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# Phytochemicals and acetylcholinesterase activity of stem bark daniella oliveri ethyl acetate extract

**Maurice Jemkur[1]*, Amos Mamman[2], Toyin Florence Ayandokun[3]**
[1]Department of Chemistry, Air Force Institute of Technology, Kaduna, Nigeria. mauricejemkur99@gmail.com
[2&3]Department of Chemistry, University of Ilorin, Ilorin, Nigeria. [2]dmamman51@yahoo.com, [3]ayandokuntoyin01@gmail.com

*Correspondence: mauricejemkur99@gmail.com

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## Abstract

Before the coming of modern drugs circulating now all over the world, traditional plants were in existence. The parts of the plants mostly used are root, stem bark, stem, flower, fruits and seed are ingredients of orthodox medicines. The components of phytochemical signify the healing value of plants. Phytochemical performs physiological activities on the human system; some of the significant phytochemical are flavonoids, alkaloids, phenolic and tannins compounds. In this research, the GC-MS of Daniella Oliveri ethyl acetate stem bark extract revealed 49 bioactive components, δ-cadinene and ϒ-Muurolene, having the highest percentage among other antioxidant compounds. The acetylcholinesterase (AChE) donepezil used to examine the inhibition activity shows a linear progression with the D. Oliveri extracts. Even though there is extensive information on the ethnopharmacological uses of D. Oliveri, there is a shortage of scientific reports on the anti-fungal properties of the plant, therefore, this study aimed at evaluating the biochemical compositions of the plant in order to ascertain its ethnomedicinal use in the treatment of skin ailments and others diseases.

**Keywords:** Acetylcholinesterase (AChE), Bioactive, Donepezil, Phytochemical, δ-cadinene, ϒ-Muurolene

## 1. Introduction

The naturally occurring biologically active substances called phytochemicals that can be used to cure disease are found in plants, the phytochemical are also refer to as secondary metabolites (Abdurrahman, 1992; Farombi et al., 1998). Because of their antioxidant effects, phytochemicals are far more effective at preventing disease. In the event that molecules are attacked by free radicals, antioxidants protect them against oxidation. They shield them from reactive oxygen as well. This makes it feasible to prevent the spread of numerous diseases and food deterioration (Chetia et al., 2014; Koleva et al., 2000). The Shea butter tree (*Vitellaria paradoxa*), which is one of the medicinal plants with a wide range of uses and significant economic potential. The seeds' oil and phytochemicals can

be utilized to produce soap, cosmetics, cooking oil, treatment of ailments, margarine, chocolate, and food (Maurice et al., 2022).

### 1.1. Using animals as a source for natural products

Animals are not excluded because they have historically been a significant source of intriguing chemicals that have been used in pharmaceuticals. The poisonous skin of the Ecuadorian frog is where epibatidine is found. Compared to morphine, it is 10 times more efficient (Cragg et al., 1997). Animal toxins and venoms were used extensively in the treatment of several ailments. Teprotide, which is derived from the Brazilian viper, is one such. It resulted in the creation of the antihypertensive drugs captopril and cilazapril (Clark, 1996).

## 2. Literature review

### 2.1. Daniella *Oliveri*

In Nigeria, many plants are used in ethnomedicine for the treatment of a variety of diseases, one of which is Daniella *Oliveri* (Fabaceae), commonly identified as West African copal plants, Ilorin balm, African copaiba ointment, Accra copal and Benin resin copal. The D. *Oliveri* herbal is found in both temperate and humid provinces of the world, the Amazon area, Latin America and part of Africa (Meggers, Ayensu & Duckworth, 1973; Phillips & Gentry, 1993). It is an indigenous plant of Africa found extensively in Benin, Cameroon, Gambia and Nigeria. The leave, stems bark, and trunk of D. *Oliveri* usually give fluid oleoresin which contains large but variable quantities of volatile oils, non-volatile resinous constituents and minor quantities of acids (Gilbert, 2000). The oleoresin is applied in traditional medicine to treat skin ailments, inflammation and genitourinary tract diseases (Raffauf, 1992). They are similarly utilized as an antiseptic, antibacterial, purgative, laxative, diuretic and hypotensive agents (Fleury, 1997).

The leaf, root and stem bark of D. *Oliveri* are used to treat ailments like ringworm, syphilis, scrotal elephantiasis, typhoid, dysentery and ear aching (Nwaeze & Abariku, 2006). Decoction of leaf and bark is used as a mouthwash for toothache and tooth troubles. Young leafy shoots are pounded to a paste and applied on wounds to arrest bleeding and hasten to healing. Tiv people in Nigeria take leaf sap as cough medicine. The gum exudate from the bark is applied externally to treat itching skin and skin diseases (Burkill, 1994).

**Figure 1:** Daniellia *Oliveri* Plant

In Nigeria, many treasured seeds which might be oil-wealthy are allowed to perish every 12 months due to the fact that they are non-traditional oil spores. Daniella *Oliveri* (Rolfe) Hutch and Dalziel of

the own circle of relatives Caesalpiniaceae is a famous herbal in West Africa and the Amazon area (Meggers et al., 1973; Atolani & Olatunji, 2016). The trees are domestically regarded as "EMI ya" in South West and Nmi Iko Langtang, Plateau State Nigeria, (Maurice et al., 2022).

The tree exudates had been carried out equally as a factor of skincare and their ability as anti-wrinkle sellers had remained unproved because there is no proper account of (Lamy et al., 2010). Polylactic, a Furano-terpene has been found in exudates of the plant (Atolani & Olatunji, 2014), also the biochemical constituents of the gum had been scrutinized (Atolani & Olatunji, 2016). Some planted flora which encompasses the Shea butter plants known as *Vitellaria paradoxa* are from the circle of relatives Sapotaceae, cola millenii and Moringa oleifera which also have numerous organic activities (Maurice et al., 2022).

Therefore, in addition, isolation and validation of the compounds from this species may also screen greater approximately their contribution to pharmacological properties. Inhibit tumour boom, decorate anticancer outcomes of bortezomib in a couple of myelomas, antibacterial agent (strong inhibit micro-organism: Vibrio paraharmolyticus, Enterobacter aerogenes, Bacillus subtilis (Lee et al., 2015), Germacrene D. Stem bark Antimicrobial, antifungal, antitumor (Montanari et al., 2011; Duarte et al., 2005). βcaryophyllene Leaf, stem bark Anti-inflammatory and nearby anaesthetic, antibacterial agent, mild cytotoxicity in vitro, antimalarial (Ghelardini et al., 2001; Oladimeji et al., 2016; Tchoumbougnang et al., 2005) δ-cadinene Stem bark Antibacterial, Moderate cytotoxicity in vitro Reduce the quantity of microorganism at any level of the boom while mixed with indole compound (Atolani & Olatunji, 2016).

The biochemical constituent of the oleoresin on Daniella *Oliveri* changed into the investigation. The 3 essential compounds are δ-cadinene, copaene, cis-muurola-4(14), and 5-diene contributed approximately 60% indicating that this tree has potential supply of herbal sesquiterpenes. Diagnosed sesquiterpenes can be an essential biochemical component for the short chemo-taxonomical classification of the herbal species and their own circle of relatives. The oleoresin indicated low interest towards the prostate most cancers molecular stripeplus a mild essential scavenging ability. The oleoresin can be a probable supply of herbal antioxidants for in addition

### 2.2. Antimicrobial function

Animals and plants resist infection from living microorganisms. They are the easy targets for pathogens and it makes them not to avoid hectic climates. It emanates that plants can synthesize a range of useful compounds which assist them to resist assaults from microorganism such as bacteria, viruses and fungi. Usually, these chemicals are alkaloids, phenolic, and terpenoids. In most of the Asteraceae especially, lactones which is the sesquiterpene from plants such as cola *millenii*, and Daniella *Oliveri* served as the fundamental mechanisms for this defense. Sesquiterpenes diminish damage that a microbial outbreak would have caused to the microbe's membrane cell of the plants (Cowan, 1999).

### 2.3. Medicinal plants that treat malaria

In numerous regions of the world, orthodox medicine remedies have been utilized for thousands of years to treat malaria. The alkaloid quinine, still widely utilized, was derived from the bark of Cinchona / Rubiaceae classes and was the first antimalarial medication used in the Occident. As early

as 1632, plant bark infusions were used to cure malaria (Baird et al., 1996). It was later quinine discovered, making it the eldest and greatest significant antimalarial medication (Saxena et al., 2003). Artemisia annua, which has been used as a medicine for millennia Europe, was redeveloped in China around 1970s and is a significant basis of the antimalarial called artemisinin drug (Bruce-Chwatt, 1982; Klayman, 1985). The use of Artemisinin-Combined Treatments (ACT) became official. From 2005 onwards were publicly adopted in Nigeria as the first-line treatment for uncomplicated malaria (Mokuolu et al., 2007). Nevertheless, the partial manufacture of artemisinin derivatives in accordance with GMP (Good Manufacturing Practices) criteria, expensive costs, and noxiousness of ACT prevent its widespread usage (Haynes, 2001; Malomo et al., 2001; Borstnik et al., 2002; Adebayo & Malomo, 2002; Afonso et al., 2006; Boareto et al., 2008).

### 2.4. Hunt for fresh phytochemicals with antimalarial properties

Because conventional medicine is not widely used, there is attention in home-grown medicine during the past ten years. Other approaches based on cultural alternatives frequently support healthcare in underdeveloped nations (Maurice et al., 2022). One-fifth of patients in many underdeveloped nations utilize local herbal treatments to treat illnesses like malaria (Willcox & Bodeker, 2004). Although some societies have access to modern treatment, herbal remedies frequently maintain appeal due to historical and cultural considerations as well as their lower cost. The usage of herbal treatments has grown rapidly in recent years, and researchers are constantly looking for novel phytochemicals that might one day be turned into effective (Willcox, 1999).

Before now, trees were chosen casually and tested for activity of antimalarial. Nevertheless, these processes were time-consuming and cannot produce many results. Example, extracts from 600 classes in 126 plant groups were tested in 1947, the Vivo effectiveness against the then-current laboratory models of avian malaria. From species in 33 genera, active extracts were isolated, and species in the Simaroubaceae family consistently produced excellent results. Plants were chosen according to ethnobotanical info is considered to be a preferable strategy. Trees are been chosen according to their traditional medicinal uses to treat malaria fever (Carvalho et al., 1991).

### 2.5. Objectives

The objective of this study is to determine the phytochemicals and acetylcholinesterase activity of stem bark Daniella *Oliveri* ethyl acetate extract.

## 3. Materials and methods

### 3.1. Plant materials

Early in the morning, tree barks and stems were cut. Daniella *Oliveri* obtained from the University of Ilorin's premises; it was verified as authentic by the department of plant science's herbarium at the university's school of physical sciences in Ilorin, Kwara State.

### 3.2. Purification of Solvents

Prior to being employed for the extraction, the solvent underwent distillation to purify it. Since contaminants are typically present, the ethyl acetate was purified after being purchased from a local market.

### 3.3. Extraction of plant material

The stem bark of D. *Oliveri* was unwrapped and cut into pieces. For three weeks, it was air dried in the laboratory. 750g was soaked for five days at room temperature with intermittent shaking in transparent reagent vials with ethyl acetate. To get rid of the extraction solvent, the extract was sieved and dried in a Rotary Evaporator.

### 3.4. Apparatus and materials used

Beakers, preparative thin layer chromatography plates, fast fit distillation flasks, measuring cylinders, spatulas, aluminum foil, reagent bottles, masking tape, thin layer chromatography tanks, and rotary evaporators are among the supplies needed.

### 3.5. Thin layer chromatography

A small quantity of concentrated ethyl acetate extract was placed in a beaker. Using a Pasteur pipette, a drop of the extract was deposited on a TLC plate. The plate was prepared using n-hexane and ethyl acetate in a 3:1 ratio as the mobile phase. In a TLC tank, add the solvent and shake to ensure homogeneity. Place the thin layer plate with the spots in the tank and cover it. Slender layer the chemical components found in the stem could be identified by chromatography of n-hexane extract. A UV lamp with a 366 nm wavelength was used to view the thin layer chromatogram. Spots of pink, yellow, and blue fluorescence were observed, with the blue fluorescence being the most prominent (major).

### 3.6. Acetylcholinesterase (AChE) Inhibitory activity

With a few modifications, the Lopez et al. (2002) methodology will be followed for the AChE inhibitory experiment and the investigation of the inhibition kinetics. The assay combination contained 200 L of Tris-HCl 50 mM pH 8.0, 0.1 percent BSA buffer, 100 L of extracts or fractions solution that would be liquefied in buffer-MeOH (10 percent), and 100 L of AChE. (0.22UmL-1), before adding 500 mL of DTNB (5, 5Vdithiobis [2-nitrobenzoic acid] (3 mM) and 100 mL of substrate acetylthiocholine iodide (ATCI), the mixture was incubated at room temperature for 2 min (15 mM). After 4 minutes, the growing creamy pigment was observed at 405 nm. As a positive control, donepezil hydrochloride will be added to the test mixture at a concluding conc. of 0.2 g mL-1. When expressing AChE inhibitory activity as a percentage of AChE inhibition, the formula is (1-B/A) X 100, "A" represents the variation in absorbance of the bioassay minusextract from the plants (abs. with enzyme-abs. Without enzyme) and B represents the change in absorbance of the assay with the plant extract.

## 4. Results and discussions

**Table 1:** Chemical Composition of *Daniella Oliveri* Ethyl Acetate Extract

| S/N | RETENTION TIME (Sec) | COMPOUND NAME | MOLECULAR COMPOUND | %COMPOSITION |
|---|---|---|---|---|
| **1** | 6.61 | Glycerin | $C_3H_8O_3$ | 0.32 |
| **2** | 6.81 | Hemellitol | $C_9H_{12}$ | 0.30 |
| **3** | 8.09 | D-Mannitol | $C_6H_{14}O_6$ | 1.36 |
| **4** | 9.61 | 1,3-Oxathiolane, 2-acetyl-2-methyl | $C_6H_{10}O_2$ | 0.55 |
| **5** | 10.90 | alpha-Cubebene | $C_{15}H_{24}$ | 0.44 |
| **6** | 11.16 | Copaene | $C_{15}H_{24}$ | 0.13 |
| **7** | 11.22 | alfa.-Copaene | $C_{15}H_{24}$ | 2.08 |
| **8** | 11.33 | beta.-copaene | $C_{15}H_{24}$ | 0.78 |
| **9** | 11.56 | Cyclopropa[a]naphthaleneoctahydro-1,1,3a,7tetramethyl,[1aR(1a.alpha.,3a.alpha.,7b.alpha.)] | $C_{15}H_{24}$ | 1.03 |
| **10** | 11.69 | Isocaryophyllene | $C_{15}H_{24}$ | 0.24 |
| **11** | 11.77 | 1-Ethyl-3-vinyl-adamantane | $C_{14}H_{22}$ | 0.11 |
| **12** | 11.87 | Aromandendrene | $C_{15}H_{24}$ | 0.13 |
| **13** | 12.03 | cis-.beta.-Ocimene | $C_{10}H_{16}$ | 0.16 |
| **14** | 12.08 | Alloaromadendrene | $C_{15}H_{24}$ | 0.95 |
| **15** | 12.16 | gamma.-Muurolene | $C_{15}H_{24}$ | 6.79 |
| **16** | 12.34 | Germacrene D | $C_{15}H_{24}$ | 0.93 |
| **17** | 12.37 | alpha.-Muurolene | $C_{15}H_{24}$ | 0.94 |
| **18** | 12.54 | delta.-Cadinene | $C_{15}H_{24}$ | 16.62 |
| **19** | 12.51 | Calamenene | $C_{15}H_{22}$ | 1.32 |
| **20** | 12.69 | alpha.-Cubebene | $C_{15}H_{24}$ | 0.75 |
| **21** | 12.79 | alpha.-Calacorene | $C_{15}H_{20}$ | 6.14 |
| **22** | 12.91 | Spathulenol | $C_{15}H_{24}O$ | 0.44 |
| **23** | 12.98 | Cadala-1(10),3,8-triene | $C_{15}H_{22}$ | 1.40 |
| **24** | 13.15 | Spathulenol | $C_{15}H_{24}O$ | 0.81 |
| **25** | 13.43 | Isolongifolene, 4,5,9,10-dehydro- | $C_{15}H_{20}$ | 1.58 |
| **26** | 13.45 | Neoisolongifolene, 8,9-dehydro- | $C_{15}H_{22}$ | 0.26 |
| **27** | 13.55 | Cubenol | $C_{15}H_{26}O$ | 1.04 |
| **28** | 13.68 | tau.-Muurolol | $C_{15}H_{26}O$ | 2.17 |
| **29** | 13.78 | Viridiflorol | $C_{15}H_{24}O$ | 1.32 |
| **30** | 13.93 | Cadalene | $C_{15}H_{18}$ | 2.21 |
| **31** | 13.91 | 2,3-2H-Benzofuran-2-one,3,3,4,6 tetramethyl | $C_{12}H_{14}O_2$ | 1.41 |
| **32** | 14.10 | 6-Isopropenyl-4,8a-dimethyl-1,2,3,5,6,7,8,8a-octahydro-naphthalen-2-ol | $C_{15}H_{24}O$ | 0.83 |
| **33** | 14.17 | Androstan-17-one, 3-ethyl-3-hydroxy-, (5.alpha.) | $C_{21}H_{34}O_2$ | 0.67 |
| **34** | 14.21 | Propanoic acid, 2-[4-(1-buten-3-yl)phenyl]-, methyl ester | $C_{14}H_{18}O_2$ | 1.20 |
| **35** | 14.34 | 5-Isopropylidene-6-methyldeca-3,6,9-trien-2-one | $C_{14}H_{20}O$ | 0.50 |

| | | | | |
|---|---|---|---|---|
| **36** | 14.45 | 1-Cyclohexene-1-ethanol,2,6,6 trimethyl | $C_{11}H_{20}O$ | 1.00 |
| **37** | 14.63 | 2,3-Dehydro-4-oxo-.beta.-ionol | $C_{13}H_{18}O_2$ | 1.51 |
| **38** | 14.68 | Aromadendrene oxide-(2) | $C_{15}H_{24}O$ | 0.72 |
| **39** | 14.75 | Isoshyobunone | $C_{15}H_{24}O$ | 1.64 |
| **40** | 14.94 | Spiro[tricyclo[4.4.0.0(5,9)]decane-10,2'-oxirane],1-methyl-4-isopropyl-7,8-dihydroxy-, (8S) | $C_{15}H_{24}O_3$ | 3.92 |
| **41** | 15.23 | Murolan-3,9(11)-diene-10-peroxy | $C_{15}H_{24}O_2$ | 2.58 |
| **42** | 15.50 | Alloaromadendrene oxide-(1) | $C_{15}H_{24}O$ | 1.94 |
| **43** | 15.55 | 4-t-Butyl-1-(1-methylallyl) cyclohexanol | $C_{14}H_{26}O$ | 1.34 |
| **44** | 16.08 | 1-Heptatriacotanol | $C_{27}H_{76}O$ | 4.28 |
| **45** | 16.85 | 17-Octadecynoic acid | $C_{18}H_{32}O_2$ | 3.55 |
| **46** | 17.01 | 3,7,11,15-Tetramethyl-2-hexadecen-1-ol | $C_{20}H_{40}O$ | 1.46 |
| **47** | 19.29 | cis-13,16-Docasadienoic acid | $C_{22}H_{40}O_2$ | 2.61 |
| **48** | 19.84 | 1-Heptatriacotanol | $C_{37}H_{76}O$ | 6.69 |
| **49** | 20.42 | 17-Octadecynoic acid | $C_{18}H_{32}O_2$ | 5.10 |

**Table 2:** % Inhibition of acetyl cholinesterase activity of Daniella *Oliveri* ethyl acetate extract

| **Conc. (ug/ml)** | **1st %Inh** | **2nd %Inh** | **3rd %Inh** | **Ave %Inh** | **SD** | **SEM** |
|---|---|---|---|---|---|---|
| **10** | 50.88729 | 44.23245 | 47.29368 | 47.47114 | 3.330967 | 47.47114±3.330967 |
| **20** | 44.36555 | 54.34781 | 53.28303 | 50.66546 | 5.481799 | 50.66546±5.481799 |
| **50** | 49.15703 | 50.75419 | 53.01684 | 50.97602 | 1.939441 | 50.97602±1.939441 |
| **100** | 58.07452 | 54.7471 | 58.74 | 57.18720 | 2.139231 | 57.18720±2.139231 |
| **150** | 60.60335 | 62.20052 | 60.60335 | 61.13574 | 0.922122 | 61.13574±0.922122 |

**Table 3:** Concentration of Daniella *Oliveri* crude extracts VS Donepezil

| Conc.(Ug/ml) | D. Ethyl A. | Donepezil |
|---|---|---|
| **10** | 47.47114 | 16.65758 |
| **20** | 50.66546 | 24.68797 |
| **50** | 50.97602 | 35.97392 |
| **100** | 57.1872 | 40.85727 |
| **150** | 61.13574 | 49.10469 |

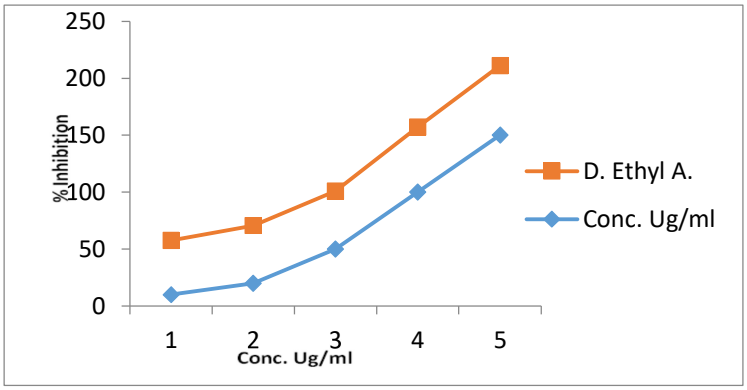


**Figure 2:** Graph representation of % Inhibition of *Daniella Oliveri* crude extract

### 4.1. Daniella *Oliveri*

In the stem bark of Daniella *Oliveri*, Delta Cadinenehas the highest percentage composition (16.62%). The cadinenes are bicyclic sesquiterpenes chemically. This kind of complexes has been fragmented to different subclasses of four, according to stereochemistry of isopropyl group with bridgehead of two carbon atoms due to vast quantity of identified double-bond and isomers stereochemical (Borg-Karlson et al., 1981). A category of isomeric hydrocarbons known as cadinenes are found in a wide range of plants that produce essential oils. Delta-cadinene synthase belong to an enzyme in the study of enzymes which activate/catalyzes the biochemical reaction. These enzymes belong to lyase family, specifically the phosphate-acting carbon-oxygen lyases. This enzyme takes part in the production of terpenoids. Magnesium is the only cofactor it uses. Ovarian cancer cells are prevented from growing by cadinene through caspase-dependent apoptosis and cell cycle arrest (Hui et al., 2015).

Second, gamma-muurolene is an octahydronaphthalene, a sesquiterpene (sesquiterpenoids), a carbobicyclic molecule. These terpenes have three isoprene units in a row. Standards; Natural Products Extracted; Pharmaceutical/API Drug Impurities/Metabolites which that state Muurolene is a terpenoid that is naturally present in Garcinia brasiliensis and the essential oil from Bulgaria. -Muurolene may have anti-inflammatory and antioxidant properties (Merdzhanov et al., 2016; Queiroz et al., 2014). This has justified the statement of Raffauf, 1992 in the literature reviews mentioned above. The extract has about 49 bioactive components identified by GC-MS and most of them are free fatty acids. They act as antioxidants and are also antimalarial.

The acetylcholinesterase used in carrying out the % inhibition is donepezil, the preliminary binding ability of the extract and donepezil are shown in table 3 with the linear progressive graphic

in figure 2. As the concentration increases, the inhibition % shows a progressive increment while table 2 shows % Inhibition of acetylcholinesterase activity of Daniella *Oliveri* ethyl acetate extract.

## 5. Conclusion

The above reviews gave a motivation to carry out research on Daniella *Oliveri*, despite numerous applications of this plant not much has been explore about it bioactive components. More also preliminary binding ability of this extract has not been fully conducted. In comparison to plants from other biomes, humid forest trees are recognized to contain larger number of natural biochemical resistances and to be more diverse, making them possible sources of new medications. Sub-Saharan Africa does not have any natural Cinchona trees (Artemisia annua), which the utmost powerful medications (artemisinin and quinine) were gotten. Given that African nations account for the majority of malaria-related deaths, therefore, researchers are encouraging to conduct research on herbal trees from these areas to cushion the challenges of malaria and other related diseases.

## ORCID

Maurice Jemkur https://orcid.org/0000-0003-1923-8652

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