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Phytochemical and oil quality analyses of medicinal plant of *Jatropha curcas* L. Euphorbiaceae

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Abstract
This study investigated the phytochemical constituents and oil quality of *Jatropha* oil collected from two states in southwest Nigeria. *Jatropha curcas* is a promising plant with potentials for biodiesel production, industrial, pharmaceutical and medicinal applications. The aim of this study is to analyze the phytochemical constituents and oil quality of *Jatropha curcas* seeds based on geographical locations and infer the medicinal property aside the biodiesel property. Seeds were collected from Abeokuta and Ibadan, in Ogun and Oyo states respectively. Extraction of oil from seeds was done mechanically with Grazia hydraulic press machine for 24 hrs. Phytochemical analysis was done by standard methods and the quality of oil was analyzed using model VN 203 spectrophotometer. Statistical analysis was performed using SPSS version 20.0 software on the quantitative phytochemicals and oil quality data collected. Mean was separated with Duncan multiple using one way analysis of variance. Results showed significant differences among the phenolic, flavonoid and alkanoid constituents at $P<0.05$. *Jatropha* oil from Abeokuta has the highest mean phenolic and flavonoid contents with 23.33µg GAE/mg and 17.14µg QUE/mg respectively and low free fatty acid (0.61), acid value (1.55), saponification value (116.78), iodine value (78.58) and peroxide value (2.48). The higher phenolic and flavonoid contents suggest that *Jatropha* oil from Abeokuta may have better antioxidant properties, potentially stronger anti-inflammatory effects and greater potential for free radical scavenging. The higher alkaloid content in Ibadan samples indicates possibly stronger biological activities, potential medicinal properties and could contribute to the oil's antimicrobial properties. The potential reasons for these quality differences between *Jatropha* oils from Ibadan and Abeokuta could be climate variations, rainfall pattern, and timing of harvest among others.

Keywords: Phytochemical, *Jatropha curcas*, Oil quality, analysis
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Introduction

Jatropha curcas L., a promising species that offers significant potentials due to its versatile and multi-purpose product range (Openshaw, 2000). It belongs to the genus *Jatropha*, family Euphorbiaceae and commonly known as physic nut, purging nut or pig nut (Sharma *et al*. 2016), Botuje in southwest Nigeria. It originates from Mexico and Central America, but has spread all over the world and is mostly used for hedges (Pinto *et al*., 2018). *Jatropha curcas* has garnered widespread interest in tropical and sub-tropical regions due to its remarkable adaptability. The plant's key attributes include exceptional hardiness, easy propagation, drought resistance, high oil content, rapid growth, and versatility across diverse agro-climatic conditions, making it an attractive crop with multiple potential applications (Kmar and Sharma, 2008; Divakara *et al*. 2010; Sarabia *et al*., 2022).

Jatropha curcas offers multiple environmental and economic benefits. It thrives on fringe lands, helps reclaim eroded areas, and serves as a natural cattle deterrent to protect crops. The plant's seeds yield bio-oil suitable for diesel engines, powering machinery and generators, and can also be used in soap production (Openshaw, 2000). Additionally, the seed residue functions as a fertilizer and biogas source, demonstrating the plant's comprehensive utility. The name "Jatropha" refers to medicinal uses, from the Greek iatrós, meaning"doctor" and "trophè", meaning "food". Preparations of all parts of the plant, including seeds, leaves and bark, fresh or as a decoction, are used in traditional medicine and veterinary purposes. The oil has a strong purgative action and is widely used to treat skin diseases and to soothe pain from rheumatism. The sap flowing from the stem is used to control the bleeding of wounds.

Researchers had evaluated and reported the phytochemical and antimicrobial analyses of *Jatropha curcas* (Amabye and Bezabh, 2015; Sabandar*et al*., 2013; Sharma *et al*. 2016). There should be awareness that *Jatropha curcas* is medicinal aside from the biodiesel property that is well known (Sarabia *et al*., 2022). Different parts of the plants possessed potent antibacterial activity (Sharma *et al*., 2016) and had been used in folk medicine to treat varied ailments and diseases (Prasad, 2012). Amabye and Bezabh (2015) showed in their study that its seed oil possessed pharmacological potentials.

Plants accumulate compatible solutes under stress that protect membrane integrity and facilitate osmotic adjustment (Tomar *et al*., 2014). They contain antioxidants (secondary metabolites) which help them in combating adverse environmental conditions, which in turn, help human in building their immunity when ingested or cure an ailment when used topically. Secondary metabolites found in medicinal plants; including alkaloids, glycosides, steroids, and flavonoids, represent promising drug development sources (Kajaria *et al*., 2011). Tungmunnithum *et al.* (2018) expressed phenolics and flavonoids as the most abundant plant-derived phytochemicals with potent antioxidant capabilities. *Jatropha* species exhibit notable toxicity, primarily concentrated in their latex and seeds, with the underlying pharmacological mechanisms remaining largely unexplored (Wu *et al*., 2019). Ramadan (2022) examined the bioactive phytochemicals produced as byproducts during *Jatropha curcas* L. oil processing and explored the valorization potential of *Jatropha curcas* press cake. Majorly, extensive research and phytochemical analysis have been done on every parts of *Jatropha* plants (Sarabia *et al*., 2022) but rarely on its seed oil. Thus, this study aimed at analyzing the phytochemical constituents and oil quality of *Jatropha curcas* seeds based on geographical locations and infer the medicinal property aside the biodiesel property.

Material and methods

Plant material

Matured seeds of *Jatropha curcas* were collected from different locations in Abeokuta and Ibadan, in Ogun and Oyo states respectively at the same season (Table 1). Most of the fruits were fully ripe and dried in Ogun State while a little were ripe and most were unripe (Oyo State.

Plant oil extraction

Extraction processing of *Jatropha* oil was carried out in the Department of Forest products development and utilization, Bio-energy section *Jatropha* biodiesel unit, Forestry Research Institute of Nigeria (FRIN), Ibadan. The *Jatropha* seeds were de-shelled, where the shells were removed from the back of the kernel. The kernels were oven-dried for 1hrs at 65 ℃ in a room temperature using Gallenkamp Model Ov-440 oven. 498.29 g of oven dried seeds were measured on weighing scale. The kernels were ground into smaller particles with grinding machine. Extraction of the oil was done mechanically with Grazia hydraulic press machine for 24 hrs.

Phytochemical Analysis on the extracted oils

Phytochemical analysis was done on the extracted oils according to the official

standard methods described by AOAC, 2010 at the Nigerian Stored Products Research Institute, Ibadan. Spectrophotometric method was used following the AOAC method using NV 203 Light spectrophotometer.

Table 1: Locations of *Jatrophacurcas* seeds collected

Site of collection	Latitude	Longitude
Odeda local government area	7°13'40.008" N	3° 32' 2.004"
Ido local government (Omi adio)	7° 27' 3.996"	3° 57' 24.012"
Apakila	11° 6' 13.464"	16° 29' 16.368"
Isolu	7° 12' 59.004"	3° 26' 40.992"

Results

Phytochemical analysis of *Jatropha curcas* oils from different states at the same season (May and June, 2024) revealed variation in the contents of total phenolic, flavonoid and saponin analyzed. *Jatropha* oil from Abeokuta has the highest mean phenolic and flavonoid contents with 23.33 µg GAE/mg and 17.14 µg QUE/mg respectively. *Jatropha* oil from Ibadan has the highest alkaloid content of 8.29 mg/100g (Table 2). The mean saponin content (0.71 mg/100g) was the same in both locations. The oil quality analysis was highest in free fatty acid (1.26 %), acid value (2.01 mg KOH/g), saponification value (179.5 mg KOH/g), iodine value (116.1) and peroxide value (4.51meq/kg) of Ibadan oil. Low free fatty acid (0.61 %), acid value (1.55 mg KOH/g), saponification value (116.78 mg KOH/g), iodine value (78.58) and peroxide value (2.48meq/kg) was observed in Abeokuta oil (Table 3).

Table 2: Phytochemical analysis of *Jatropha* oil from Abeokuta Ogun State and Ibadan, Oyo State

SAMPLES	Phenolics (µg GAE/mg)	Flavonoids (µg QUE/mg)	Alkaloid (mg/100g)	Saponin (mg/100g)
Abeokuta *Jatropha* oil	23.33 ± 0.57	17.14 ± 0.57	6.29 ± 0.15	0.71 ± 0.37
Ibadan *Jatropha* oil	19.60 ± 1.07	15.30 ± 0.84	8.29 ± 0.16	0.71 ± 0.01

P<0.05 Mean± standard error

Table 3: Oil quality analysis of *Jatropha* oil from Abeokuta Ogun State and Ibadan, Oyo State.

SAMPLES	Free fatty Acid (%)	Acid Value (mg KOH/g)	Saponification Value (mg KOH/g)	Iodine Value (gI_2/ 100 g)	Peroxide value (meq/kg)
Abeokuta *Jatropha* oil	0.61±0.08	1.55 ± 0.04	116.78 ± 2.28	78.58 ± 1.02	2.48 ± 0.02
Ibadan *Jatropha* oil	1.26±0.08	2.01 ±0.02	179.95 ± 1.10	116.10 ± 1.01	4.51 ± 0.10

P<0.05 Mean± standard error

Discussion

Phytochemical and oil quality analyses of *Jatropha curcas* seeds indicate significant variations in phytochemical contents and oil quality parameters across different locations. The higher phenolic (23.33 µg GAE/mg) and flavonoid (17.14 µg QUE/mg) mean contents suggest that *Jatropha* oil from Abeokuta may have enhanced antioxidant properties, potentially stronger anti-inflammatory effects and greater potential for free radical scavenging than the others. Sharma *et al*. (2012) revealed in their findings that the extracts of *Jatropha* studied depicted high quantity of phenolic and flavonoid compounds. Due to their antioxidant properties, phenolic compounds and flavonoids can be utilized in cosmetic formulations to enhance skin protection against oxidative stress, making *Jatropha* oil an attractive ingredient in skincare products. The high levels of these phytochemicals may lead to the development of new medicinal products or supplements that leverage their health benefits, particularly in traditional medicine or herbal remedies.

The higher alkaloid mean content (8.29 mg/100g) in Ibadan samples indicates possibly stronger biological activities, potential medicinal properties and could contribute to the oil's antimicrobial properties. This could also indicate potential variations in the chemical composition of *Jatropha* seeds based on geographical location. Sharma *et al*. (2016) suggested that all parts of the *Jatropha* plant studied possess potent antibacterial activity. Alkaloids often exhibit various biological activities, including anti-inflammatory, analgesic, and antimicrobial properties. The presence of high alkaloid content could enhance the oil's potential as a source for developing pharmaceuticals or nutraceuticals (Amabye and Bezabh, 2015). While alkaloids can contribute to the overall chemical profile of *Jatropha* oil, their presence in high concentrations may affect the oil's performance as biodiesel. Alkaloids can influence combustion characteristics and fuel stability, which may require additional processing or refining to ensure optimal fuel quality. The potential reasons for these quality differences between *Jatropha* oils from Ibadan and Abeokuta could be climate variations, rainfall pattern, and timing of harvest among others.

Interestingly, the mean saponin content was consistent across both locations, recorded at 0.71 mg/100g, suggests similar environmental conditions affecting saponin production, consistent genetic expression for saponin synthesis and comparable emulsifying properties in both samples. It could also suggest a stable presence of this phytochemical in *Jatropha* seeds regardless of origin.

The oil from Ibadan showed higher quality with a free fatty acid content of 1.26% and an acid value of 2.01 mg KOH/g, which are critical parameters indicating lower levels of degradation and higher usability for biodiesel production. The saponification value, which reflects the potential for converting oils into biodiesel, was significantly higher in Ibadan oil at 179.5 mg KOH/g compared to Abeokuta's 116.78 mg KOH/g. The iodine value, a measure of unsaturation in fatty acids, was also higher in Ibadan oil (116.1gI_2/ 100 g) than in Abeokuta oil (78.58gI_2/ 100 g), indicating a greater proportion of unsaturated fatty acids in the former. Lastly, the peroxide value, indicative of oxidative stability, was recorded at 4.51 meq/kg for Ibadan oil compared to 2.48 meq/kg for Abeokuta oil, further supporting the superior quality of Ibadan's *Jatropha* oil. The quality of the oil of *Jatropha* extracted by Serouti *et al.* (2021) demonstrated that *Jatropha* seeds represent a promising industrial oil source.

These findings emphasize the importance of geographical variations in both phytochemical composition and oil quality of *Jatropha curcas* seeds, which can influence their applications in biodiesel production, medicinal and other industrial uses.

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