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Solvent Extraction and Quality Evaluation of Two Varieties of Njangsa (Ricinodendron Heudelotii) Seed Oil

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ABSTRACT

Ricinodendron heudelotii (Njangsa) is is a tropical tree, that produces oily seed containing high levels of polyunsaturated fatty acids (PUFAs). In Cameroon, there are two varieties of this tree known and produce an oily seed called "new Njangsa" and "old Njangsa." While significant research has been carried out on the seed's oil, there is a dearth in knowledge regarding the distinctions between the oils obtained from the two seed variants. The objective of this study was to utilize the solvent (hexane) extraction method to extract oil from both seed varieties and subsequently examine the physicochemical properties of the extracted oils. The findings reveal oil yields of 46.96% and 53.29% for new Njangsa seeed oil (NNSO) and old Njangsa seed oil (ONSO) respectively, with a yellow colour that remains liquid at room temperature. The analysis of Njangsa seed oils (NSO) encompassed the assessment of peroxide value, free fatty acid, saponification value, iodine value, moisture, refractive index, carotenoid content, color and fatty acid profile. With the exception of the saponification value, the examined quality parameters were significantly lower ($p < 0.05$) in ONSO compared NNSO. Nevertheless, both oils qualities within the acceptable range for unrefined oils. The primary fatty acids identified in both NNSO and ONSO were α-eleostearic, oleic acid, linoleic acid, palmitic acid and stearic acid, and both oils demonstrated a high level of polyunsaturated fatty acids 69.16% and 76.79%, respectively, predominantly attributed to α-eleostearic (α-ESA), with ONSO exhibiting a higher PUFAs content than NNSO.

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Introduction

Ricinodendron is a member of the Euphorbiaceae family, with only one species known as Ricinodendron heudeloti (Njangsa), according to Tchoundjeu Ricinodendron heudelotii, a tropical tree known for its oily seeds, goes by different names in various African countries. In Cameroon, it is referred to as Njangsa, esangasanga, ezan, kpe, and djansang depending on the region. Léonard, identified two distinct varieties of this tree species: Ricinodendron heudelotii var. Heudelotii and Ricinodendron heudelotii var. Africanum [1].

The tree is highly prized for its seeds and commonly used for thickening and flavouring a wide variety of dishes in Cameroon. The tree produces fruits which when fully matured, is manually collected and processed to extract the seeds and subsequently dried for commercialisation. Traditionally, it takes approximately one to three months to process the fruit in order to obtain the seeds and two varieties of the seeds produced are locally called new Njangsa seed and old Njangsa seed from which oil can be further extracted.

Different researchers accounted for different oil yield ranging from 40.5% to 63.5%. According to several researchers, PUFAs are the most abundant fatty acid, with either linoleic acid or α-ESA being the predominant fatty acid.states that Ricinodendron heudelotii oil contains polyunsaturated fatty acids (PUFAs) with α-ESA (50.3%.) in abundance. Controversially,reported that linoleic acid (60.3%) accounts for the majority of PUFAs. The Njangsa seed oil (NSO) contains other significant fatty acids, including oleic acid, palmitic acid and stearic acid. Also, the diverse range of fatty acids present in these oils contributes to their nutritional value and potential health benefits for humans. Furthermore, the oil contains a variety of biologically active chemicals, nutrients, minerals, vital amino acids, antioxidants, vitamins, PUFAs and omega-3 fatty acids [2-4].

The Central African forests contains numerous oil-bearing trees whose economic potential remains largely untapped and unexplored. One of these is the Njangsa tree, which produces Njangsa seeds and Njangsa seed oil (NSO). Despite being recognized as a significant and economically viable tree in Cameroon, the Njangsa tree is not fully exploited, and the nutritional and economic benefits of its oil remain unclear. Njangsa seeds are mostly utilized for cooking, and its oil is commercially unavailable. Indeed, as highlighted by, this neglected and underutilized oil seeds have the potential to tackle poverty, hunger, and malnutrition. As a result, it is critical to harness knowledge of processing techniques and utilization of NSO in order to fulfil their economic potential in the future [5].

Even though numerous studies have explored Njangsa seed oil (NSO), no clear distinction between the oils extracted from the two seed varieties which could possibly be Ricinodendron heudelotii var. Heudelotii and Ricinodendron heudelotii var. Africanum, have been documented. Although there may be more variants of the seed, only types have been identified and extensively studied in Cameroon. By extracting oil from both seed varieties, additional insights into their oil yield and quality can be gained. Hence, the objective of this study is to extract oil from two varieties of Njangsa seeds sourced from Cameroon and evaluate the quality attributes of their respective seed oils.

Materials and Methods

Materials

The two Njangsa seed varieties locally called new Njangsa and old Njangsa were sourced from Muyuka market, a community in the southwest region of Cameroon. Traditional heat treatment was used to process the seeds out of the fruits, followed by dehulling and sun drying. The reagents for oil extraction and analysis were obtained from the Food Analysis Laboratory in the Department of Food Science and Technology at Kwame Nkrumah University of Science and Technology in Ghana.

Sample Preparation

The Njangsa seeds were ground into a moderately fine powder in a blender (Aspro mixer grinder, India) at room temperature (25°C) t.

Oil Extraction

For fat extraction, AOAC method 948.22 was employed. Approximately 25 grams of dried, ground Njangsa seed was placed into an extraction thimble and inserted into the Soxhlet apparatus (Electrothermal, UK). Subsequently, 200 ml of hexane was added into the round bottom flask. The setup underwent reflux at 60°C for six hours. Following this, the oil and cake were removed from the extractor, and the solvent was evaporated in an oven (Binder, gmbh, Germany) at 60°C for two hours. After cooling in a desiccator, the sample was reweighed to determine the extracted oil's amount (weight loss). The oil was then transferred to a reagent bottle and stored in a fridge (5°C) for subsequent analysis. The percentage of oil yield was calculated relative to the weight of the ground seed.

$$\text{Oil Yield (\%)} = \frac{\text{Weight of oil}}{\text{Weight of sample}} \times 100$$

(i) (ii) (iii)

(iv) (v) (vi)

Figure 1: New Njangsa seed (i), grounded new Njangsa seed (ii), new Njangsa seed oil (iii), old Njangsa seed (iv), grounded old Njangsa seed (v), old Njangsa seed oil (vi)

Quality parameters of Njangsa seed oil (NSO)

Free fatty acid (FFA) and Acid value (AV)

The assessment of free fatty acids followed AOAC international method 969.33 (2016). In a conical flask, 2 grams of NSO were introduced, along with 50 ml of neutralized ethanol, and swirled to ensure complete sample dissolution. Three drops of phenolphthalein indicator were added using a dropper, and the solution was titrated with 0.1 N NaOH solution until the first permanent pink color emerged, with the volume recorded. The calculation of free fatty acid and acid value proceeded as outlined below:

$$\%\text{FFA} = \frac{\text{Titre value} \times \text{normality of NaOH} \times \text{molarmass of oleic acid} \times 100}{\text{Weight of sample} \times 1000}$$

Acid value (AV) = 1.99 x %FFA

Peroxide Value (PV)

The determination of the peroxide value was conducted using the AOCS Official Method Cd 8-53 (2003). Two grams of NSO were measured into a conical flask, followed by the addition of 30ml of a solvent mixture containing glacial acetic acid and chloroform (3:2); the mixture was swirled to completely dissolve the oil samples. Subsequently, 0.25ml of saturated potassium iodide was introduced and swirled for one minute, followed immediately by 30ml of distilled water, shaken vigorously, and then 0.5 ml of 1% starch indicator was added. The resulting mixture was titrated with 0.01 N Na2S2O3 solution until the blue-grey color just disappeared. Alongside the oil samples, a control sample was prepared under same conditions. The peroxide value was computed as follows:

$$\text{Peroxide value (PV)} = \frac{\text{Titre value} * \text{normality of NaOH} * 1000}{\text{weight of sample}}$$

Saponification Value (SV)

Adopting a similar approach as per the, 2 grams of NSO were placed in a conical flask, followed by the addition of 25 ml of 0.5 N ethanolic KOH. The mixture underwent reflux for 30 minutes, cooled to room temperature, then 3 drops of phenolphthalein indicator were included and titrated with 0.5 N HCL continued until the pink color vanished. A parallel blank test was conducted under the same conditions, and the saponification value of the sample was determined using the equation [6].

$$\text{Saponification Value (SV)} = \frac{56.1 \times \text{normality of HCL} \times \text{titre value}}{\text{weigh of sample}}$$

Iodine Value (IV)

The iodine value (IV) was determined following the method outlined in. One gram of oil was placed in a conical flask, and 25 ml of chloroform was added, ensuring complete dissolution. Then, 25 ml of Wijs reagent was introduced, the flask was stoppered and swirled. After keeping the mixture in the dark for an hour, 15 ml of KI solution was added, followed by 100 ml of distilled water and thorough shaking. The released I2 was titrated gradually with 0.1 N Na2S2O3 until the yellow solution turned colourless. Finally, a few drops of 1% starch indicator were added, and titration continued until the blue colour disappeared. A parallel blank test without fat/oil was conducted simultaneously and the calculations was done as follows [6]:

$$\text{Iodine Value (IV)} = \frac{12.69 \times (\text{Volume of blank} - \text{Volume of sample}) \times \text{normality of Na2S2O3}}{\text{weight of sample}}$$

Moisture Content

A modified method from was employed. Two petri dishes were washed, dried in an oven at 105°C for 1 hour, cooled in a desiccator, and weighed. A 2g of the oil sample was placed in the two dry petri dishes, dried in an oven at 105°C for 3 hours, cooled, and weighed. This process was repeated at 2-hour intervals until a constant weight was achieved. The moisture content was calculated using the following expression [6].

$$\text{Moisture Content (\%)} = \frac{(\text{Weight of sample before drying}) - (\text{Weight of sample after drying})}{\text{weigh of sample}}$$

Refractive index

The refractive index was measured using a digital tabletop refractometer (A.KRÜSS Optronic gmbh, Germany). Calibration to zero was done with distilled water, and a small quantity of oil was applied to the glass prism, then closed. The refractive index values were recorded at 30°C.

β-Carotene, and total carotenoid

Adopting the procedure outlined by, 0.1g of the oil sample was carefully weighed into a dry test tube. Subsequently, 10 ml of an acetone-hexane mixture in a 4:6 ratio was added, and votexed. After allowing it to stand for approximately 30 minutes in the dark to facilitate efficient pigment extraction, absorbance (A) readings were taken at wavelengths 663nm, 645nm, 505nm, and 453nm using a UV-Vis spectrophotometer (Mettler Toledo, Switzerland). The following formulas were then applied to compute β-carotene, total carotenoid, chlorophyll a, and b [7].

Chlorophyll a = (A663×0.999) -(A645×0.0989)
Chlorophyll b = (A663×-0.328) + (A645×1.77)
B-Carotene (mg/100ml) = (A663 × 0.216) – (A645 × 51.22) – (A505 × 0.304 ×) + (A453 × 0.452)

Total carotenoid (mg/100ml) =
((1000 × A453) – (Chlorophyll a × 2.27) – (Chlorophyll b× 81.4))

The findings are presented in µg/g for each extract.

Color Determination

Surface color measurements were assessed using a CR-400 Chroma Meter (Minolta Co., Osaka, Japan), which comprised a measuring head (CR-400) with an 8 mm diameter measuring area, 2 standard observers, and a data processor. Calibration of the Chroma meter was performed based on a white tile (D65: Y = 85.1, x = 0.3168, y = 0.3236). Duplicate measurements of color content were conducted following a protocol similar to that outlined by, and the results were quantified in terms of Hunter and CIELAB color parameters, with L/L* representing lightness, +a/+a* indicating redness, and +b/+b* denoting yellowness [8].

Fatty Acid Composition

Fatty acid methyl esters (FAMEs) were produced from oil samples following the methodology outlined by. At room temperature, 1 mg of oil underwent a reaction with 0.1 mol/L methanolic NaOH for 5 minutes, followed by a reaction with 1.1 mol/L methanolic HCL for an additional 5 minutes. After adding water to halt the reaction, hexane was employed to extract the FAMEs. The samples were subjected to GC-MS analysis using a Gas Chromatograph (PerkinElmer GC Clarus 580) interfaced with a Mass Spectrometer (PerkinElmer Clarus SQ 8 S). The equipment was equipped with a ZB-5HTMS (5% diphenyl/95% dimethyl polysiloxane) fused capillary column (30 0.25 m ID 0.25 m DF). The oven temperature was initially set at 80°C, increased by 15°C/min to 150°C, then increased by 3°C/min to 250°C, where it was held for 6 minutes. An electron ionization device in electron impact mode with an ionization energy of 70 eV was employed for GC-MS detection. Helium gas (99.999%) served as the carrier gas with a constant flow rate of 1.6 ml/min, and an injection volume of 1 µl was used. The injector temperature was maintained at 250°C, while the ion-source temperature was set at 220°C. Mass spectra were collected at 70 eV with a scan interval of 0.5s and an MS scan range of 45 to 450 Da. The solvent delay ranged from 0 to 3 minutes, and the overall GC/MS run duration was 44 minutes. The Turbo-Mass detector and Turbo-Mass ver-6.1.0 software were utilized for mass-spectrum GC-MS interpretation, relying on the National Institute of Standards and Technology (NIST) database containing over 62,000 patterns [9].

Statistical Evaluation

Stata (version 18.0) and Microsoft Excel® were used for the statistical analysis. Analyses were performed in duplicate for each set-up, and the outcomes were presented as Mean±SD. The independent t-test was employed for comparisons, with a significance level set at ($p < 0.05$).

Results and Discussion

Oil Yield

Table 1 show the percentage oil yield between new Njangsa seed (NNS) and old Njangsa seed (ONS). The volume of oil from old Njangsa seed (ONS) was higher than that from new Njangsa seed (NNS) but the percentage oil yield is statistically indifferent (46.96±0.11, 53.29±1.36) for NNSO and ONSO respectively. The difference in the oil volume can be attributed to the genetic makeup and storage conditions of the seeds. The percentage of oil yield in NNS is similar to the percentage oil yield (46.43±0.05; 47.4±0.02) reported by respectively using hexane extraction. The percentage oil yield of 52.2% stated by was comparable to old Njangsa seed oil (ONSO) as well the 53.22% oil yield reported by both using hexane as the solvent for extraction. considered Njangsa seed as a high oily seed and indicated that may have contributed to the seeds' oily looks [10-12].

Table 1: Ppercentage yield of Njangsa seed oils

Parameters	% Oil yieled
NNSO	46.96±0.11 [a]
ONSO	53.29±1.36 [a]

Values are means ±SD, values with same superscript are not statistically significant. New Njangsa seed oil (NNSO), Old Njangsa seed oil (ONSO)

Quality Properties of Njangsa seed oils

Vegetable oils contain triglycerides molecules which can easily disintegrate into glycerol and free fatty acids (FFA) molecules. The determination of free fatty acids (FFA) is crucial in assessing the suitability of an oil for either edible or non-edible applications. The obtained FFA values for NNSO and ONSO, (0.42±0.00 and 0.28±0.00 oleic acid) respectively, indicate minimal occurrence of hydrolytic rancidity in the oil, as suggested by.

A study by recorded a value of (0.33%) which is similar to the findings of (0.20% oleic acid) by. Conversely, exhibited FFA values of (1.53% and 5.09%), respectively [10,12-14]. In oil, a high free fatty acids (FFA) level signifies a high acid value (AV), and this limit the food applications of the oil due to decreased sensory and nutritional qualities. Acid value (AV) monitors the degree of hydrolysis of triglycerides in oils and the hydrolysis of triglycerides is influenced greatly by processing conditions and enzymatic actions. It is clear from Table 2 that, NNSO has higher acid value (0.84 mg KOH/g) relative to ONSO (0.56 mg KOH/g), signifying a higher FFA and glycerol content in NNSO compared to ONSO. The AV documented in this study surpassed the values reported by (0.39 mg KOH/g) and relatively, lower as compared to the values of (3.06 mg KOH/g), (5.01 mg KOH/g) and (12.29 mg KOH/g). Refined oil samples are considered acceptable when their acid values (AV) are below 0.6 mg KOH/g. However, observed in a prior study that unrefined vegetable oils generally exhibit higher AV than refined oils. Furthermore, the acid values for both NNSO and ONSO were below 4%, the maximum recommended acid value for crude oils. It can be inferred that the AV of the oils from this study is low, suggesting that the oil is either fresh or has not been exposed to harsh conditions that could lead to increased hydrolysis [3,12,14-18].

Table 2: Quality Properties of Njangsa Seed Oils

Parameters	NNSO	ONSO
Free Fatty acid (%)	0.42±0.00 [a]	0.28±0.00 [b]
Acid Value (mg KOH/g)	0.84±0.00 [a]	0.56±0.00 [b]
Peroxide Value (meq/kg)	12.46±0.03 [a]	11.21±0.35 [a]
Saponification Value (mg KOH/g)	168.64±0.12 [a]	171.24±0.13 [b]
Iodine Value (mg I2/100 g)	154.03±0.21 [a]	142.24±0.76 [b]
Moisture Content (%)	4.07±0.24 [a]	2.13±0.26 [b]
Refractive Index 30°C	1.5011±0.00 [a]	1.4981±0.00 [b]
Beta Carotene	151.42±7.04 [a]	93.57±0.88 [b]
Chlorophyll a	187.33±8.14 [a]	122.18±0.54 [a]
Chlorophyll b	303.59±14.09 [a]	191.65±1.63 [b]
Total Carotenoid	1367.90±64.58 [a]	843.80±8.01[b]

Values are means ±SD, Parameters with same superscript are not statistically significant, different superscript are statistically significant. New Njangsa seed oil (NNSO), Old Njanga seed oil (ONSO)

Peroxide value (PV) is used to evaluate the development and breakdown of hydroperoxides in oils. It is important in assessing oxidation during every stage of the oil from processing until use. The peroxide value of ONSO (12.46±0.03) and NNSO (11.21±0.35) are not significantly different and are similar to the peroxidase values of Ricinodendron heudelotii seed oil reported by (11.04 ± 0.02). Moreover, the PV observed in this study were lower than the value (45.95 meq/kg) reported by but higher than the value (7.2 meq/kg) reported by. Higher peroxidase value indicates short shelf life due to increased susceptibility to rancidity, higher peroxidase value indicates altered physical properties. The observed difference in PV could be attributed to the differences in extraction methods in the various study and also the variety of the seed used. Additionally, indicated that a product with a peroxide value ranging from 1 to 5 meq/kg is categorized as having a low oxidation state, 5 to 10 meq/kg as a moderate oxidation state, and >10 meq/kg as a high oxidation state. This suggests that the level of oxidation in Njangsa seed oil is either moderate or high [6,12,14,19].

The saponification value (SV) of vegetable oil is considered a quality parameter when the oil is for industrial application specifically within the soap industry. Saponification value indicates the presence of smaller molecular weight molecules present in the oil. NNSO exhibited a lower saponification value (SV) at 168.64±0.12 mg KOH/g, in contrast to ONSO at 171.24±0.13 mg KOH/g. This difference implies the presence of smaller molecular weight molecules in ONSO compared to NNSO. The high SV of Njangsa seed oil shown in (Table 2) makes it an ideal raw material for industrial application (soap industry). Also, the saponification values of Njangsa seed oil from this study was higher than that of (145.9±5 mg KOH/g) but lower than the values recorded by (189.24 mg KOH/g), , (184.70 mg KOH/g), (208.60 ± 0.19) and (322.58 mg/KOH) [3,10,14,21].

The iodine value (IV) monitor the degree of unsaturation of the oils. It is clear from Table 2 that, NNSO has higher unsaturation (IV = 154.03 mg I2/100 g) compared to ONSO (IV = 142.24 mg I2/100 g) accounting for their statistical difference. The elevated value for NNSO suggests increased iodine attachment, higher reactivity, lower stability, a softer texture, and greater susceptibility to oxidation and rancidification of the oil. The IV reported in this study is lower compared to (179.6 ± 1.1 and 195.2 ± 1.7) but higher than that stated by (10.01 mg I2/100 g). The IV of NNSO was similar to the values of (158.8 ± 8) and (156.82 g I2/100 g) but proved higher for ONSO by the same researchers [3,11,14,19-21].

The moisture content serves as an indirect indicator of the oil's quality and its resistance to thermal oxidation. Table 1 displays the moisture content for NNSO and ONSO. The moisture content of ONSO (2.16±0.26) was significantly different from that of NNSO (4.07±0.24). NNSO exhibited a higher moisture content, rendering it more prone to thermal hydrolysis. However, the low % moisture content for both oils suggests that they can be stored for an extended period without undergoing hydrolysis. The moisture content determined in this study was lower when compared to values reported by which were (7.5%, 9.5%, 6%), respectively [11,12,14].

Refractive index provides an indication of the oil's level of unsaturation, and it exhibits an inverse relationship with the degree of saturation. A difference in the refractive indices (1.5011 and 1.4981) was observed for NNSO and ONSO respectively and aligns with the results obtained by (1.49) at 30°C, as well as (1.501) at 25°C, but higher than (1.457), and lower than that of (1.61). The refractive index of oil is notably impacted by the composition of its molecules and purity [2,14,20,22].

Oils contain aantioxidants and pro-oxidant properties which provide protection against oxidative processes. Chlorophyll displays pro-oxidative characteristics, whereas carotenoids offer defence against oxidative processes. Chlorophylls (a, b) and carotenoids (β-carotene and total carotenoids) composition of Njangsa seed is shown in Table 2 above. The results a showed greater concentration of Chlorophyl b than Chlorophyl a for NNSO and ONSO. The Chlorophyl b of NNSO (303.59±14.09) was significantly higher than (191.65±1.63) while the Chlorophyl a (187.33±8.14 and 122.18±0.54) for NNSO and ONSO respectively, were statistically insignificant. The higher chlorophyll content of NNSO makes it highly susceptible to autooxidation and subsequent rancidity compared to the ONSO. Solvent extracted oils contain high amounts of chlorophyl and carotenoids compared to pressed extracted oils, as the solvent used dissolve the pigment from the cell wall leading to higher amount of pigments in the oil. The total Carotenoid composition of the NSO was greater than the β-carotene content. The total Carotenoid (1367.90±64.58) and β-carotene content (151.42±7.04) composition of NNSO was significantly higher than that of ONSO (843.80±8.01 and 93.57±0.88) respectively. The high carotene and carotenoid content of NNSO signifies higher antioxidants protection against oxidative sensitizers compared to NNSO [14,23].

Since Njangsa seed oil is not commercially accessible in the market, there are no specific standards provided by the Codex Alimentarius Commission for evaluating its quality parameters [16].

Table 3: Color Parameters of Njangsa Seed Oils

Parameters	NNSO	ONSO
L	81.51±0.01 [a]	92.19±0.01 [b]
A	-2.46±0.00 [a]	-0.29±0.01 [b]
B	8.58±0.04 [a]	3.95±0.01 [b]
L*	85.22±0.017 [a]	93.89±0.01 [b]
A*	-2.52±0.00 [a]	-0.29±0.02 [b]
B*	9.21±0.04 [a]	3.94±0.01 [b]

Values are means ±SD, Parameters with same subscripts is not statistically significant, different subscripts is statistically significant.New Njangsa seed oil (NNSO), Old Njangsa seed oil (ONSO)

Varied amounts of chlorophyll and carotenoids are found in unrefined vegetable oils, contributes to the yellow or green tint to the oils. Consumers will reject oil with a color outside the acceptable range, as the oil's color reflects its overall quality. The color of NNSO and ONSO can be influenced by the levels of chlorophyll and carotenoid content they contained. As seen in (Table 3), NNSO and ONSO had high L/ L* values but the L/ L* value of ONSO was higher than NNSO where L/ L*depicts the lightness of the oil. The negative a/a* values indicate a degree of greenness whereas the positive b/b* values tell of the degree of yellow. It is clear that the Njangsa seed oil has a light and yellowish color as evidenced by the values of the color parameters with ONSO having a lighter yellow color as compared to NNSO [24].

Fatty Acid Composition of Njangsa Seed Oils

Table 4: Fatty Acid Composition

Fatty Acid	NNSO (%)	ONSO (%)	(Assanvo et al., 2015)	(Arrey et al., 2022)	(Sompila et al., 2014)	(Ezekwe et al., 2014)
Caprylic acid (C8:0)	0.77	-	-	-	-	-
Nonanoic acid (C9:0)	0.30	0.43	-	-	-	-
Palmitic acid (C16:0)	8.13	5.82	-	9.24	5.4	28.1
Stearic acid (C18:0)	10.82	6.81	-	8.10	8.0	15.2
Oleic acid (C18:1)	9.80	8.55	7.2	8.70	11.2	6.89
Linoleic acid (C18:2)	26.96	26.15	29.5	31.78	28.1	24.9
A-Eleostearate (α-ESA) (C18:3)	39.23	50.64	50.3	40.92	35	-
Arachidic acid (C20:0)	0.33	0.22	-	0.27	-	-
11(Z)-Eicosenoic acid (C20:(11Z))	-	0.58	-	-	-	-
13(Z)-Octadecenoic acid (C18:1(13Z))	-	0.23	-	-	-	-
Eicosapentanoic acid (C20:5)	2.98	-	-	-	-	48.6

Saturated fatty acids (sfas)	20.35	13.28	13.6	18.56	13.4	-
Monounsaturated fatty acids (mufas)	9.80	9.36	-	8.70	11.2	-
Polyunsaturated fatty acids (pufas)	69.16	76.79		72.70	74.1	-

Values are means ±SD, Parameters with same subscripts is not statistically significant, different subscripts is statistically significant, Not detected (-), New Njangsa seed oil (NNSO), Old Njanga seed oil (ONSO)

Table 4 above, displays the fatty acid (FA) composition of the extracted oil from new Njangsa seed and old Njangsa seed, revealing a substantial presence of various fatty acids in both oils. NNSO contained caprylic acid (0.77%) and eicosapentanoic acid (2.98%), however, it was below detectable limit in ONSO. Controversially, ONSO had 11(Z)-Eicosenoic acid and 13(Z)-Octadecenoic acid but absent in NNSO. NNSO exhibited significantly higher amounts of palmitic acid (8.13%), stearic acid (10.82%), oleic acid (9.80%), linoleic acid (26.96%), and arachidic acid (0.33%) compared to the levels observed in ONSO, which were palmitic acid (5.82%), stearic acid (6.81%), oleic acid (8.55%), linoleic acid (26.15%), and arachidic acid (0.22%). Additionally, nonanoic acid (0.43%), and α-Eleostearate acid (50.64%) was higher in ONSO and relative to nonanoic acid (0.30%) and α-Eleostearate acid (39.23%) found in NNSO. The saturated fatty acid content in NNSO (20.35%) surpasses that in ONSO (13.28%), while the predominant fatty acid found in both oil samples was alpha-eleostearic acid (α-ESA); a member of the conjugated fatty acid class (C18:3). The polyunsaturated fatty acids (PUFAs) content in NNSO and ONSO is 69.16% and 76.79%, respectively, with ONSO exhibiting a higher PUFA content than NNSO. This elevated PUFA level can provide notable health benefits.

Conclusion

This study concentrated on the oil yield and the analysis of physicochemical parameters of the oil extracted from two types of Njangsa seeds, namely new and old Njangsa seeds. The solvent extraction (using hexane) from both varieties produced a light-yellow oil that remains in a liquid state at room temperature. Despite the slightly higher yield of old Njangsa seed oil (53.29±1.3) compared to new Njangsa seed oil (46.96±0.11), these variations were deemed insignificant. However, the two oils exhibited distinct physiological properties.

NNSO oil exhibited significantly higher ($P< 0.05$) free fatty acid, acid value, iodine value, moisture content, and refractive index (0.42±0.00, 0.84±0.00, 154.03±0.21, 4.07±0.24, 1.5011±0.00) respectively compared to ONSO (0.28±0.00, 0.56±0.00, 142.24±0.76, 2.13±0.26, 1.4981±0.00) respectively. Additionally, the peroxide value of NNSO (12.46±0.03) was higher than that of ONSO (11.21±0.35), but these differences were not significant, while ONSO (171.24±0.13) demonstrated a significantly higher saponification value compared to NNSO (168.64±0.12). Based on these quality parameters, ONSO exhibited superior quality, implying a longer shelf life and greater stability for both edible and non-edible applications compared to NNSO. These variations may stem from differences in the seed origins, leading to varying levels of saturated, monounsaturated, and polyunsaturated fatty acids, thereby influencing oxidation degrees. Additionally, factors such as processing techniques, storage conditions (time, temperature, air, and light), can impact the oil's quality. Notably, in comparison to ONSO, NNSO displayed a stronger antioxidant property due to its higher levels of β-carotene and total carotenoids.

NNSO exhibited noteworthy amounts of α-eleostearic acid (α-ESA) (39.23%), linoleic acid (26.96%), stearic acid (10.82%), oleic acid (9.8%), palmitic acid (8.13%), eicosapentaenoic acid (2.30%), caprylic acid (0.77%), arachidic acid (0.33%), and nonanoic acid (0.3%), with a composition of saturated fatty acids (SFA) at 20.35%, monounsaturated fatty acids (MUFA) at 9.8%, and polyunsaturated fatty acids (PUFA) at 69.16%. In contrast, ONSO contained significant amounts of α-eleostearic acid (α-ESA) (50.64%), linoleic acid (26.15%), oleic acid (8.55%), stearic acid (6.81%), palmitic acid (5.82%), 11(Z)-eicosenoic acid (0.58%), nonanoic acid (0.43%), 13(Z)-octadecenoic acid (0.23%), and arachidic acid (0.22%), with a composition of SFA at 13.28%, MUFA at 9.36%, and PUFA at 76.79%. It is evident that NSO serves as a valuable source of PUFA, particularly alpha-eleostearic acid (α-ESA), and can be considered comparable to other vegetable oils such as tung oil and pomegranate seed oil. Overall, the characteristics of both NNSO and ONSO make them suitable candidates for cooking, nutritional uses, and other purposes (cosmetic, pharmaceutical, soap, and varnish) [25-27].

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Conflicts of Interest

The authors assert that there were no conflicts of interest.

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