cooking. Oils are also used for salad dressing, bread dips which do not involve heat. Cooking oils are typically liquids at room temperature .Characteristics of an oil depends upon its origin , storage temperature and time. Heating an oil changes its characteristics.(1)

Cooking oils can be either refined or unrefined .Refinement does not alter the state of an oil. Oxidation of oils depends on temperature , light , time ,presence of moisture , metals etc .(2) Peroxide value is a measure of oxidation during storage and freshness of lipid matrix. Peroxide values are used to indicate rancidity of oils. Oils with high degree of unsaturation will have greater peroxide values. It is also used for assessing the quality of oil. It is the amount of peroxide oxygen present in 1 kilogram of oil. It is expressed in units of mill equivalents (3,4). In general fresh oils have a peroxide value of <10 mEq/Kg while peroxide values in the 30-40 mEq/Kg range are generally associated with a rancid taste. Rancid oil forms harmful free radicals in the body which increase the risk of cancer ,heart disease ,cellular damage and have been associated with diabetes, Alzheimer's disease and other conditions. Peroxides accelerates ageing, raised cholesterol levels, obesity etc. smoke point refers to a temperature at which oil burns or give out smoke (5). Over heating an oil with low smoke point produces harmful free radicals which initiate cellular damage and other harmful diseases. Comparatively unrefined oils will have high smoke point than refined oils because they contain impurities and free fatty acids .oils with high smoke point are better suited for cooking at high temperatures. Refinement processes include bleaching, filtering, and high-temperature heating to extract and eliminate those extraneous compounds. Refined oils are neutral-flavored with a longer shelf life and a higher smoke point (6). According to the opinion of the Working Group of Regional Food Chemistry Experts and the German Federal Public Health Department of 1991, the smoke point of a cooking oil must be at least 170 °C and must not differ from the temperature of the fresh fat by more than 50 °C so that the fat can still be classified as usable.

2. METHODOLOGY

2.1 Chemicals : Simple Cuisine Original Instant Read Digital Meat Thermometer with Long Probe and LCD Screen for Liquids, Grill, Cooking, BBQ, and Candy – Black, Acetic acid , chloroform , potassium iodide ,

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hypo and starch of analytical grade were used for determining smoke point ,peroxide values of various fresh edible oils.

2.2 Sample oils : Fresh edible oil samples like ground nut oil ,sunflower oil , coconut oil , mustard oil , rice bran oil , castor oil ,olive oil ,cow ghee , buffalo ghee and vanaspati (fully or partially hydrogenated vegetable oil) used for study were purchased from local market located in and around banjarahills ,Hyderabad, Telangana ,India .

2.3 Methodology : Smoke point of selected oils was determined in open lab with lots of fresh air flow. About 150ml of oil was taken in a beaker and heated until it starts giving out smoke at this point smoke point was noted using digital meat thermometer. Peroxide value determination was carried out using the method described by Pearson (1981) and Ranken (1988) . About 2ml of oil sample ,accurately weighed was taken in a 250ml conical flask fitted with glass stopper ,10 ml mixture of glacial acetic acid and chloroform (3:2) ,0.5ml of saturated potassium iodide solution was added to conical flask and was shaken vigorously for about a minute then it was kept in dark for approximately 5 minutes to complete the liberation of iodine and to avoid photochemical reaction of iodine , then it was taken out from dark spray washed the walls of flask with about 10ml of distilled then titrated against 0.01N hypo until yellow color was discharged at this stage 5ml of freshly prepared starch was added to conical flask and continued titration until blue color was discharged. Blank titre value was obtained by following the same procedure omitting oil. Peroxide value is calculated using the equation below:

$$\text{Peroxide value} = \frac{2(a-b)}{\text{Weight of oil sample used}}$$

Where a = sample titre value b = blank titre value

3. Results and discussions

The smoke point of an oil increases as free fatty acid content decreases . Heating an oil produces free fatty acid and as heating time increases, more free fatty acids are produced, thereby decreasing smoke point (6). Heating increases peroxide value of oils therefore oils with more free fatty acids will have greater peroxide value(7).

The peroxide value method is referenced in both the American Oil's Chemist Society

(AOCS) and the Association of Analytical Chemists (AOAC) as methods 965.33 (AOAC) or Cd-8b (AOCS).The theory and science behind the method involves measurement of iodine liberated from potassium iodide by a peroxide present in oil sample, using sodium thiosulfate solution as the titrant. In the presence of acetic acid . mechanism can be represented as follows .

Step – 1 $\text{Peroxides} + KI + H^+ \rightarrow I_2$

Step – 2 I_2 (purple)$+ 2Na_2S_2O_3 \rightarrow Na_2S_4O_6 + 2NaI$ (colourless)

Table -1 Peroxide values and smoke point values of fresh and refined edible oils

S.No	Name of oil sample	Peroxide value of fresh oil (meq/kg)	Smoke point (^oc)
1	Ground nut oil	1.6	225
2	Sunflower oil	2.0	232
3	Coconut oil	1.2	205
4	Mustard oil	2.8	254
5	Rice bran oil	1.7	232
6	Castor oil	2.0	200
7	Olive oil	1.5	190
8	Vanaspati /hydrogenated vegetable oil	3.5	212
9	Buffalo ghee	0.5	198
10	Cow ghee	0.6	192

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CONCLUSION

The order of rancidity or deterioration in oils based on their peroxide values is buffalo ghee < cow ghee < coconut oil < olive oil < groundnut oil < rice bran oil < sunflower oil = castor oil < mustard oil < vanaspati and peroxide values of reused edible oils are in the order vanaspati > buffalo ghee > mustard oil > castor oil > rice bran oil > sunflower oil > groundnut oil = olive oil = cow ghee > coconut oil . Smoke point values are in the order olive oil < cow ghee < buffalo ghee <castor oil < coconut oil < hydrogenated vegetable oil < ground nut oil < sunflower oil = rice bran oil < mustard oil . from table -1 the study attempts to conclude that oils with low smoke point are not suitable for high temperature cooking. Selection of cooking oil should depend on how we intend to use it, its nutritional qualities and its flavour. Depending on the source referenced, the smoke point of cooking oils will vary slightly due to impurities in the oil and the fact that oils break down gradually, rather than at one specific temperature. For low temperature cooking, or adding to dishes and salad dressings oils with a higher Omega-3 fatty acids can be preferred since they promote healthy cells and decrease stroke and heart attack risk (8). They are also known for their anti-inflammatory action.

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