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Investigation of the Physical and Chemical Properties of Different Species of Onion

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Abstract

An investigation on the physical and chemical properties of white, red, and brown onions was carried out to assess the potential applications of the different species sampled in this study. The physical properties monitored include refractive index, viscosity, and density. For red onion, the refractive index, viscosity, and density were measured as 1.35322, 1.631 cSt, and 1.1140 g/cm³, respectively. Brown onion exhibited values of 1.3571, 3.045 cSt, and 1.1130 g/cm³, while white onion showed 1.34926, 2.45 cSt, and 1.1036 g/cm³. These measurements indicate variations in optical and flow properties among the species, which may influence their suitability for different industrial and medicinal formulations. Regarding chemical properties, the iodine value, saponification value, free fatty acid (FFA), peroxide value, and acid value were evaluated. The iodine values were 15.2802%, 18.092%, and 28.1082% for red, brown, and white onions, respectively, suggesting differences in the degree of unsaturation of oils extracted from each species. The saponification values were determined as 3.927%, 15.708%, and 10.94%, while FFA values recorded were 23.04%, 20.48%, and 11.264% for red, brown, and white onions, respectively, indicating differences in hydrolytic stability and potential nutritional quality. Furthermore, the peroxide values were found to be 60%, 55%, and 45%, reflecting the extent of oxidation, whereas the acid values were 2.384%, 2.244%, and 2.106%, providing additional insights into the oil quality and freshness. Overall, the results demonstrate significant variations in both physical and chemical characteristics among the three onion species, highlighting their distinct compositional profiles. These differences suggest that the oils and extracts obtained from these onions possess diverse bioactive properties, making them suitable for applications in pharmaceutical, nutraceutical, and medical industries, particularly in areas such as antioxidant formulations, anti-inflammatory treatments, and natural preservative production. The findings underscore the importance of species-specific evaluation to optimize the use of onion-derived products for targeted industrial and therapeutic applications.

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INTRODUCTION

Established CVD risk factors include dyslipidemia, obesity, hypertension, and diabetes mellitus (WHO. Prevention of cardiovascular disease: Guidelines for assessment and management of cardiovascular risk) [1–5]. The study by Galeone et al. (2009), the first from Mediterranean countries, suggests that a diet rich in onions may have a favorable effect on the risk of acute myocardial infarction; therefore, these vegetables could be useful in a CVD preventive diet [6]. Several biomarkers are measured to predict CVD events including blood lipids levels (LDL-cholesterol and triglycerides), fibrinogen (a marker of thrombosis and inflammation), D-dimer (a marker of thrombosis), plasminogen-activator inhibitor type1 (a marker of

fibrinolytic potential and endothelial function), high-sensitivity C-reactive protein (CRP) (inflammation marker), homocysteine (a marker of endothelial function and oxidant stress), B-type and N-terminal pro–atrial natriuretic peptides, serum aldosterone, plasma renin (markers of neurohormonal activity), and urinary albumin-to-creatinine ratio (a marker of glomerular endothelial function) [7–10].

Alterations in lipid profiles, diabetes, hypertension, and obesity are risk factors conventionally associated with the early appearance of CVD.

Focusing on onion lipid-lowering effects, this vegetable has been reported to exert moderately hypolipidemic effects in experimental animals, such as healthy pigs fed a high-fat diet, and consequently potentially reduce risk indices of CVD and obesity [11–14]. Among bioactive compounds involved in onion hypolipidemic effects, quercetin has been shown to have the ability to reduce serum cholesterol levels and arteriosclerosis severity (Glasser et al., 2002). A recent study also proclaimed the lipid-lowering action of the S-methyl cysteine sulfoxide (SMCS) isolated from *Allium cepa* [15–18]. Onion has also been reported to have hypoglycemic effects [19]. The ability of onions to lower blood cholesterol and lipid peroxidation may be the mechanism by which they have a positive ameliorating effect on diabetic nephropathy. In diabetic rats, dietary onions significantly slowed the progression of renal lesions [20]. Onion hypoglycemic effects have been evaluated in several rat experiments [21, 22]. In animal models of type 2 diabetes mellitus, onion skin was recently found to be useful in reducing hyperglycemia, at least in part because it inhibits alpha-glucosidase activity [23–25].

Complications from thrombosis are a significant factor in CVD. A complex chain of events involving platelets, other cells, and the activation of particular blood proteins known as coagulation factors is necessary for the development of blood clots. A blood clot known as a thrombus is created when Onion inhibits platelet aggregation *in vitro* and *in vivo* [25–30]. The mechanism by which onion exerts its antithrombotic effect has been shown to involve the inhibition of thromboxane A2 formation, a potent inducer of platelet aggregation [28]. The antiplatelet activity observed in onion is influenced by genotype, environmental factors, and genotypically determined sulfur content of the bulb, having onion α-sulfinil-disulfides (cepaenes) demonstrated antithrombotic activity [21].

A mixture of onion juice and honey is applied to the eyes to improve vision and stop cataracts from developing. Although there is no scientific proof, many people in India use this mixture to slow the progression of cataracts and postpone eye surgery. For glaring eyesight, decreased vision, eye infections, occlusions, chalazion, eye floaters, and blurred vision, Ayurveda suggests using onion juice and honey eye drops [27]. By releasing digestive juices and restoring appetite, onions can benefit the digestive tract. As a digestive stimulant, onions increase the synthesis of bile salts and gastric juice, which enhances appetite and relieves indigestion.

A tropical application of onion juice might promote hair development on the scalp and lessen hair loss. The blood flow to the scalp and hair roots is enhanced by onion juice. Onion juice contains sulfur, which aids in the synthesis of collagen tissues. For hair to grow, collagen must be formed. Additionally, onion juice has antimicrobial and anti-dandruff properties that strengthen hairs and lessen scalp infections. Additionally, it keeps hair from thinning [30].

Onions are also known to be part of the dietary requirements of individuals who suffer from high blood sugar levels, as they are known to naturally bring down these high blood sugar levels. Medicinal uses of onions also include its effectiveness in the prevention of cancer. The sulphides present in onions are known to offer protection against the growth of tumors. The benefits of onion juice also include the use of onions to increase bone density and strengthen connective tissue. Hence, onions are usually recommended for women at the time of menopause as they tend to lose bone density [22]. The anti-inflammatory benefits offered by onions also contribute to yet another one of the medicinal uses of onions, as this anti-inflammatory property is useful in dealing with allergic airway inflammation or rheumatoid arthritis.

Numerous epidemiologic studies, mostly case-control, have evaluated the relationship between eating Allium vegetables and cancer risk [12]. These studies are often more consistent in stating that onions have a preventive effect against stomach cancer. But eating onions has also been repeatedly linked to a lower risk of colorectal cancer. Furthermore, case-control studies have shown that eating onions lowers the chance of developing lung and brain cancer. There was a substantial negative correlation between the risk of stomach cancer and onion consumption. In the European Prospective Investigation into Cancer and Nutrition (EPIC-EURGAST), a recent study found that eating more vegetables, especially those high in alliums, may protect against intestinal gastric cancer [24]. Most case-control studies on onions were carried out in China, with a few also taking place in Asia and Europe. The Netherlands was the site of a cohort study. The antibacterial qualities of onions may contribute to their chemopreventive effects against esophageal and stomach cancers. Reduced Helicobacter pylori, less nitrate being converted to nitrite in the stomach, and a lower chance of endogenous synthesis of carcinogenic N-nitroso compounds are all possible outcomes of inhibiting bacterial growth in the gastric cavity.

MATERIALS AND METHODS

Materials and Equipment

The following materials and equipment were used for the investigation, as stated below:

- *Apparatus Used for the Experiment:* Distillation Flask (5 liters), 5000 mls receiving flask, heating mantles (2), water flexible hose, condensers (2), retort stands, clamps, knives, stainless containers, distilled water, sodium methasulfide, recovery containers, MS GC, and digital test kit for physiochemical test, Burette, pipette, beakers, conical flask, reagents, etc.

Sample Collection

The onion (*allumcepa*) was obtained from the fruit garden market D-line Port Harcourt and then transported to the department of Chemical/Petrochemical laboratory, Rivers State University, for analysis. After processing, 23.5 kg was used for the extraction of the essential for the three varieties of the onion.

Experimental Set-Up

The experiment was conducted using the *steam distillation method*, which is one of the most common techniques for extracting and isolating essential oils from plant materials for use as natural products. In this process, steam vaporizes the volatile compounds present in the plant material, which are then condensed and collected as essential oils.

Experimental Procedure: Steam Distillation Process

i. A large stainless-steel container known as a *still* was used to hold the plant sample, and steam was introduced into it.
ii. Steam was injected through an inlet into the sample containing the desired oil. The heat released the aromatic molecules from the plant material, converting them into vapor.
iii. The vaporized compounds were directed into a condenser – a cooling flask equipped with an inlet and outlet to allow cold water to enter and hot water to exit. This process cooled the vapor, converting it back into liquid form.
iv. The condensed liquid, containing both water and essential oil, dripped from the condenser into a receptacle known as a *separator*. Since oil and water are immiscible, the essential oil floated on top and was siphoned off into a receiving flask.
v. The volume of essential oil recovered from the 23 g sample was measured and recorded.5kg used for extraction was 1.3 liters for brown onion, 1.5 liters for white onion, and 1.2 liters for red onion, respectively.
vi. From the estimate and available information, 250 mL of the onion oil costs ₦5,500. Which means that the onion, which was bought at an amount of ₦7,500 could yield a minimum income of ₦5,500 x5 = ₦27,500.00; therefore, the profit margin is very encouraging.

Sample Analysis

The analysis was conducted in two parts:

i. Physical properties of the essential oil analysis. This comprises the following: viscosity, flash point, refractive index, and specific gravity of the oil.
ii. Chemical properties of the oil analysis, comprising the following: saponification value, peroxide value, free fatty acid value, iodine value, and pH.

PHYSICAL PROPERTY ANALYSIS

Viscosity

Viscosity is defined as the internal resistance of a fluid to flow. Quantitatively, it represents the force acting on a unit area of a fluid layer when the velocity gradient between adjacent layers is equal to 1 s^{-1} at a given fluid density.

Apparatus

i. Viscometer cup with capillary and ball valve.
ii. Constant temperature bath with stirrer.
iii. Redwood flasks (50 mL).
iv. Stopwatch.
v. Thermometer.

Procedure

i. Fill the oil sample into the viscometer cup.
ii. Adjust the bath temperature to the desired value by heating or adding ice water, ensuring uniform temperature using the stirrer.
iii. When the temperature becomes constant, open the ball valve briefly to allow some fluid to flow until the level indicator tip just touches the liquid surface.
iv. Position a 50 mL receiver (Redwood flask) beneath the outlet.
v. Using a stopwatch, record the time taken for 50 mL of oil to flow into the flask.

Density and Specific Gravity

The density of a substance – whether solid or liquid – is a key physical property used to assess its quality. Each essential oil has a characteristic density that influences its yield and purity. Since density is temperature-dependent, an increase in temperature causes the volume to expand while the mass remains constant, thereby reducing the density.

Although density and specific gravity are commonly used for classifying fats and oils, they are not highly distinctive parameters for characterization except in certain cases, such as high-density oils, like castor oil or hydrogenated castor oil.

$$SG = \frac{\text{Density of substance}}{\text{Standard Density of water}}$$

Methods of Obtaining Density and Specific Gravity

- Hydrometer method.
- Pycnometer method (specific gravity bottle or density bottle).

Pycnometer Method

1. The empty density bottle weighed using an analytical balance.
2. The bottle was filled with the oil sample, and the weight was recorded.
3. Any spills were carefully cleaned to avoid errors.
4. The mass of the oil and the volume of the bottle were used to calculate the density.

Refractive Index

The refractive index (RI) is defined as the ratio of the velocity of light in a vacuum to its velocity in a medium, in this case, oil. Typically, it is measured using a light of known wavelength (usually 589.3 nm, the sodium D-line). RI is an important property for identifying oils, determining purity, monitoring reactions such as catalytic hydrogenation and isomerization, and analyzing binary esters.

Procedure

1. Switch on the refractometer's lamp.
2. Open the prism box by releasing the toggle and swinging it to the left.
3. Clean the prisms with acetone and cotton wool.
4. Place 3–5 drops of the oil sample onto the fixed prism and close the apparatus.
5. Look through the upper telescope and turn the control knob until the field is divided into light and dark areas.
6. Eliminate color dispersion by adjusting the dispersion drum until a clear, high-contrast field is observed.
7. Align the border line exactly with the eyepiece intersection.
8. Record the scale reading from the lower telescope, interpolating the fourth decimal if necessary.

Chemical Property Analysis: Free Fatty Acid (FFA) Determination

FFA value is an important parameter for evaluating oil quality. Oils naturally contain some free fatty acids, which increase over time during storage and transport. The nutritional and physical properties of oils depend in part on their FFA content, which is determined by the fatty acid composition of their triglycerides.

Procedure

9. Weigh 2.5 g of the oil sample into a conical flask.
10. Add 100 mL of neutralized alcohol.
11. Add 2 drops of phenolphthalein indicator.
12. Titrate with 0.1 N NaOH until a pink endpoint is observed.
13. Record the titer value for calculations.

Hydrogen Ion Concentration (pH)

The pH indicates the relative acidity or alkalinity of the oil. Two methods are commonly used:

- *Electrometric method* using a pH meter.
- *Colorimetric method* using litmus paper.

Procedure (Electrometric Method)

1. Assemble the pH meter and oil sample.
2. Turn on the pH meter and allow it to warm for 15 minutes.
3. Standardize the electrode using a buffer solution of pH 4 or 7.
4. Measure 100 mL of oil in a 250 mL beaker.
5. Immerse the electrode, ensuring the lower part reaches the bottom of the beaker.
6. Take the reading and record it.
7. Remove the electrode and clean with distilled water.

Saponification Value

The saponification value represents the milligrams of potassium hydroxide required to saponify 1 g of fat. It indicates the average molecular weight or chain length of fatty acids in the oil.

Procedure

1. Measure 4 g of oil into a conical flask containing 50 mL of alcoholic potash.
2. Heat the flask for 1 hour while shaking.
3. After cooling, add 2 drops of phenolphthalein; a pink color will appear.
4. Titrate with 0.5 N HCl until the pink color disappears.
5. Perform a blank determination using distilled water in the same manner.

Calculation

$$\text{Saponification Value (SV)} = \frac{(V_{\text{blank}} - V_{\text{sample}}) \times N \times 56.1}{\text{Weight of sample}}$$

where:

- V_{blank} = titration volume of blank.
- V_{sample} = titration volume of sample.
- N = normality of HCl.

Peroxide Value

Peroxide value measures the extent of oxidation in oils and fats, expressed in milliequivalents of peroxide per 1,000 g of sample. It is an indicator of oil deterioration: higher peroxide values suggest poor-quality oil and correlate with increased FFA levels. Peroxide value is particularly useful for monitoring the stability of oils such as palm oil.

Procedure

i. Measure 2.0 g of oil into a 250 mL conical flask.
ii. Add 50 mL of acetic acid and chloroform solution and swirl.
iii. An amount of 0.5 mL of potassium iodide was added and shaken vigorously for 1 minute.
iv. Then add 30 mL of distilled water, titrate with sodium thiosulphate until the yellow color disappears.
v. Do the same for blank.

Iodine Value of the Oil

Iodine value is a measure of the total number of double bonds present in fats and oils. It is expressed as the number of grams of iodine that will react with the double bonds in 100 g of fats or oil. It can be determined in fats and oils with thermometric titration, by dissolving a weighed sample in a non-polar solvent and then adding glacial acetic acid.

Procedure

i. Measure 5 g of oil into a 500 mL flask.
ii. Add 20 mL of carbon tetrachloride (ccl4) into the flask containing the oil; add 25 mL of Wijs reagent solution.
iii. Prepare 9 g of iodine in 1liter of glacial acetic acid.
iv. Add 10 mL of iodine acetic acid solution into the 500 mL flask.
v. Shake vigorously for 1 minute.
vi. The flask is then stored for 30 minutes in a dark locker.
vii. After which, 20 mL of potassium iodide (KI) solution followed by 100 mL of distilled water was added into the flask.
viii. The solution was titrated against 0.1N Sodium thiosulphate (Na_2SO_3).
ix. An amount of 0.5 mL of starch solution was added after the first titration.
x. And titrate again with 0.1N (Na_2SO_3).
xi. Do the same for the blank with distilled water.

RESULTS AND DISCUSSION

The results obtained from the research are presented in Tables as demonstrated below:

Physical Properties Analysis, Results, and Calculations of the Essential Oil

The physical parameters monitored include refractive index, viscosity, and density of the three species of the onion sampled, and the obtained results are shown below. Also, the computational approach for each of the parameters examined was well demonstrated in this research.

Table 1 demonstrates the refractive index value of the three different varieties of onion species sampled, and the result obtained revealed an increase in the following order: Brown onion > Red onion > White onion. The calculation in terms of the determination of density results and calculations of the three onion species are illustrated as shown below.

Table 1. Refractive index of the three onion species.

Sample	Scale Value	Refractive Index
Red	5.4	1.35322
Brown	5.8	1.3571
White	5.0	1.34926

For Red Onion

Empty pycnometer = 17.0329 g.

pycnometer + liquid = 44.8830 g.

Volume of pycnometer = 25 mL.

From the formula:

$$\text{Density} = \frac{\text{Wt of empty pycnometer \& liquid} - \text{empty pycnometer}}{\text{Volume of pycnometer}}$$

$$\text{Density} = \frac{44.8830 - 17.0329}{25}$$

$$= 1.1140 \text{ g/cm}^3.$$

For Brown Onion

Empty pycnometer = 17.0329 g.

pycnometer + liquid = 44.8585 g.

Volume of pycnometer = 25 mL.

From the formula:

$$\text{Density} = \frac{\text{Wt of empty pycnometer \& liquid} - \text{empty pycnometer}}{\text{Volume of pycnometer}}$$

$$\text{Density} = \frac{44.8585 - 17.0329}{25}$$

$$= 1.1130 \text{ g/cm}^3.$$

For White Onion

Empty pycnometer = 17.0329 g.

pycnometer + liquid = 44.6220 g.

Volume of pycnometer = 25 mL.

From the formula:

$$\text{Density} = \frac{\text{Wt of empty pycnometer \& liquid} - \text{empty pycnometer}}{\text{Volume of pycnometer}}$$

$$\text{Density} = \frac{44.6220 - 17.0329}{25}$$

$$= 1.1036 \text{ g/cm}^3.$$

The determination of viscosity results and calculations of the three onion species (using capillary viscometer method) is demonstrated below:

For Red Onion

No. 150ASTM capillarity viscometer constant (0.035).

Time = 46.61 sec.

Viscosity = viscometer reading (sec) * constant

46.61 * 0.035 = 1.63135Cst

For Brown Onion

No. 150ASTM capillarity viscometer constant (0.035).

Time = 87sec

Viscosity = viscometer reading (sec) * constant

87 * 0.035 = 3.045 Cst

For White Onion

No. 150ASTM capillarity viscometer constant (0.035).

Time = 70 sec.

Viscosity = viscometer reading (sec) * constant

70 * 0.035 = 2.45Cst.

Tables 2 and 3 show the result of the physical properties of the density and viscosity of the essential oil. These physical properties determine the quality of the oil. The order of magnitude of the three different species of the onion revealed Red > Brown > White in terms of density whereas in terms of viscosity is obtained result demonstrates Brown onion > White onion > Red onion.

Table 2. Density results for the three onion species.

Sample	Density (g/cm^3)
Red	1.1140
Brown	1.1130
White	1.1036

Table 3. Viscosity results in the three onion species.

Sample	Viscosity (Cst)
Red	1.63
Brown	3.05
White	2.45

Chemical Properties Analysis, Results, and Calculations of the Essential Oil

The chemical properties of the different species of the onion are determined by the application of a known concept as illustrated below:

Determination of Iodine Value of the Essential Oil, Results, and Calculations for the Three Onion Species

For Red Onion

$$\text{I V} = \frac{(\text{TV of Blank} - \text{TV of sample}) * \text{N} * 12.9}{\text{Weight of sample}}$$

where:

N = 0.1.

Weight of sample = 4 g.

Titer value (TV) of sample = 25.7.

(TV) of blank = 93.4.

$$\text{I V} = \frac{(93.4-25.7) * 0.1 * 12.9}{4}$$

= 15.2802%.

For Brown Onion

$$\text{I V} = \frac{(\text{TV of Blank} - \text{TV of sample}) * \text{N} * 12.9}{\text{Weight of sample}}$$

where:

N = 0.1.

Weight of sample = 4 g.

Titer value (TV) of sample = 37.3.

(TV) of blank = 93.4.

$$\text{I V} = \frac{(93.4-37.3) * 0.1 * 12.9}{4}$$

= 18.092%.

For White Onion

$$\text{I V} = \frac{(\text{TV of Blank} - \text{TV of sample}) * \text{N} * 12.9}{\text{Weight of sample}}$$

where:

N = 0.1.

Weight of sample = 4 g.

Titer value (TV) = 4.8.

(TV) of blank = 93.4.

$$\text{I V} = \frac{(93.4-4.8) * 0.1 * 12.9}{4}$$

= 28.1083%.

Determination of Saponification Value of the Essential Oil, Results, and Calculations
For Red Onion

$$\text{S V} = \frac{(\text{TV of Blank} - \text{TV of sample}) * \text{N} * 56.1}{\text{Weight of sample}}$$

where:

N = 0.5.

Weight of sample = 10 g.

Titer value (TV) of sample = 22.5.

(TV) of blank = 23.9.

$$S V = \frac{(23.9-22.5) * 0.5 * 56.1}{10}$$

= 3.927%.

For Brown Onion

$$S V = \frac{(\text{TV of Blank} - \text{TV of sample}) * N * 56.1}{\text{Weight of sample}}$$

where:

N = 0.5.

Weight of sample = 10 g.

Titer value (TV) of sample = 18.3.

(TV) of blank = 23.9.

$$S V = \frac{(23.9-18.3) * 0.5 * 56.1}{10}$$

= 15.708%.

For White Onion

$$S V = \frac{(\text{TV of Blank} - \text{TV of sample}) * N * 56.1}{\text{Weight of sample}}$$

where:

N = 0.5.

Weight of sample = 10 g.

Titer value (TV) of sample = 20.0.

(TV) of blank = 23.9.

$$S V = \frac{(23.9-20.0) * 0.5 * 56.1}{10}$$

= 10.94%.

Determination of Free Fatty Acid (FFA) of the Essential Oil, Results, and Calculations

For Red Onion

$$FFA = \frac{TV * N * 25.6}{\text{Weight of sample}}$$

where:

N = 0.5.

Weight of sample = 5 g.

Titer value (TV) = 9.

$$\text{FFA} = \frac{9 * 0.5 * 25.6}{5}$$

= 23.04%.

For Brown Onion

$$\text{FFA} = \frac{\text{TV} * \text{N} * 25.6}{\text{Weight of sample}}$$

where:

N = 0.5

Weight of sample = 5 g.

Titer value (TV) = 8.

$$\text{FFA} = \frac{9 * 0.5 * 25.6}{5}$$

= 20.48%.

For White Onion

$$\text{FFA} = \frac{\text{TV} * \text{N} * 25.6}{\text{Weight of sample}}$$

where:

N = 0.5.

Weight of sample = 5 g.

Titer value (TV) = 4.4.

$$\text{FFA} = \frac{4.4 * 0.5 * 25.6}{5}$$

= 11.264%.

Determination of Peroxide Value of the Essential Oil, Results, and Calculations
For Red Onion

$$\text{PV} = \frac{(\text{TV of blank} - \text{TV of sample}) * \text{N} * 1000}{\text{Weight of sample}}$$

where:

N = 0.5.

Weight of sample = 10 g.

Titer value (TV of Blank) = 2.0.

Titer value (TV) of sample = 0.8.

$$\mathrm{PV} = \frac{(2.0 - 0.8) * 0.5 * 1000}{10}$$

= 60%.

For Brown Onion

$$\mathrm{PV} = \frac{(\text{TV of blank} - \text{TV of sample}) * \mathrm{N} * 1000}{\text{Weight of sample}}$$

where:

N = 0.5

Weight of sample = 10g

Titer value (TV of Blank) = 2.0

Titer value (TV) of sample = 0.9

$$\mathrm{PV} = \frac{(2.0 - 0.9) * 0.5 * 1000}{10}$$

= 55%.

For White Onion

$$\mathrm{PV} = \frac{(\text{TV of blank} - \text{TV of sample}) * \mathrm{N} * 1000}{\text{Weight of sample}}$$

where:

N = 0.5.

Weight of sample = 10 g.

Titer value (TV of Blank) = 2.0.

Titer value (TV) of sample = 1.1.

$$\mathrm{PV} = \frac{(2.0 - 1.1) * 0.5 * 1000}{10}$$

= 45%.

Determination of Acid Value of the Essential Oil, Results, and Calculations
For Red Onion

$$\mathrm{AV} = \frac{\mathrm{TV} * \mathrm{N} * 56.1}{\text{Weight of sample}}$$

where:

N = 0.5.

Weight of sample = 10 g.

Titer value (TV) = 0.85.

$$\text{AV} = \frac{0.85 * 0.5 * 56.1}{10}$$

= 2.384%.

For Brown Onion

$$\text{AV} = \frac{\text{TV} * \text{N} * 56.1}{\text{Weight of sample}}$$

where:

N = 0.5.

Weight of sample = 10 g.

Titer value (TV) = 0.8.

$$\text{AV} = \frac{0.8 * 0.5 * 56.1}{10}$$

= 2.244%.

For White Onion

$$\text{AV} = \frac{\text{TV} * \text{N} * 56.1}{\text{Weight of sample}}$$

where:

N = 0.5.

Weight of sample = 10 g.

Titer value (TV) = 0.75.

$$\text{AV} = \frac{0.75 * 0.5 * 56.1}{10}$$

= 2.104%.

These physicochemical properties reflect the quality of the essential oil and can be used to assess its quality.

From the analysis conducted on the essential oil after preservation, it is observed that the concentration of (0.4 g) is the best to be used in preserving the essential oil due the fact that it retained all the properties possessed by the fresh essential oil from the onion.

Some of the physical properties are as follows:

- Color.
- Fragrance.

- Taste, etc.

Also, the results for the 0.2 concentration are in agreement with those of the fresh oil, which is better than the other concentrations.

CONCLUSIONS

From the analysis conducted on the essential oil after preservation, it is observed that the concentration of (0.4 g) is the best to be used in preserving the essential oil since it retained all of the properties possessed by the fresh essential oil from the onion.

Also, the research revealed that the chemical properties of the 0.4 g concentration are in conformity to those of the fresh oil, which is better than the other concentrations. This is also recommended for preservation. However, from the research, the influencing component to the yield is attributed to weight, time, and operating temperature and the investigation revealed that BROWN ONION showed the optimum condition for the efficient production processes of the essential oil, which is recommended for the extraction.

This research has outlined the possible outcomes and usefulness of the oil extracted from the three species of the onion sampled. Indeed, diets rich in fruit and deep-yellow vegetables, dark-green vegetables, and onions and garlic are modestly associated with reduced risk of colorectal adenoma, a precursor of colorectal cancer. Decreased risk for colorectal cancer with the consumption of onion was generally found in case control studies.

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