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Effects of Repeated Deep Frying on Refractive Index and Peroxide Value of Selected Vegetable Oils

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ABSTRACT

Objectives: In preparation for deep frying, the peroxide values and refractive indices of palm, sesame, and sunflower oils were measured. The peroxide value and refractive indices of the vegetable oils used to fry white Indian potato chips in three batches were determined after each stage of deep frying. According to the findings, deep-frying significantly alters the refractive index and peroxide value of vegetable oils.

Material & Method: Medical and scientific indexing sites like PubMed and Google Scholar were used to find relevant medical and scientific articles.

Result & Discussion: Sesame palm and sunflower oil's refractive index and peroxide value do rise when fried, but not linearly. A rise in refractive index (RI) of palm oil and a rise in the RI of sunflower oil were observed following the frying of three consecutive batches. Sesame oil's refractive index remained essentially unchanged. After three deep fryings, the peroxide values of palm oil rose from 1.9948 mEq/kg to 9.3020 mEq/kg. Sunflower oil peroxide increased from 10.6359 mEq/kg to 19.3101 mEq/kg, while sesame oil peroxide increased from 3.9914 mEq/kg to 11.9555 mEq/kg after the second batch of Indian potato chips was fried and then decreased to 11.3095 mEq/kg after the third batch of Indian potato chips was fried in the oven.

Keywords- Refractive Index, Peroxide Value, Vegetable oil, Palm olein, Sesame oil, Sunflower oil.

I. INTRODUCTION

Fats include cooking oils (liquid) and solid fats. Fats enhance the diet's texture, flavour, and taste, making it more palatable. To supply some dietary demands such vital fatty acids (linoleic n-6 and alpha-linolenic n-3) and to provide a source of energy, fats are essential. As a result, it is important to take fats in moderation. High-calorie diets, on the other hand, are necessary for the development of young children. For this reason, since they cannot eat significant quantities of substantial cereal- and pulse-based diets, they must include enough amounts of fat in their diets (1 gramme fat = 9 kcal). Because of their high fat content, fats also help to absorb A, D, E and K as well as a feeling of fullness and pleasure, which helps to delay hunger pangs. Fats, together with proteins, make up a significant portion of the fluids and membranes of the human body. Linoleic and alphalinolenic acids (major dietary polyunsaturated fats) are processed at numerous places in the body to produce physiologically active chemicals, which perform several critical physiological tasks in the body, such as regulating blood lipids. It is possible for vegetable oils to go rancid and lose their nutritional value and flavour if they are handled or stored incorrectly. Sunlight and anti-oxidants, as well as moisture and bacteria, all contribute to the oils' rancidity.

Some of the most important quality control parameters include the iodine value (degree of unsaturation), peroxide value (the development of primary oxidation products), moisture content, specific gravity, and acid value (the formation of free fatty acids due to rancidity). Because of the development of harmful and reactive oxidation products when vegetable oils go rancid, they may offer health hazards such as cancer and inflammation. Unsaturated oils are preferable to saturated ones when it comes to good health. High-saturated palm oil consumption has been linked to an elevated risk of cardiovascular disease. While polyunsaturated fats are resistant to rancidity in animal fats (such as coconut oil), they're abundant in vegetable oils (such as sunflower, olive, canola, and Niger seed oil).

In contrast to Ethiopia, which has lax food safety regulations, wealthy countries like the United States and Europe take food safety very seriously. Compared to developing countries, societies in developed countries are more aware of the importance of making informed decisions when it comes to purchasing edible oils, according to research. The levels of heavy metals, fatty acid composition, antioxidants, micronutrients, and other physicochemical parameters in various edible vegetable oils have been established by the WHO/FAO [18]. the acid value (0.6 mg potassium hydroxide/g oil) and peroxide value (10 mill-equivalents oxygen/kg oil) are all set at the maximum permissible levels by the WHO-FAO guideline.

Due to the lack of published data and the importance of oil quality to public health, regular oil quality testing is necessary. As a result, the study's goal was to evaluate the rancidity and fatty acid saturation levels of edible vegetable oils obtained in Gondar, Ethiopia.

Oils can be used for more than just cooking. A growing body of research shows that fatty acids (FAs) play an important role in human nutrition, including disease therapeutics and prophylaxis, human embryonic growth and development, brain function, and protection against numerous serious diseases, such as cardiovascular disease and inflammation. Anticancer properties have been discovered in a number of FAs. When it comes to human nutrition, lipids and fatty acids are becoming increasingly important. FAs play an important role in a wide range of industrial products, from soaps and detergents to cosmetics and lubricants to inks, varnishes, and paints. For both nutritional and industrial reasons, there is a growing demand for oilseed crops. There are a number of fatty acids produced by plants, each with its own structure and a distinct set of physical and chemical characteristics that contribute to their utility.

There has long been a pressing need to find new sources of industrially and nutritionally important fatty acids due to rising petroleum prices and diminishing natural resources. An increase in efforts to engineer metabolic pathways for the creation of useful and/or novel fatty acids has been spurred on by advances in understanding the processes in metabolic pathways. In order to compete with petroleum-based products, it is possible to generate designer oils with a preference for producing certain fatty acids.

Humans rely heavily on vegetable oils in their diets. Soybean, canola, sunflower, and peanut oil are the most commonly produced edible vegetable oils. As a source of edible fatty acids that can be ingested (saturated, monounsaturated, or polyunsaturated), they play a significant function in cellular metabolism. Research shows that FAs are critical to cell growth and development. Cell membranes, hormones, neurotransmitters, etc. are all made up of these molecules. Human health is directly influenced by the consumption of different fatty acids. Saturated fatty acids, for example, have been related to an increased risk of cardiovascular disease. As a result, a low-saturated-fat diet is recommended. Some very long-chain polyunsaturated fatty acids (VLC-PUFA; C20-C22), such as arachidonic acid (ARA; 20:4), eicosapentaeneoic acid (EPA; 20:5) and docosahexaneoic acid (DHA; 22:6), which are typically sourced from marine resources, have been proven to have a significant nutritional role.

II. MATERIAL & METHODS

Medical and scientific indexing sites like PubMed and Google Scholar were used to find relevant medical and scientific articles.

III. RESULT & DISCUSSION

Refractive indices of the oil samples

- Peanut Oil: 1.460 - 1.465.
- Maize Oil: 1.465 - 1.468.
- Mustard Oil: 1.461 - 1.469.
- Sesame Oil: 1.465 - 1.469.
- Soybean Oil: 1.466 - 1.470.
- Sunflower Oil: 1.461 - 1.468.
- Palm Oil: 1.458 - 1.460

After frying the potato chips, the refractive index of the oils rose from the original 1.4604 to 1.4655 due to the addition of palm oil. The refractive index of sunflower oil rose from 1.4725 to 1.4705 when the third batch was fried. The mean RI values of palm olein and sunflower oil differ significantly ($p \leq 0.05$). However, the refractive index of sesame oil is stable between 1.4722 and 1.4723 from its initial value. The RI of sesame oil does not change much after repeated frying. In the table of results, all of the oils had a standard deviation of 0.0002. The findings are in line with what we expected. Palm oil's p-value of 0.0098 and sunflower oil's p-value of 0.0035 both indicated statistically significant shifts in refractive indices ($p \leq 0.05$). Sesame oil's refractive index change was not statistically significant at the 0.05 significance level since the p-value observed was 0.085, which is more than 0.05.

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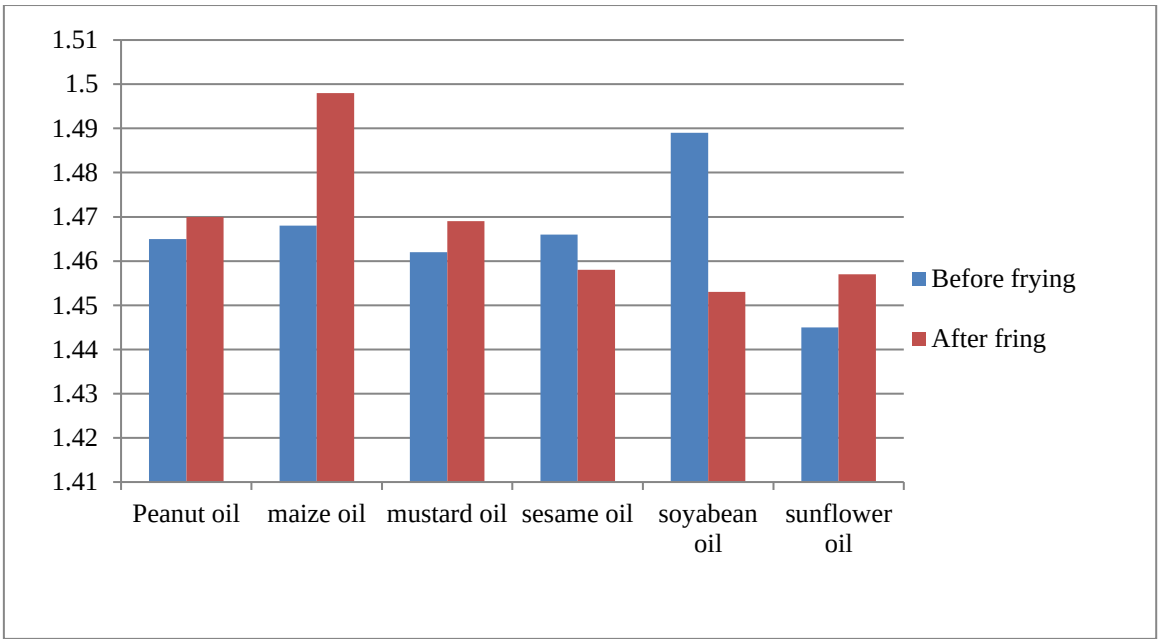

Fig: 1: Mean Refractive Index of the oils.

IV. PEROXIDE VALUE

At the beginning of cooking, the index of peroxide rises to a maximum and then begins to decline. Those oils that are less unsaturated are more susceptible to oxidation than those oils that are more unsaturated. Hydroperoxide levels in all three oils, palm, sunflower, and sesame, have risen, according to the peroxide value data. It's also possible to create the lipid hydroperoxides radical by reheating the oil, then reusing it. Peroxide value of sesame oil decreases on the third fry due to secondary oxidation chemicals such aldehydes and ketones, which also showed nonlinear variation in the peroxide value of oils in Emhemmed et al, 2016. Leptides degrade mostly due to the reaction between oxygen and unsaturated fatty acids, which produces hydroperoxides as the principal product. Because of their quick breakdown into aldehydes with a strong disagreeable flavour and odour, hydroperoxides have no taste or odour. An early indication of oxidation or rancidity can be determined by measuring the peroxide concentration, which is also known as the peroxide value (Richard D., 2008). Rancidity in unsaturated fats and oils can be detected by looking for peroxide in the samples. Primary oxidation is the phrase used to describe oxidation in its early phases. Autoxidation is aided by the presence of double bonds in fats and oils. High-unsaturated oils are the most vulnerable to autoxidation. A measurement of peroxide value is the best way to check for autoxidation. To evaluate peroxide value, milliequivalents per kg of fat or oil are commonly used. When potassium iodide reacts with the peroxide in the oil or fat, the amount of iodine released is measured.

V. CONCLUSION

There is also an interchange of components between the oil and the food, which causes chemical reactions, during frying. Heat transmission between the media usually helps with this. However, the refractive index of sesame oil is stable between 1.4722 and 1.4723 from its initial value. The RI of sesame oil does not change much after repeated frying. The oil's refractoriness and peroxide value were measured to determine its state of degradation. Repeated frying increases the oil's PV and RI, according to the study. The mean RI values of palm olein and sunflower oil differ significantly ($p \leq 0.05$). The refractive index of oil is moderately affected by the peroxide values, as shown by correlation and regression. Sunflower oil's average PV rose from 10.6359 mEq/kg to a final 19.3101 mEq/kg after the third batch of chips was fried, while sesame oil's average PV rose from 3.9914 mEq/kg to 11.3095 mEq/kg. Everyone should be concerned about this, because good health is the foundation of a fulfilling life. Rancidity may have no effect on the food's texture. There is a strong correlation between this deterioration and health issues such as cell damage. The loss of vitamins B and E from the body occurs as a result of ingesting rancid oils. Other consequences include hastened ageing, increased cholesterol, and obesity. Other oxidation products are known carcinogens. Vegetable oils used in frying should be disposed after only one usage.

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