International Journal of
Chemical Separation Technology

ISSN: 2456-6691
Volume 11, Issue 2, 2025
July–December
DOI (Journal): 10.37628/IJCST

https://journalspub.com/journal/ijcst/

Research IJCST

Brown Onion Oil Characteristics of Medicinal Integrity by Looking at the Extraction Operating Conditions

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Abstract

New forms of disease are increasingly affecting people living in today's highly pressure environment, and these diseases are less responsive to conventional treatments. Aromatic plants and species are used for thousands of years for many purposes, such as medicine, perfumes and cosmetics, as well as in the food industry for culinary and medicinal uses. The brown onion shows the following physic and chemical properties as determined experimentally as Refractive index of 1.3571, Density value of 1.1130 g/cm^3, 1.1036 g/cm^3, viscosity of value of 3.045 Cst for brown, Iodine value of 28.108, Peroxide value of Saponification value of 15.708% and 10.94%, and Free fatty acid of 20.48%. The yield of the oil from the process of steam extraction of the brown onion mesh charged into the distillation is dependent on the operating temperature and distillation time. The research further revealed that the increase in the quantity of oil extracted is also dependent on the mass or the weight of the brown onion mesh introduced into the distillation column. These findings highlight the growing interest in natural aromatic sources for potential health applications, especially as modern lifestyles contribute to rising disease challenges. Brown onion oil, with its distinct physicochemical characteristics, offers valuable insights into future research aimed at improving extraction efficiency and exploring therapeutic potential. By optimizing processing conditions, researchers can enhance yield, purity, and consistency, making the oil suitable for broader industrial use. Continued investigation may reveal additional benefits, strengthening its relevance across medical, nutritional, and cosmetic fields today.

Keywords: Brown onion oil, medicinal, integrity, extraction, operational, distillation column

INTRODUCTION

Brown onions are known to go well with almost any kind of cooking because of their all-purpose flavor [1]. Onion is one of the most widely grown species of the genus Allium, which is also known by other names, including garden onion, bulb onion, common onion, mustard onion, green onion and spring onion [2, 3]. Onion is essentially a group of modified leaves of the onion plant, centered on a relatively short stalk [4]. In addition to the onion itself, the stems are another useful part of the plant and are usually very tasty and beneficial for health, particularly when eaten when tender and young [5]. Regarding their nutritional and medicinal uses, onions are known to be excellent sources of fiber, chromium, biotin, vitamin B6 and C [6]. Onion is also known to contain high levels of vitamins K and B1 and of folic acid. The various health benefits of onion juice or even whole onions are due to the presence of several organic compounds and flavonoids released by the crushing or cutting of the onion [7].

Extensive experimental and clinical studies have been carried out by scientists worldwide to find

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Received Date: March 18, 2025
Accepted Date: June 27, 2025
Published Date: August 16, 2025

Citation: Joy Chukwuemeka Peter Ukpaka, Tinuola H. Udoh, Chukwuemeka Peter Ukpaka. Brown Onion Oil Characteristics of Medicinal Integrity by Looking at the Extraction Operating Conditions. International Journal of Chemical Separation Technology. 2025; 11(2): 41–51p.

some potential compounds with low toxicity and high efficacy that could be beneficial to human health [8]. Numerous studies have been conducted on the medicinal product's therapeutic uses. However, the species vary widely from country to country and from one denomination to another [9–12]. The onion production in Nigeria may, therefore, differ significantly from that in China and other countries due to various factors such as geo-climatic location, soil type, plant life stage, pollution and harvesting time and day [13–16]. Although onion is widely used in cooking and in some traditional medicines in Nigeria, no studies have been conducted. Some studies have been conducted worldwide on vegetable oil compared to mineral oil [17, 18].

Not many people think of onions as a source of high blood pressure or fungal infections, but, like its cousin garlic, onions have many properties that have been shown to be useful in the treatment of hypertension and fungal infections [19–22]. Heavy metals present in the environment can easily contaminate many medicinal products, such as Onion, during their manufacturing and growth processes in the manufacture of the ready-to-use products. Heavy metals are present in the air, soil and water and examples are rainfall from this source, atmospheric dust fertilizers and plant protection products [23–25]. Because onion has many therapeutic uses, good quality control is essential to protect consumers from harmful substances [26] from the sacred root extract [27].

MATERIALS AND METHODS

- *Materials:* The following materials were used such as brown onion mesh, crusher, heater, distillation column, steam, condenser, storage unit, capillary tube,
- *Sample Collection:* The brown onion was purchased within Port Harcourt in Port Harcourt Local Government Area of Rivers State and then transported to the Laboratory for analysis.
- *Experimental Set-Up:* The experiment with use of steam distillation column and the concept of steam extraction and distillation methods were applied and the separation of the products were based on their boiling point.

Experimental Procedure

- *Steam Distillation Process:* The sample was placed in a large container called a still, which is made of stainless steel and the steam was added to the container. The steam was injected through the valve into the sample containing the required oil, releasing the aromatic molecules of the sample and converting them into steam. The VAP sample went into a condenser, called a condenser; it had two openings (an entrance and an exit) through which hot and cold water could flow into the condenser. This caused the vapor to cool and transform into a liquid substance. popular belief in popular religion. A by-product of the aromatic liquid is discharged from the condenser and collected in a container under the surface of which is called a separator. Since water and oil do not mix, the essential oil, floating on top of the steam, was drained into the recipient vessel.
- *Sample Analysis:* The physical characteristics of the oil analysis and the process are determined by determining the following, viscosity, flash point, refractive index, specific gravity of the oil and the chemical characteristics of the oil analysis, i.e., saponification, peroxide, free fatty acid and iodine.

Physical Property Analysis

- *Viscosity:* Viscosity is defined as the force exerted on a unit area where the velocity gradient at which the liquid is flowing is equal to 1.
- *Apparatus:* Viscometer cup with capillary and ball valve constant temperature bath with stirring rod redwood bottles 50 ml, stopwatch and thermometer.

Procedure

Pour the oil into the measuring cup and adjust the temperature of the vessel to the required level by heating it or adding ice water or use a blender to adjust the temperature. When the temperature is constant, allow some of the liquid to escape by raising the closed ball valve until the tip of the level indicator touches the surface and then, using the stopwatch, measure the time necessary to fill the redwood flask to 50 cm^3 below the opening.

Density and Specific Gravity

Essentially, the density of solids and liquids can be determined. Each essential oil has its own specific density. It is a physical property used to assess the quality of substances. Oil density determines the yield and quality of the oil. It depends on temperature; if temperature is high, the volume expands, so the mass remains constant while the density decreases.

Although density and specific gravity are the general physical characteristics used to classify fats and oils, neither is very specific for characterization, except for a few high-density oils such as cassaric oil or hydrogenated cassaric oils.

$$SG = \frac{\text{Density of Substance}}{\text{Standard Density of Water}} \frac{\text{Density of Substance}}{\text{Standard Density of Water}}$$

Methods for obtaining density and specific gravity:
- Hydrometer method.
- Pycnometer method (bottle with specific gravity or bottle with density).

PYCNOMETER METHOD

Procedure

The weight of the bottle was measured in terms of density using a weighing scale and then the bottle and liquid were measured and recorded, and the spillage was cleaned to avoid errors. The weights were compared and recorded, and the weight and volume of the bottle were determined.

Determination of Flash Point

Flash point is the lowest temperature corrected to 760 mmHg of the sample pressure at which the application of the ignition source causes the sample vapor to ignite under the test conditions specified. Flashpoint uses three energies: thermal energy, mechanical energy and electricity.

Apparatus

Pensky Martens sealed tester, thermometer (0–360ºC), smoke chamber and filtered sample.

Procedures

The flash-point container has been chemically cleaned and dried to remove any traces of petrol or gasoline. The sample to be tested was measured into the cup until it reached the mark and the cup was placed in the apparatus and fitted with the thermometer and flame, then the heater and the stirring device were switched on, and the temperature was adjusted to about 5–6°C. Test for flash point at 200°C below the flash point specification of the sample stopped the stirring before the flame was lowered, started stirring again after a second, and continued stirring. The flash point of the sample is the temperature at which the test flame causes a distinct flash within the medium.

Refractive Index

The refractive index is the ratio of the speed of light in vacuum to the speed of light in oil, generally expressed as the ratio of the sinusoidal refractive index when a light ray of known wavelength (usually 589.3 mu, the mean of the d-branes of sodium) passes through the oil, and is also useful for determining purity, and for observing the progress of the reaction such as the catalytic hydrogenation and isomerization. Rumor is too often used to describe the rampant hallucinogens.

Procedure

The lamp behind the refractometer was turned on, the box of the prison was opened by a release switch on the right side and turned to the left, and two prisons were cleaned with acetone and cotton wool and placed on the test platform with 3 to 5 drops of oil, and the apparatus closed.

With the eye on the upper telescope, the control knob was turned forward until the field was divided into a light and a dark field, and the boundary line between the fields could be colored by the diffraction of the lamp's light.

The color is removed by rotating the dispersion drum (second button) until a field of good quality contras appears without any red or blue color, and the border line is placed exactly at the intersection of the eye pieces. The scale was observed in the lower telescope, and the fourth number was interpolated over the candle.

CHEMICAL PROPERTY ANALYSIS

Free Fatty Acid Determination (FFA)

The free fatty acid content is an important quality parameter for the quality of the oil. As fats and oils contain a certain amount of free fatty acids (FFA), the acidity always increases over time during transport and storage. The nutritional value of fats and oils depends partly on the amount of free fatty acids that are produced. The physical and chemical characteristics of fats and oils are essentially determined by the fatty acid composition of their triglyceride's acid constituents.

Procedures

2.5 g of the oil sample was weighed into the conical flask and 100 ml of neutralized alcohol was added, followed by 2 drops of phenolphthalein indicator and titrated with 0.1 N NaOH until a pinkish coloration was seen and the result obtained was recorded.

Hydrogen Ion Concentration (pH)

The pH of the oil determines its relative acidity or alkalinity. There are two (2) methods, which include the electrometric method (i.e., using a pH meter) and a colorimetric method (i.e., a subtractive methodology) using a standardized word document.

Procedure

The apparatus, the sample and the pH meter were switched on and allowed to warm up for 15 minutes. The electrode was standardized with a standard buffer of pH 4 or 100 ml of oil measured in the measuring cylinder in a 250 ml flask, and the electrode was submerged in the oil, allowing the lower part of the electrode to reach the bottom of the mouth. The sample was taken and recorded, and the electrode was removed and distilled into a solvent.

Saponification Value of Oil

The saponification value is the number of milligrams of potassium hydroxide needed to saponify 1 g of fat in the desired state of the condition. This is the average molecular weight (or length of chain) of all the fatty acids present in the oil.

Procedure

4 g of oil were measured into a circular flask containing 50 ml of alcoholic potash, and the flask was placed on a heater and heated for one hour, after which it was shaken, and two drops of phenolphthalein were added and the color was obtained. This was titrated with 0.5 nHCl until the pink color disappeared and the blank (without oil) was then distilled in the same way.

Calculations

$$Sy = \frac{(\text{titration of blank} - \text{titration of sample}) * \mathrm{N} * 56.1}{Weight\ of\ sample}$$

N = normality of HCl

Peroxide Value of Oil

The peroxide value determines all substances in terms of miliequivalents of peroxide per 1000 g of sample, i.e., miscellaneous (A.C. 1986). Its significance is that it shows the extent of deterioration of palm oil (oil and fats) and that a higher value indicates poor quality oil and favors high free fatty acids (HFA). Peroxide levels explain the degree of deterioration of the oil and provide a hint of the FFA secretions.

Procedure

The measured value of 2.0 g of oil was added to 250 ml of the circular flask, and 50 ml of acetic acid and chloroform solution were added and shaken occasionally for 1 minute. Then, adding 30 ml of distilled water and titrate with sodium thiosulfate until the yellow color disappears, as well as the blank.

Iodine Value of the Oil

The iodine value is a measure of the total number of double bonds present in the triglyceride secretariat of the triglyceride. It is expressed as the number of grams of iodine per Greek alphabet as shown in Table 1 bonds in 100 grams of oil or oil. For fats and oils, it may be determined by thermometric titration by melting the sample in a non-polar solvent and then adding glacial acetic acid.

Table 1. Indication of the iodine letter, uppercase and lowercase.

Letter Name	Uppercase	Lowercase	Letter Name	Uppercase	Lowercase
Alpha	A	α	Nu	N	ν
Beta	B	β	Xi	Ξ	ξ
Gamma	Γ	γ	Omicron	O	o
Delta	Δ	δ	Pi	Π	π
Epsilon	E	ε	Rho	P	ρ
Zeta	Z	ζ	Sigma	Σ	σ
Eta	H	η	Tau	T	τ
Theta	Θ	θ	Upsilon	Υ	υ
Iota	I	ι	Phi	Φ	φ
Kappa	K	κ	Chi	X	χ
Lambda	Λ	λ	Psi	Ψ	ψ
Mu	M	μ	Omega	Ω	ω

Procedure

The result of the extraction of brown onion oil by steam distillation and the physical and chemical properties described in the abstract of the study are shown in the Figure 1. The weight of 5 g of oil was measured in the 500 ml flask and the solution of Wijs solution was added to the prepared 9 g of iodine in 1 liter of glacial acetic acid (CCl4). The heroine was poured into the 500 ml flask and shaken vigorously for 1 minute, after which the bottle was stored in a dark box. After the first titration, 20 ml potassium iodide (KI) solution was added to the flask followed by 100 ml distilled water and the solution was titrated with 0.1 n-ethyltryptamine (Na2SO3). The process was repeated for the distilled water of the gallon.

RESULTS AND DISCUSSION

The result of the extraction process of brown onion oil by steam distillation is shown in the Figure 1 and the physical and chemical characteristics are described in the abstract of the research paper.

Figure 1 shows the trend in brown onion functional parameters as per concentration. The functional parameter of the oil obtained differs, which has been attributed to the weight of the strands of brown onion bulbs introduced into the distillation unit. An increase in the extracted oil extract was found and characterized in the range of 50 to 200 g and a subsequent decrease from 200 g in terms of the volume of extract obtained by the process. The volume of variation in the oil extract can indeed be attributed to the change in the mass distribution introduced into the distillation column and to the effects of time and temperature. The line equation of $F_{Te,}$ and F_{Ti} is expressed as $y = 0.2x + 100$, and $y = 0.2x + 10$, which showcases the contribution of temperature and time dependent in the recovering process, as the square root of its best fit is obtained as $R^2 = 1$, for temperature and time relationship. The line curve expression of volume of oil obtained from the brown onion is expressed as $y = -0.000x^2 + 0.377x + 14$ and the value of $R^2 = 0.990$.

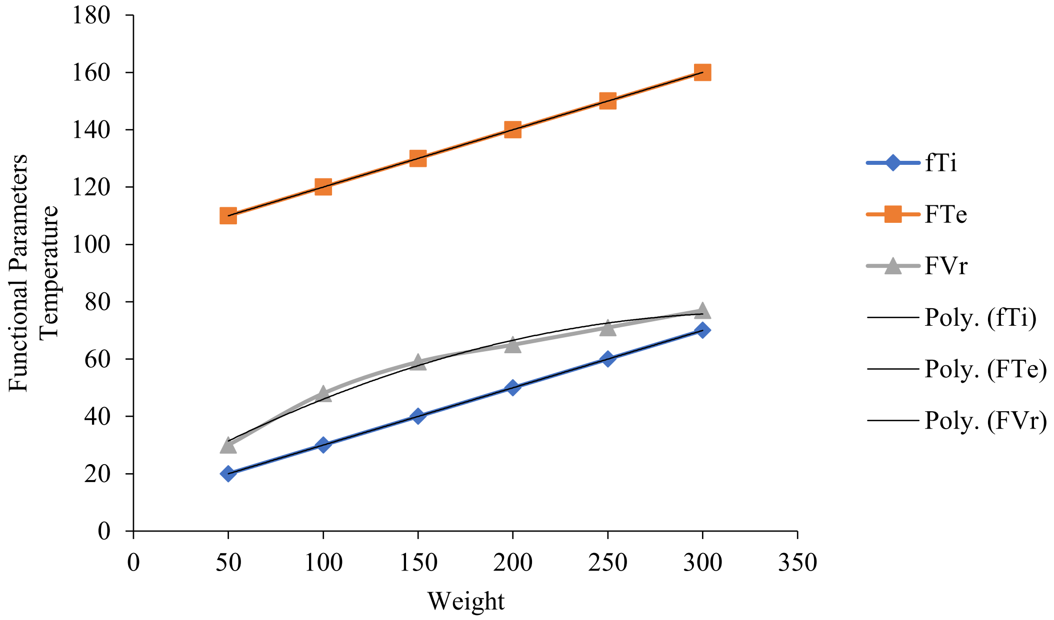

Figure 1. Plot of the functional parameters of the brown onion against different concentrations (variable weight, time and temperature).

Figure 2 shows the concept of functional parameter of mass or weight effect on oil extracted from the distillation unit using the application of steam method. The concentration of oil obtained at times changes in the processing of the brown onion at constant weight of 50 g. Similarly, increase in oil extracted or recovered was viewed and obtained within the operating temperature range of 110 to 130 ^{O}C and this trend of behavior was obtained with increase in time as well as time range of > 0 to < 40 minutes and later decrease in the volume of oil extracted was experienced in the process. The line curve is expressed as y = 1x + 90 and $R^2 = 1$, which shows it as a function of temperature and time. The line curve for oil recovered in terms of volume of the brown onion is expressed as:

$$y = -0.014x^2 + 1.142x + 13 \text{ and } R^2 = 0.803.$$

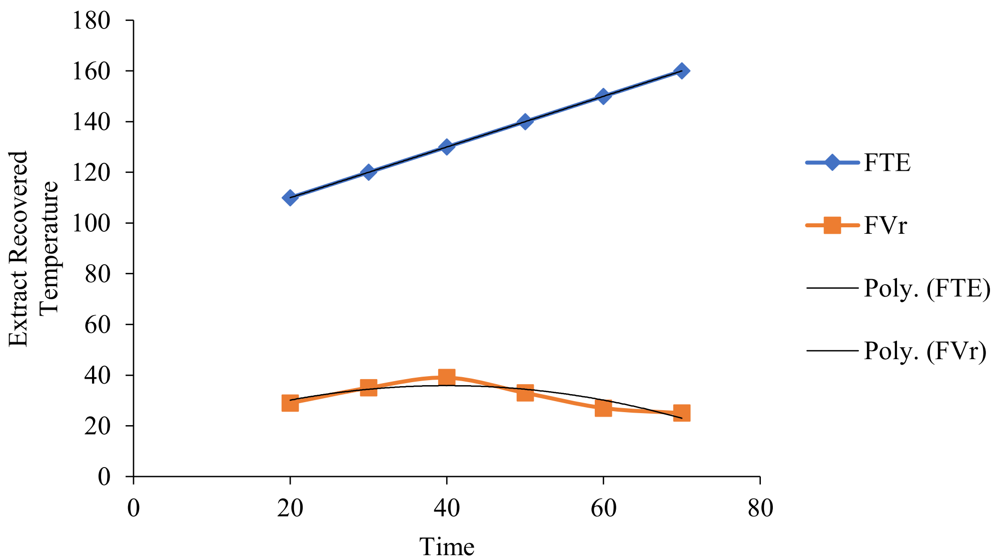

Figure 2. Plot of functional parameter versus time for brown onion at constant weight of 50 g.

Figure 3 demonstrates the potential which was attributed to the functional parameters involved in the production of oil through the mechanism of steam extraction method for recovering oil. Furthermore, it is noticed that trend and the quantity of oil extracted is dependent on extract variation in time and temperature for brown onion at constant weight of 100 g. The investigation shows increase in oil extracted with temperature range of 110 to 130°C and the range of >0 to <40 minutes. However, decrease in oil extracted was noticed at temperature of 50°C. The changes in the oil extracted in terms of volume recovered can be ascribed to changes in the period of extraction time. Indeed, the line equation is defined as $y = 1x + 90$ and $R^2 = 1$, for function of temperature and the line equation for volume of oil obtained from the brown onion is defined as $y = –0.018x^2 + 1.467x + 27.9$ and $R^2 = 0.909$.

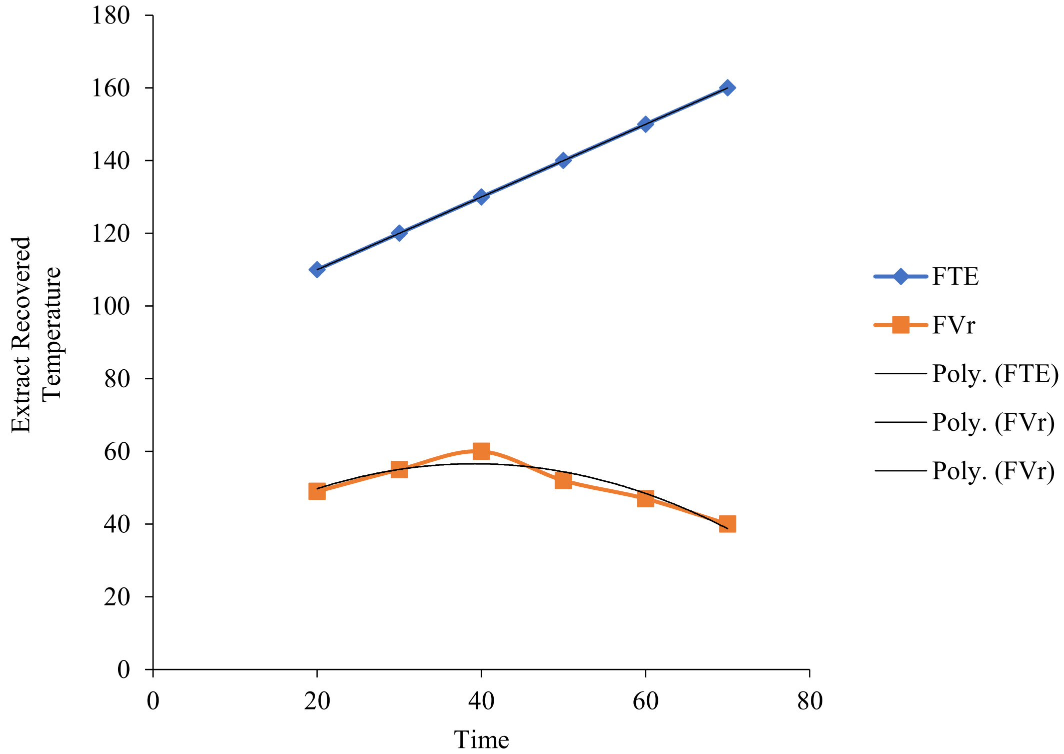

Figure 3. Plot of functional parameter versus time for brown onion at constant weight of 100 g.

Figure 4 shows the functional parameter in terms of oil extracted which is classified as recovered. The extracted oil quantity recovered varies with function of time for brown onion at constant weight of 150 g. The research outcomes revealed increase in quantity of oil extracted or recovered which was dependent on factors such as temperature range of 110 to 1300176°C and time range of >0 to <40 minutes. The equation of the line is written as $y = 1x + 90$ as the $R^2 = 1$, for process temperature control. The line curve for volume control from the brown onion is written as $y = –0.016x^2 + 1.277x + 42.22$ and $R^2 = 0.823$.

Figure 5 shows the conceptual functional parameter of temperature and time effect on oil produced using brown onion charged in the distillation with the application of steam extraction mechanism. The oil extracted is dependent on time as identified from the brown onion at constant weight of 200 g. However, the research integrated the increase in oil extracted as well as recovered as a function of the temperature range of 110 to 140°C as well as time range of >0 to <50 minutes. The difference in the volume of oil extracted or recovered is a result of increase in extraction time. The line equation is written as $y = 1x + 90$ whereas $R^2 = 1$ in the case of temperature and in terms of volume recovered for the brown onion is written as $y = –0.017x^2 + 1.399x + 45.47$and $R^2 = 0.924$.

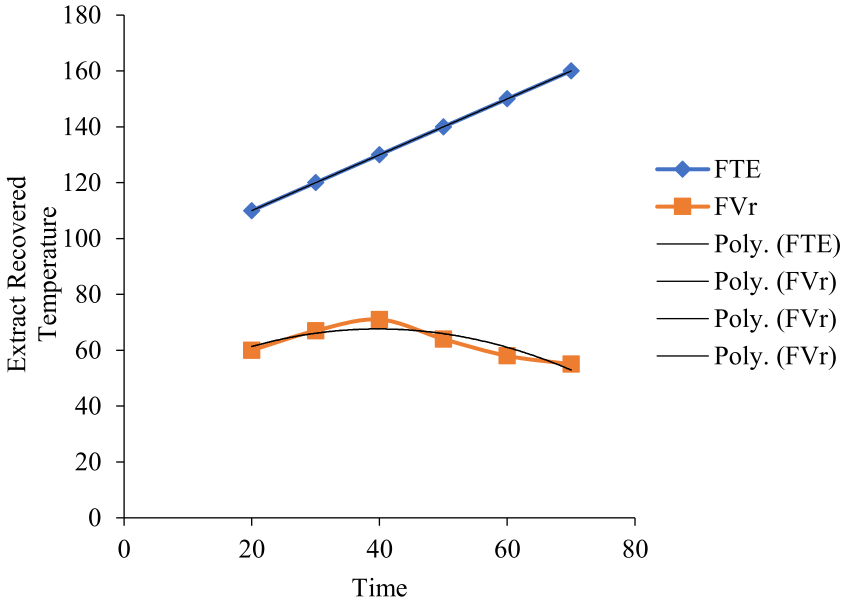

Figure 4. Plot of functional parameter versus time for brown onion at constant weight of 150 g.

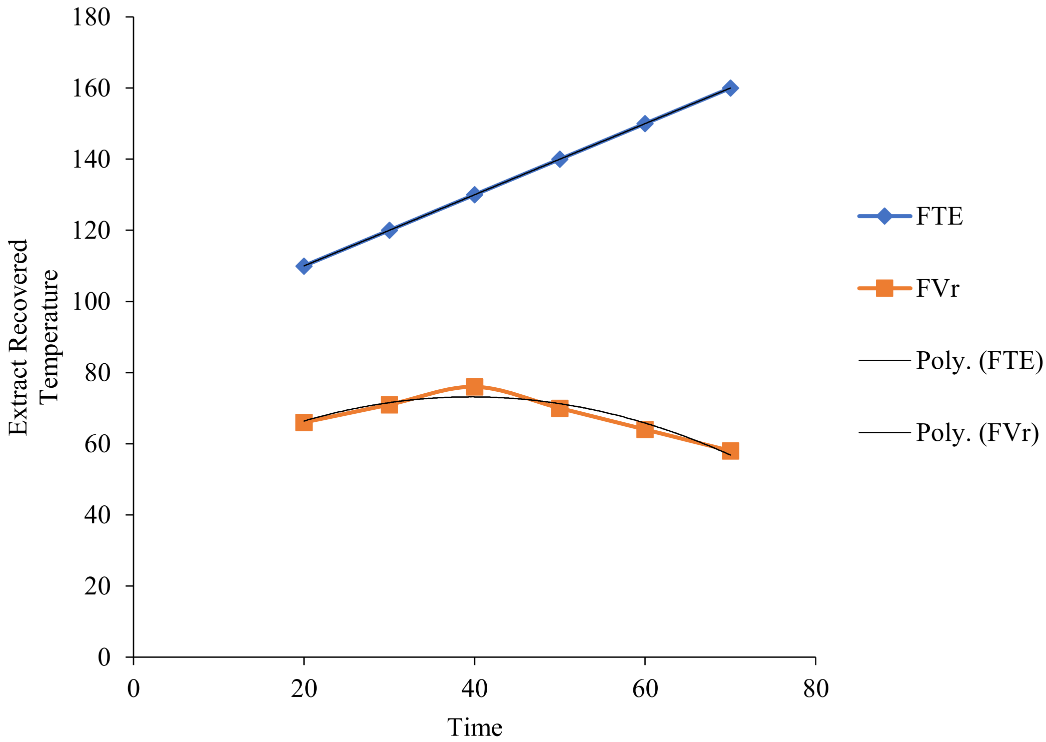

Figure 5. Plot of functional parameter versus time for brown onion at constant weight of 200 g.

Figure 6 showcases the significance of the functional parameter of time and temperature as a controlling factor is the quantity of oil to be extracted through the application of steam extraction concept using distillation column. The potential of the oil extracted revealed that at that time, temperature influenced the brown onion at constant weight of 250 g. Also, the investigation further addresses the effect of increase in oil extracted within the temperature range of 110 to 140°C and time within the range of >0 to <50 minutes. The potential change in the volume of oil extracted could be integrated into potential change in extraction time. The line equation is expressed as $y = 1x + 90$ in which the $R^2 = 1$, as defined for temperature effect as well as for volume extracted from the brown onion is given as $y = –0.019x^2 + 1.678x + 46.14$ and $R^2 = 0.926$.

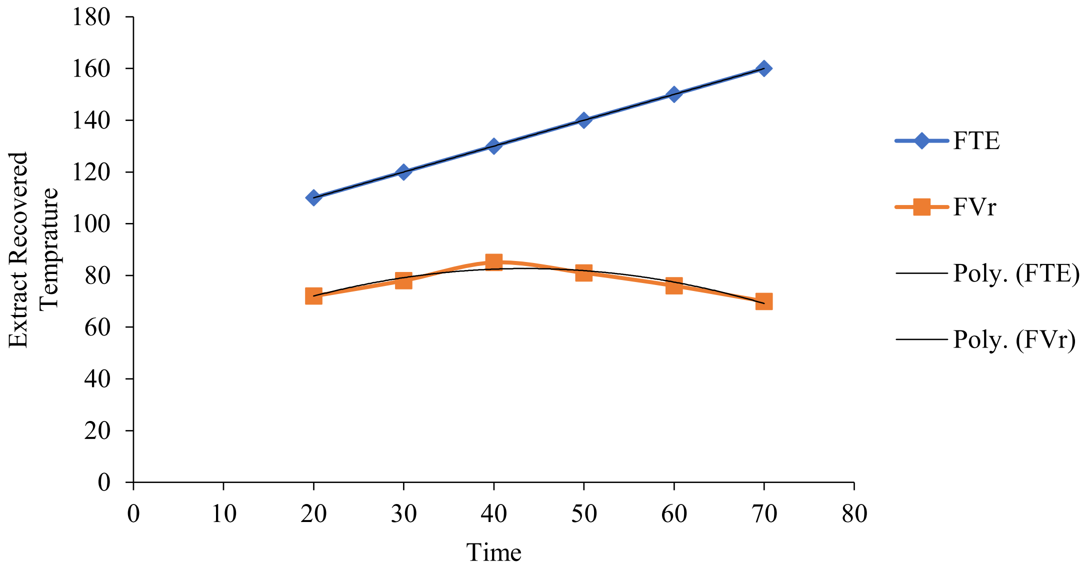

Figure 6. Plot of functional parameter versus time for brown onion at constant weight of 250 g.

Figure 7 shows the massive contribution of weight of the mesh to the functional parameter relationship in oil recovered increased in the extraction at different operating temperature under the condition of brown onion at constant weight of 300 g. Increase in quantity of oil recovered revealed the temperature range of 110 to 130°C is a contributing factor along with increase in time within the range of >0 to <40 minutes. The line curve equation is written as $y = 1x + 90$ and $R^2 = 1$, for the temperature control whereas for volume of oil extracted from the brown onion is written as $y = –0.017x^2 + 1.243x + 61.15$ as the value of $R^2 = 0.796$.

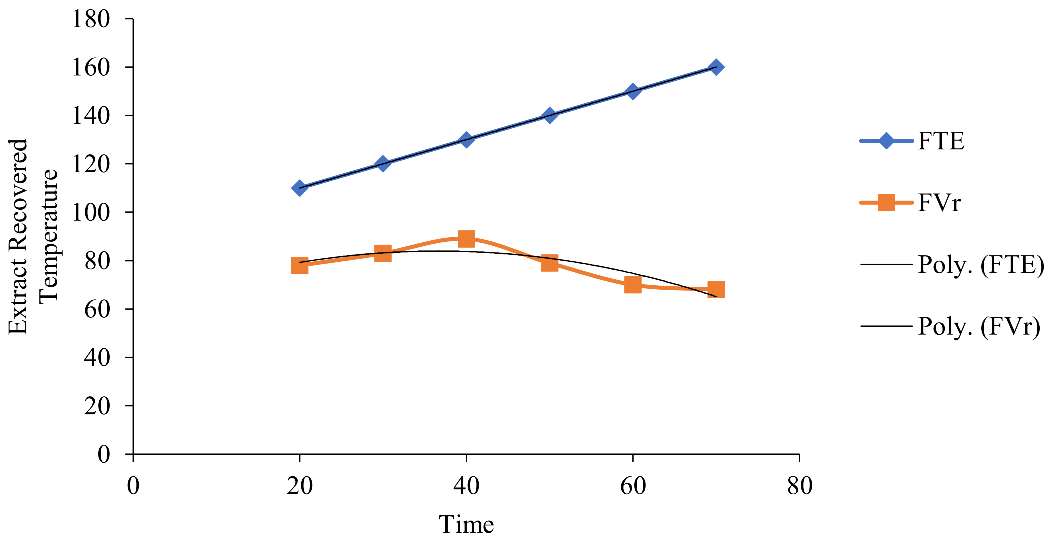

Figure 7. Plot of functional parameter versus time for brown onion at constant weight of 300 g.

CONCLUSIONS

The investigation on the characteristics of the brown onion in terms of the quality and quantity of oil recovered demonstrated that temperature is an influential factor to be monitored during production as well as the operational time.

- The research further revealed that the oil production trend is progressive provided its extracted from the mesh introduced into the distillation column.
- The process ensures that the oil obtained through this mechanism is edible for human utilization in terms of pharmaceutical application, direct utilization for domestic application.
- The oil extracted can be synthesizer for other chemical applications.
- The volume of oil extracted is dependent on the mass of the raw material charged into the distillation as well as the operating conditions.

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