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An α-Sophoradiol Glycoside from the Root Wood of *Erythrina senegalensis* DC. (Fabaceae) with α-Amylase and α-Glucosidase Inhibitory Potential

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Abstract

Phytochemical study of the roots of *Erythrina senegalensis* led to the isolation of a new α-sophoradiol glycoside, erythrinoside (**1**), together with four known compounds, lupeol (**2**), α-sophoradiol (**3**), isoneorautenol (**4**) and D-mannitol (**5**). The structures of the compounds were elucidated using spectroscopic data including 1D and 2D NMR, mass spectrometry and by comparison made with some data reported previously; the samples (extracts and compounds) were also subjected to antidiabetic assay. Erythrinoside and isoneorautenol exhibited good α-amylase inhibitory potential of 54.6% and 53.3%, respectively, compared to acarbose (72.5%) at 400 μg/mL. With α-glucosidase, all samples showed promising inhibition percentages above 50% at 200 μg/mL. In the α-glucosidase assay, the ethyl acetate extract (65.5%), methanol extract (72.1%), erythrinoside (63.3%) and isoneorautenol (66.0%) had percentage inhibitions closer to that of acarbose (69.0%) at 200 μg/mL. The methanol extract ($IC_{50} = 81.2 \pm 0.9$ μg/mL) was more active than acarbose ($IC_{50} = 94.5 \pm 0.7$ μg.mL) in the α-glucosidase assay. The inhibition of α-amylase and α-glucosidase indicates that *E. senegalensis* extracts and compounds could be used to manage diabetic conditions.

Keywords

Erythrina senegalensis, erythrinoside, α-sophoradiol glycoside, α-amylase inhibition, α-glucosidase inhibition, antidiabetic potential

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Introduction

The Fabaceae is a large family comprising over 16 000 species, which are grouped into about 480 genera. *Erythrina senegalensis* DC, a member of this family, is a tree (6 to 7 meters high)[1] found in Cameroon among the savannah woods and shrubs of the Sudano-Guinean woodland of the Adamawa Region and is equally spread in many other tropical and subtropical zones.[1,2] In African countries, *E. senegalensis* is a medicinal plant used as a general tonic and as remedy for several ailments such as cough, pneumonia, bronchial infection, malaria, snake bites, stomach ache, wound healing, normal fever and yellow fever, toothache, gastrointestinal disorders, jaundice, nose bleed, female infertility, gonorrhea and other venereal diseases, abdominal pain, and microbial and parasitic infections.[2,3-6] Previous scientific studies have shown biological activities possessed by this plant such as antimicrobial, antidiabetic, antioxidant, analgesic, anti-inflammatory, antiviral, antimalarial and antitumor.[2,7-10] The reported constituents of *E. senegalensis* are mainly phenolic compounds and prenylated flavonoids such as erythrinasinate, octacosyl (E)-fenilate, auriculatin, 2,3-dihydroauriculation, lonchocarpol A, scandenone, erysenegalensein D-M, 4′,5,7-trihydroxy-6,8-diprenylisoflavone, 6,8-diprenylgenistein, alpumisoflavone,[2,3,11,12], and alkaloids such as erysocline, erysopine, erysotrine, erythratidine,

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11-hydroxyerysodine, 11-hydroxyerysovine, 11-oxyerysodine and glucoerysodine.[2,13,14]

There are many documented medicinal benefits of *Erythrina senegalensis,* and, thereby, it is necessary to investigate scientifically the chemical compounds contained in this plant, as well as their biological activities. In this study, the roots of *Erythrina senegalensis* were investigated for their chemical composition, and the extracts, together with the isolated compounds, were evaluated for their antidiabetic potential through α-amylase and α-glucosidase inhibitory activities. To the best of our knowledge, the chemical compounds from the roots of *E. senegalensis* have not been the subject of any phytochemical and pharmacological studies.

Results and Discussion

Column chromatographic separation on silica gel of the ethyl acetate extract (25 g) of the roots of *E. senegalensis* led to the isolation of a new α-sophoradiol glycoside, named erythrinoside (**1,** 10 mg), isolated for the first time from a natural source, and three known compounds, lupeol (**2**, 1000 mg), α-sophoradiol (**3,** 14 mg) and isoneorautenol (**4,** 15 mg). The methanol extract (25 g) yielded one known compound, D-mannitol (**5**, 3 mg). The structures of the isolated compounds (Figure 1) were established by extensive analysis of their spectroscopic data and comparison with some previously reported data.

Compound **1** was obtained as an amorphous beige solid soluble in methanol. Its HR-ESI-TOF MS + mass spectrum (see supplemental material) showed a pseudomolecular ion peak $[M+Na]^+$ at m/z 597.4129 (Calcd. for 597.4131) corresponding to the molecular formula $C_{35}H_{58}O_6$, accounting for seven degrees of unsaturation. The compound responded positively to the Liebermann-Büchard test characteristic of a triterpenoid skeleton. The ^{1}H-NMR spectrum of **1** showed signals attributable to eight methyl groups at δ_H ppm 0.81 (3H, s), 0.90 (3H, s), 0.93 (3H, s), 1.00 (3H, s), 1.00 (3H, s), 1.02 (3H, s), 1.05 (3H, s), 1.15 (3H, s); one olefinic proton as a triplet at δ_H 5.26 ppm (1H, *t*, $J = 7.6$ Hz) characteristic of H-12 of the olean-12-ene triterpene type[15]; two oxymethine protons at δ_H ppm 3.42 (1H, *dd*, $J = 8.0$, 3.1 Hz) corresponding to H-3, and 3.18 ppm (1H, dd, $J = 13.6$, 4.2 Hz) corresponding to H-22. The proton spectrum of **1** presents some similarities to that of sophoradiol, which was previously isolated and described from the same plant.[16] However, this spectrum showed additional signals corresponding to the presence of a sugar moiety. Several signals were observed between δ_H 3.15 and 4.20 ppm. The signal at δ_H 4.20 ppm (1H, d, $J = 7.4$ Hz) corresponds to an anomeric proton (H-1′) of the sugar moiety. The coupling constant ($J = 7.4$ Hz) of the anomeric proton indicates that the sugar moiety adopts the β-configuration on the aglycon. We also observed three oxymethine proton signals appearing at δ_H 3.17, 3.31 and 3.49 ppm, as well as two diastereotopic protons of an oxymethylene at δ_H 3.85 and 3.14 ppm, all belonging to the sugar moiety. The sugar residue was identified as D-xylose by comparison with reported data, which is the form that usually occurs endogenously in living things.[17] The ^{13}C-NMR spectrum of **1** showed signals at δ_C 122.4 and 143.8 ppm corresponding to C-12 and C-13 of an olean-12-ene triterpene type.[15] A joint analysis of the ^{13}C NMR spectrum with DEPT and HSQC spectra indicated two oxymethine carbons at δ_C 81.9 ppm (C-3) and 78.3 ppm (C-22); one anomeric carbon from the sugar moiety at δ_C 101.3 ppm (C-1′), three oxymethine carbons of the sugar moiety at δ_C ppm 69.9 (C-4′), 73.5 (C-2′) and 76.5 (C-3′) and one oxymethylene carbon at δ_C 65.3 ppm (C-5′). The COSY spectrum of **1** showed cross peaks between H-3 at δ_H 3.42 ppm and two diastereotopic protons at δ_H 1.52 and 1.36 ppm corresponding to Ha-2 and Hb-2, respectively. The spectrum also showed important correlation between the proton at δ_H 3.18 ppm (H-22) (which overlaps with two other proton signals) and two diastereotopic protons at δ_H 1.63 ppm and 1.57 ppm corresponding to Ha-21 and Hb-21, respectively. The HMBC correlation spectrum of **1** enabled us to locate the sugar moiety on the aglycon. The spectrum showed correlation between the anomeric proton at δ_H 4.20 ppm (H-1′) and C-3 at δ_C 81.9 ppm of the aglycon moiety, suggesting that the sugar moiety is attached to the aglycon on C-3. All of these spectral data led to the identification of compound **1** as 3-*O*-β-D-xylopyranosylolean-12-en-22-ol to which the trivial name erythrinoside was given. To the best of our knowledge, this compound is isolated for the first time from a natural source.

The known compounds have been previously described in many other plants, lupeol (**2**),[18] α-sophoradiol (**3**),[16] isoneorautenol (**4**),[19] and D-mannitol (**5**).[20] Their structures were determined by comparison with the data from the literature referenced above respectively.

The ethyl acetate and methanol extracts and the isolated compounds from *Erythrina senegalensis* were evaluated for their antidiabetic capacity by measuring their α-amylase and α-glucosidase inhibition (Table 1); the results are reported as inhibition percentages and IC_{50} values of α-amylase and α-glucosidase inhibition. The methanol extract showed higher inhibition (46.3%) of α-amylase at the dose of 400 mg/mL than the ethyl acetate extract (39.9%) at the same dose. Both extracts showed moderate activity on the inhibition of α-amylase. Likewise, among the tested compounds, erythrinoside (**1**) showed the best percentage inhibition (54.6%) of α-amylase at the dose of 400 μg/mL, followed by isoneorautenol (**4**) (53.3%) and sophoradiol (**3**) (48.2%) at the same dose. Lupeol (**2**) exhibited weak inhibition (19.2%) of α-amylase. For α-glucosidase, all samples showed promising inhibition above 50% at 200 μg/mL. The ethyl acetate extract (65.5%), erythrinoside (63.3%) and isoneorautenol (66.0%) had percentage inhibitions closer to that of acarbose at 200 μg/mL, while the methanol extract (72.1%) showed the highest inhibition among all tested samples, and acarbose as well. The methanol extract of *E. senegalensis* was more active than acarbose with an IC_{50} of 81.2 ± 0.9 μg/mL compared to 94.5 ± 0.7 μg.mL for acarbose in the α-glucosidase assay. Erythrinoside and sophoradiol have the same

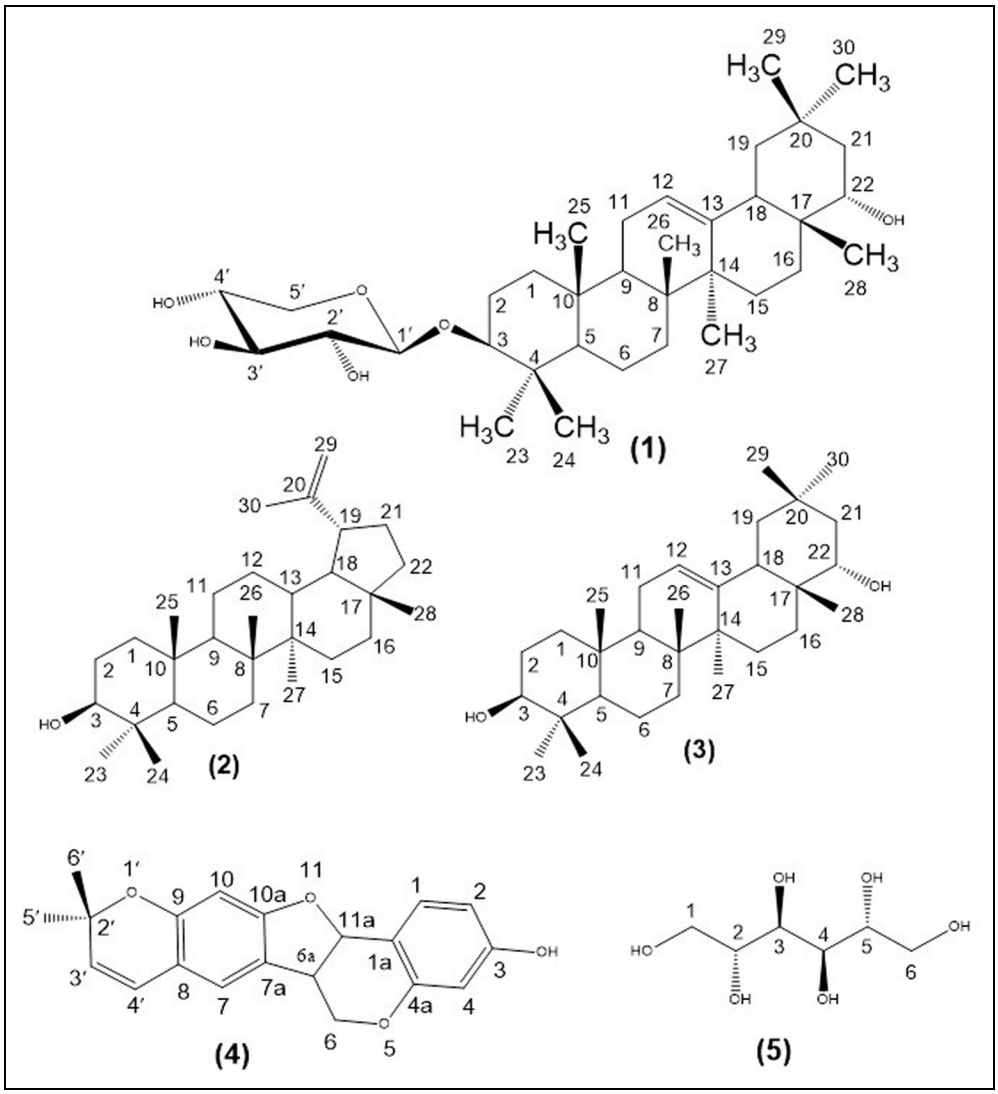

Figure 1. Structures of compounds (**1-5**) isolated from *E. senegalensis*

aglycon. However, erythrinoside was more active than sophoradiol, which could be due to the presence of a sugar moiety in its structure which correlated positively with the antidiabetic activity. D-mannitol was not tested because it was obtained in small amount. All samples tested were less active than acarbose (72.5% inhibition) used as a reference drug. Compounds **1** and **4** and the extracts showed good inhibition percentages on α-amylase and α-glucosidase and could be applied in the management of diabetic conditions.

Material and Methods

General Experimental Procedure

Column chromatography (CC) was performed on silica gel 60 (70-230 mesh, Merck), and thin layer chromatography (TLC) on silica gel pre-coated plates F-254 Merck (20 × 20 cm). Compounds were visualized under UV light (254 and 365 nm), then sprayed with dilute sulfuric acid, and heated. The ^{1}H and ^{13}C NMR data were recorded on Bruker Avance AV-500 and 600 spectrometers, with trimethylsilane (TMS) as standard. Chemical shifts are given in ppm (δ) and coupling constants (J) in Hz. HR-TOF-MS LD^{+} spectra were registered on a QTOF Spectrometer (Bruker, Germany).

Plant Material

The roots wood of *Erythrina senegalensis* was collected in Ngaoundere in the Adamawa Region during July 2020. The plant was identified at the National Herbarium of Cameroon (NHC) with the voucher number: N° 50119 NHC.

Extraction and Isolation Procedure

The roots of *Erythrina senegalensis* were collected, dried at room temperature then ground into powder. Two Kg of the plant material was successively extracted by maceration at room

Table 1. α-Amylase and α-Glucosidase Inhibition by Extracts and Tested Compounds.

	α-amylase		α-glucosidase	
Samples	%inh. (400 μg/mL)	IC_{50} (μg/mL)	% inh. (200 μg/mL)	IC_{50} (μg/mL)
Ethyl acetate extract	39.9	>400	65.5	127.3 ± 1.4
Methanol extract	46.3	>400	72.1	81.2 ± 0.9
Erythrinoside (1)	54.6	291.4 ± 0.5	63.3	103.3 ± 0.5
Lupeol (2)	19.2	>400	53.0	176.1 ± 1.2
α-Sophoradiol (3)	48.2	>400	57.0	144.8 ± 0.3
Isoneorautenol (4)	53.3	325.8 ± 1.0	66.0	111.6 ± 1.1
Acarbose	72.5	263.3 ± 2.5	69.0	94.5 ± 0.7

temperature with 10 L of ethyl acetate and 8 L of methanol. For each solvent, extraction was made three times at the rate of one extraction every 72 h before moving on to the next solvent. The resulting solutions were evaporated using a rotary evaporator to obtain 30 g of ethyl acetate crude extract and 33 g of methanol crude extract. Twenty-five g of each extract was separated through column chromatography on silica gel using a gradient system of *n*-hexane/ethyl acetate (0 → 100%) and ethyl acetate/methanol (0 → 100%). From the ethyl acetate extract, 352 fractions were obtained and grouped into sixteen sub-fractions (A-P), according to their TLC profile. Sub-fractions B, C, D and G crystallized and were filtered and washed to obtain compounds **2** (1000 mg), **4** (15 mg), **3** (14 mg) and **1** (10 mg), respectively. Likewise, from the methanol extract, 200 fractions were collected and grouped into ten sub-fractions (A–J), out of which only sub-fraction E could be studied; this afforded compound **5** (3 mg) by purification using column chromatography.

General NMR Data of Compounds 1 to 5

Erythrinoside (1)<PE: Please Check Heading Level.>. Amorphous beige solid; HR-ESI-MS(+) m/z = 597.4129 $[M+Na]^+$ (Calcd. for $C_{35}H_{58}O_6$ + Na, 597.4131); ^{1}H NMR (CD_3OD, 600 MHz) δ_H ppm : 5.26 (H-12, *t, J* = 7.6 Hz), 4.20 (H-1′, *d, J* = 7.6 Hz), 3.49 (H-4′, *m*), 3.42 (H-3, *dd*, *J* = 8.0, 3.1 Hz), 3.32 (H-3′, *m*), 3.18 (H-22, *dd*, *J* = 13.6, 4.2 Hz), 3.17 (H-2′, *m*), 3.14 (H-5′a, *m*), 3.85 (H-5′b, *m*), 2.11 (H-9, *m*), 2.03 (H-18, *m*), 1.90 (H-16a, *m*), 1.93 (H-16b, *m*), 1.80 (H-11a, *m*), 1.03 (H-11b, *m*), 1.78 (H-15a, *m*), 1.04 (H-15b, *m*), 1,76 (H-19, *m*), 1.63 (Ha-21, *m*), 1.57 (Hb-21, *m*), 1,58 (H-6a, *m*), 1,45 (H-6b, *m*), 1,53 (H-1a, *m*), 1,36 (H-1b, *m*), 1.52 (H-2a, *m*), 1.36 (H-2b, *m*), 1,39 (H-7, *m*), 1.15 (H-27, *s*), 1.05 (H-23, *s*), 1.02 (H-26, *s*), 1.00 (H-25, *s*), 1.00 (H-28, *s*),0.93 (H-29, *s*), 0.90 (H-30, *s*), 0.81 (H-24, *s*), 0.77 (H-5, *m*).

^{13}C NMR (CD_3OD, 150 MHz) δ_C ppm: 36.4 (C-1), 26.5 (C-2), 81.9 (C-3), 38.4 (C-4), 55.3 (C-5), 18.1 (C-6), 32.7 (C-7), 39.4 (C-8), 44.8 (C-9), 36.6 (C-10), 23.2 (C-11), 122.4 (C-12), 143.8 (C-13), 41.8 (C-14), 25.4 (C-15), 27.3 (C-16), 25.4 (C-17), 45.4 (C-18), 46.1 (C-19), 29.8 (C-20), 38.6 (C-21), 78.2 (C-22), 27.5 (C-23), 14.7 (C-24), 14.9 (C-25), 16.2 (C-26), 24.2 (C-27), 27.3 (C-28), 31.2 (C-29), 19.7 (C-30), 101.3 (C-1′), 73.5 (C-2′), 76.5 (C-3′), 69.9 (C-4′), 65.3 (C-5′).

Lupeol (2). White solid; ESI-MS (+) m/z = 449.9 $[M+Na]^+$ for $C_{30}H_{50}O$; ^{1}H NMR ($CDCl_3$, 500 MHz) δ_H ppm: 4.55 (H-29, *d, J* = 1,6 Hz), 3.21 (H-3, *m*), 2.45 (H-19, *m*), 1.93 (H-21a, *m*), 1.32 (H-21b, *m*), 1.67 (H-30, s), 1.66 (H-13, *m*), 1,52 (H-6a, *m*), 1.63 (H-1a, *m*), 0.92 (H-1b, *m*), 1.51 (2H, *m*, H-2a and 2b), 1.38 (H-6b, *m*), 1,37 (2H, *m*, H-7a and 7b),1.47 (Ha-21, *m*), 1.35 (H-16a, *m*), 1,45 (H-16b, *m*), 1.25 (H-9, *m*), 1.37 (H-22a, *m*), 1,18 (H-22b, *m*), 1.03 (H-26, *s*) 0,95 (H-27, *s*), 0.90 (H-23, *s*), 0.85 (H-25, *s*), 0.79 (H-28, *s*); 0.77 (H-24, *s*). ^{13}C NMR ($CDCl_3$, 125 MHz) δ_C ppm: 38.7 (C-1), 27.5 (C-2), 78.9 (C-3), 38.8 (C-4), 55.2 (C-5), 18.4 (C-6), 34.3 (C-7), 41.0 (C-8), 50.5 (C-9), 37.2 (C-10), 20.9 (C-11), 25.3 (C-12), 38.1 (C-13), 42.8 (C-14), 27.4 (C-15), 35.3 (C-16), 42.4 (C-17), 48.4 (C-18), 47.9 (C-19), 151.1 (C-20), 29.6 (C-21), 39.9 (C-22), 27.9 (C-23), 15.7 (C-24), 16.2 (C-25), 15.9 (C-26), 14.7 (C-27), 17.8 (C-28), 109.5 (C-29), 19.4 (C-30).

α-Sophoradiol (3). White powder; ESI-MS (+) m/z = 465.8 $[M+Na]^+$ for $C_{30}H_{50}O_2$; ^{1}H NMR (CD_3OD, 500 MHz) δ_H ppm: 5.27 (H-12, *t, J* = 7.5 Hz), 3.41 (H-3, *dd*, *J* = 8.0, 3.1 Hz), 3.17 (H-22, *dd*, *J* = 13.6, 4.2 Hz), 1.55 (H-9, *m*), 1.02 (H-16a, *m*), 0.99 (H-16b, *m*), 1.91 (2H, *m,* H-11a and 11b), 1.78 (H-15a, *m*), 1.04 (H-15b, *m*), 1,76 (2H, *m,* H-19a and 19b), 1.47 (Ha-21, *m*), 1.35 (Hb-21, *m*), 1,58 (H-6a, *m*), 1,45 (H-6b, *m*), 1,66 (H-1a, *m*), 1,00 (H-1b, *m*), 1.64 (H-2a, *m*), 1.57 (H-2b, *m*), 1,41 (2H, *m,* H-7a and 7b), 2.03 (H-18, *m*), 1.14 (H-27, *s*), 1.05 (H-23, *s*), 1.02 (H-26, *s*), 0.80 (H-25, *s*), 1.31 (H-28, *s*), 0.92 (H-29, *s*), 0.85 (H-30, *s*), 0.99 (H-24, *s*), 0.75 (H-5, *m*). ^{13}C NMR (CD_3OD, 150 MHz) δ_C ppm: 38.4 (C-1), 26.5 (C-2), 75.5 (C-3), 38.6 (C-4), 55.3 (C-5), 18.1 (C-6), 32.8 (C-7), 39.4 (C-8), 48.2 (C-9), 36.6 (C-10), 23.1 (C-11), 122.3 (C-12), 143.8 (C-13), 41.9 (C-14), 25.5 (C-15), 27.3 (C-16), 25.4 (C-17), 45.3 (C-18), 46.1 (C-19), 29.9 (C-20), 40.8 (C-21), 78.2 (C-22), 27.6 (C-23), 14.7 (C-24), 14.9 (C-25), 16.2 (C-26), 24.0 (C-27), 28.4 (C-28), 31.1 (C-29), 19.0 (C-30).

Isoneorautenol (4). Gray powder; ESI-MS (+) m/z = 345.5 $[M+Na]^+$ for $C_{20}H_{18}O_4$; ^{1}H NMR (CD_3OD, 500 MHz) δ_H ppm: 7.29 (H-1, *d, J* = 8.4 Hz), 6.92 (H-7, *s*), 6.51 (H-2, *dd, J* = 8.4, 2.4 Hz), 6.32 (H-4, *d, J* = 2.4 Hz), 6.30 (H-4′, *d, J* = 9.8 Hz), 5.51 (H-3′, *d, J* = 9.8 Hz), 5.43 (H-11a, *d, J* = 6.8 Hz), 4.22 (H-6eq, *dd, J* = 10.7, 4.8 Hz), 3.53 (H-6ax, *m*), 3.43 (H-6a, *m*), 1.39 (H-5′, *s*), 1.37 (H-6′, *s*). ^{13}C NMR (CD_3OD, 125 MHz) δ_C ppm: 111.3 (C-1a), 131.7 (C-1), 109.3 (C-2), 158.7 (C-3),

102.7 (C-4), 156.6 (C-4a), 66.1 (C-6), 39.4 (C-6a), 119.5 (C-7a), 121.9 (C-7), 114.8 (C-8), 154.2 (C-9), 98.3 (C-10), 160.1 (C-10a), 78.6 (C-11a), 76.0 (C-2′), 127.0 (C-3′), 121.9 (C-4′), 26.8 (C-5′), 26.7 (C-6′).

D-Mannitol (5). White solid; ESI-MS (+) $m/z = 205.06$ $[M+Na]^+$ for $C_6H_{14}O_6$; ^{1}H NMR (DMSO-d_6, 600 MHz) δ_H ppm: 4.50 (2H, *d*, $J = 5.8$ Hz, HO-2 and 5), 4.40 (2H, *t*, $J = 6.0$ Hz, HO-1 and 6), 4.25 (2H, *d*, $J = 7{,}3$ Hz, HO-3 and 4), 3.60 (2H, *m*, H-1a and 6a), 3,55 (2H, *t*, $J = 7{,}1$ Hz, H-3 and 4), 3.45 (2H, *m*, H-2 and 5), 3,40 (2H, *m*, H-1b and 6b). ^{13}C NMR (DMSO-d_6, 150 MHz) δ_C ppm: 64.3 (C-1 and 6), 71.7 (C-2 and 5), 70.0 (C-3 and 4).

In Vitro α-Amylase Inhibition Assay

The α-amylase inhibition assay was performed using the 3,5-dinitrosalicylic acid (DNSA) method.[21] Extracts and compounds (**1**, **2**, **3** and **4)** isolated from *Erythrina senegalensis* were dissolved in a minimum amount of 10% DMSO and further dissolved in buffer [(Na_2HPO_4/NaH_2PO_4 (0.02 M), NaCl (0.006 M) at pH 6.9] to give concentrations of 100, 200 and 400 µg/mL. Two hundred µL of α-amylase solution (2 units/mL) was mixed with 200 µL of the extract and incubated for10 min at 30 °C. Thereafter 200 µL of starch solution (1% in water (w/v)) was added to each tube and incubated for 3 min. The reaction was terminated by the addition of 200 µL DNSA reagent (12 g of sodium potassium tartratetetrahydrate in 8.0 mL of 2 M NaOH and 20 mL of 96 mM 3.5-dinitrosalicylic acid solution) and was boiled for 10 min in a water bath at 85-90 °C. The mixture was cooled to ambient temperature and diluted with 5 mL of distilled water; the absorbance was measured at 540 nm using a UV-Visible spectrophotometer. The blank with 100% enzyme activity was prepared by replacing the plant extract or/compound with 200 µL of buffer. A positive control sample was prepared using acarbose and the reaction was performed similarly to the reaction with plant extract, as mentioned above. The α-amylase inhibitory activity was expressed as percentage inhibition and was calculated using the equation given below:

$$\%\,\text{inhibition of } \alpha\text{-amylase} = \frac{\text{Abs control} - \text{Abs sample}}{\text{Abs control}} \times 100$$

In Vitro α -Glucosidase Inhibition Assay

β-Glucosidase inhibitory activity was determined as described elsewhere.[22] Briefly, mixtures of 20 µL sodium phosphate buffer (pH 5.0), 20 µL p-nitrophenyl-β-D-glucopyranoside (Sigma Chemical Co., 1 mg/mL) and 10 µL of the sample at different concentrations (dissolved in DMSO) were incubated in a 96-well plate at 37 °C for 10 min, followed by the addition of 10 µL β-glucosidase solution from almonds (Sigma Chemical Co., 5 mg/mL) to each well, and incubation at 37 °C for 30 min. The reaction was terminated by adding 140 µL of sodium carbonate buffer, pH = 10. Absorbance was determined at 410 nm using a microplate reader (iTecan Microplate). To the control and blank were added 10 µL DMSO instead of the sample solution. The system without β-glucosidase was used as blank, and acarbose was used as positive control. The β-glucosidase inhibitory activity was expressed as the percentage of inhibition and calculated by the following equation:

$$\%\ \text{inhibition of } \alpha\text{-glucosidase} = 100 \times \left(1 - \frac{\text{ODsample} - \text{ODblank}}{\text{ODcontrol} - \text{ODblank}}\right)$$

Conclusion

Investigation of the chemical constituents from the roots of *Erythrina senegalensis* resulted in the isolation and characterization of five compounds, including one new oleanane-type triterpenoid glycoside (erythrinoside) and four known compounds. The antidiabetic potential of the extracts and the isolated compounds were evaluated by measuring the inhibition of α-amylase. Compounds **1** and **4** exhibited good α-amylase inhibitory potential, while the extracts exhibited moderate activities by showing appreciable percentage inhibition of the enzyme. Since α-amylase is a key enzyme involved in the breakdown of starch into glucose, inhibiting this enzyme can delay starch hydrolysis and reduce the amount of glucose in the system. This is a favorable phenomenon in diabetic conditions thus indicating that *Erythrina senegalensis* and its constituents could be potent candidates for the development of antidiabetic therapies.

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Ethical Approval

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Statement of Human and Animal Rights

This article does not contain any studies with human or animal subjects.

Statement of Informed Consent

There are no human subjects in this article and informed consent is not applicable.

Trial Registration

Not applicable, because this article does not contain any clinical trials.

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Supplemental Material

Supplemental material for this article is available online.

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