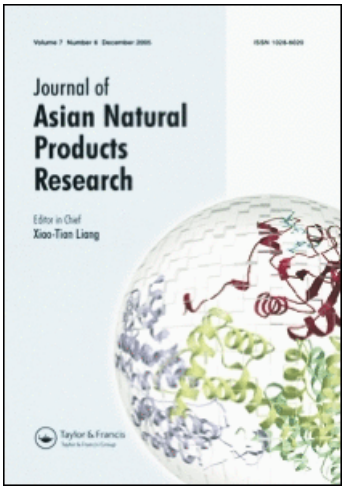
This article was downloaded by:
On: *22 January 2011*
Access details: *Access Details: Free Access*
Publisher *Taylor & Francis*
Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Journal of Asian Natural Products Research
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713454007

Two new isoflavanones from *Erythrina costaricensis*

Hitoshi Tanaka[a]; Hisanori Hattori[a]; Tomoko Oh-Uchi[a]; Masaru Sato[b]; Ryozo Yamaguchi[b]; Magoichi Sako[c]; Yoichi Tateishi[d]
[a] Faculty of Pharmacy, Meijo University, Nagoya, Japan [b] Department of Oral Pathology, Asahi University School of Dentistry, Gifu, Japan [c] Ohara Pharmaceutical Co. Ltd, Shiga, Japan [d] Faculty of Education, University of the Ryukyus, Okinawa, Japan

To cite this Article Tanaka, Hitoshi , Hattori, Hisanori , Oh-Uchi, Tomoko , Sato, Masaru , Yamaguchi, Ryozo , Sako, Magoichi and Tateishi, Yoichi(2008) 'Two new isoflavanones from *Erythrina costaricensis*', Journal of Asian Natural Products Research, 10: 10, 983 — 987
To link to this Article: DOI: 10.1080/10286020802217598
URL: http://dx.doi.org/10.1080/10286020802217598

PLEASE SCROLL DOWN FOR ARTICLE

Full terms and conditions of use: http://www.informaworld.com/terms-and-conditions-of-access.pdf

This article may be used for research, teaching and private study purposes. Any substantial or systematic reproduction, re-distribution, re-selling, loan or sub-licensing, systematic supply or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The accuracy of any instructions, formulae and drug doses should be independently verified with primary sources. The publisher shall not be liable for any loss, actions, claims, proceedings, demand or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.

Journal of Asian Natural Products Research
Vol. 10, No. 10, October 2008, 983–987

Taylor & Francis
Taylor & Francis Group

Two new isoflavanones from *Erythrina costaricensis*

Hitoshi Tanaka[a]*, Hisanori Hattori[a], Tomoko Oh-Uchi[a], Masaru Sato[b], Ryozo Yamaguchi[b], Magoichi Sako[c] and Yoichi Tateishi[d]

[a]*Faculty of Pharmacy, Meijo University, Nagoya, Japan;* [b]*Department of Oral Pathology, Asahi University School of Dentistry, Gifu, Japan;* [c]*Ohara Pharmaceutical Co. Ltd, Shiga, Japan;* [d]*Faculty of Education, University of the Ryukyus, Okinawa, Japan*

(*Received 9 February 2008; final version received April 2008*)

Two new isoflavanones, 5,3′-dihydroxy-4′-methoxy-5′-(3-methyl-1,3-butadienyl)-2″,2″-dimethylpyrano[5,6:6,7]isoflavanone (**1**) and 5,3′-dihydroxy-5′-(3-hydroxy-3-methyl-1-butenyl)-4′-methoxy-2″,2″-dimethylpyrano[5,6:6,7]isoflavanone (**2**), together with two known isoflavonoids, cristacarpin, and euchrenone b_{10}, were isolated from the stems of *Erythrina costaricensis*. Their structures were established on the basis of spectroscopic evidence. These new compounds are rare isoflavanones, possessing both a 2,2-dimethylpyran substituent and a prenyl analog. The antibacterial activities of **1** and **2** against the methicillin-resistant *Staphylococcus aureus* were examined.

Keywords: *Erythrina costaricensis*; Leguminosae; isoflavonoids; isoflavanones; anti-MRSA activity

Downloaded At: 18:52 22 January 2011

1. Introduction

The genus *Erythrina* (Leguminosae) has about 110 species distributed in the tropical and subtropical regions of the world, and has often been used for the folklore medicinal treatment of microbial infections [1]. We have recently reported a 2-arylbenzofuran (erythbidin E), possessing potent antibacterial activity against methicillin-resistant *Staphylococcus aureus* (MRSA), which has been isolated from the roots of *Erythrina* × *bidwillii* [2]. As a continuation of our screening of anti-MRSA isoflavonoids from *Erythrina* plants, we have focused our attention on the isolation of the secondary metabolites of *Erythrina costaricensis* Micheli and their antibacterial activities. *E. costaricensis*, a small tree with brilliant red flowers, is native to the forests of Central America. A phytochemical study of this plant documented the isolation of a few *Erythrina* alkaloids (erysodine, erysonine, and erysopine) [3], while the investigation of the non-alkaloidal metabolites has not yet been done. We now describe the isolation and structural elucidation of two new isoflavanones, **1** and **2**, along with two known compounds, cristacarpin [4] and euchrenone b_{10} [5] from the stems of this plant, and also report the anti-MRSA activities of the newly isolated compounds **1** and **2** (Figure 1).

2. Results and discussion

The CH_2Cl_2-soluble portion of the acetone extract of the *E. costaricensis* stems, upon silica gel chromatography, gave two new isoflavanones (**1** and **2**), together with two known compounds, cristacarpin and euchrenone b_{10}.

Compound **1** was obtained in the racemic form and its molecular formula, $C_{26}H_{26}O_6$, was determined from the HREIMS at *m/z*

*Corresponding author. Email: hitoshi@ccmfs.meijo-u.ac.jp

ISSN 1028-6020 print/ISSN 1477-2213 online
© 2008 Taylor & Francis
DOI: 10.1080/10286020802217598
http://www.informaworld.com

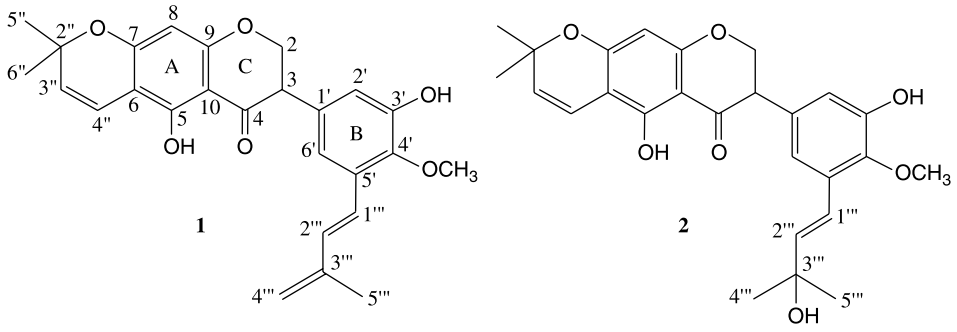


Figure 1. Structures of compounds **1** and **2**.

Downloaded At: 18:52 22 January 2011

434.1722 $[M]^+$. This compound was determined to be an isoflavanone based on the characteristic spectral data [1640 cm^{-1} for the conjugated carbonyl group in the IR spectrum and a set of aliphatic proton signals (δ 4.02 and 4.68) in the ^1H NMR spectrum (Table 1)]. Isoflavanones have been generally obtained as racemates, because the extraction and isolation process leads to racemization of the isoflavanones [6]. The ^1H NMR spectrum showed an aromatic proton singlet (δ 5.91) and a 2,2-dimethylpyran substituent (δ 1.43, 1.44, 5.64, and 6.57) on A-ring, as well as *metha*-coupled aromatic protons (δ 6.81 and 7.14), a 3-methyl-1,3-butadienyl moiety (δ 1.98, 5.09, 5.12, 6.82, and 6.98), and a methoxyl group (δ 3.77) on B-ring. The presence of the dimethylpyran ring was confirmed by the characteristic fragment ion ($[M - CH_3]^+$ *m/z* 419, base peak) [7] in the EIMS spectrum. The location of the pyran ring fused to the C-6 and C-7 positions was based on the heteronuclear multiple-bond correlation (HMBC) experiment (Figure 2), which indicated a correlation between an olefinic proton at C-3″ and a quaternary carbon at C-6, and correlations between an olefinic proton at C-4″ and quaternary carbons at C-6 and C-7. The methoxyl and the butadienyl groups were assigned to the C-4′ and C-5′ positions, respectively, based on both the HMBC spectrum (correlations: H-6′/C-1‴, H-2‴/C-5′, and OCH_3-4′/C-4′) and the NOESY data (NOE interaction: H-1‴/OCH_3-4′) (Figure 2). Attachment of the B-ring (3-hydroxy-4-methoxy-5-(3-methyl-1,3-butadienyl)phenyl moiety) to C-ring (chroman ring) at the C-3 position was decided from the HMBC spectrum (correlations: H-2′/C-3 and H-6′/C-3). Thus, compound **1** was established as 5,3′-dihydroxy-4′-methoxy-5′-(3-methyl-1,3-butadienyl)-2″,2″-dimethylpyrano[5,6:6,7]isoflavanone.

Compound **2** was also obtained in the racemic form, whose molecular formula, $C_{26}H_{28}O_7$, was determined on the basis of the HRFABMS (positive mode) at *m/z* 453.1906 $[M + H]^+$. Compound **2** also has the isoflavanone skeleton, indicated by the specific spectral data [1640 cm^{-1} in the IR spectrum and a set of aliphatic proton signals (δ 4.01 and 4.66) in the ^1H NMR spectrum]. The ^1H and ^{13}C NMR (Table 1) spectral data of **2** were similar to those of **1**, except for the disappearance of a 3-methyl-1,3-butadienyl group on the B-ring of **1** and the presence of a 3-hydroxy-3-methyl-1-butenyl moiety in **2**, which was characterized by the ^1H NMR spectrum [two methyl groups (δ 1.35) and two olefinic protons (δ 6.45 and 6.85)]. The location of the butenyl moiety at the C-5′ position was confirmed from both the HMBC experiment (correlations: H-6′/C-1‴ and H-2‴/C-5′) and the NOESY spectrum (NOE interactions: H-6′/H-2‴ and H-1‴/OCH_3-4′) (Figure 3). Thus, the structure of compound **2** was determined to be 5,3′-dihydroxy-5′-(3-hydroxy-3-methyl-1-butenyl)-4′-methoxy-2″,2″-dimethylpyrano[5,6:6,7]isoflavanone.

Table 1. ^{1}H NMR and ^{13}C NMR spectral data of **1** and **2** (in acetone-d_6).

	1		**2**	
No.	δ_H (J in Hz)	δ_C	δ_H (J in Hz)	δ_C
2	4.68 m	71.9	4.66 d (6.4)	72.0
3	4.02 dd (7.3, 5.2)	51.3	4.01 t (6.4)	51.3
4		197.8		197.9
5		159.6		159.6
6		103.5		103.4
7		162.7		162.6
8	5.91 s	96.3	5.91 s	96.3
9		163.5		163.6
10		103.5		103.5
1′		132.6		132.5
2′	6.81 d (2.0)	116.6	6.78 d (2.0)	116.0
3′		151.2		151.1
4′		145.9		145.7
5′		132.0		132.2
6′	7.14 d (2.0)	118.1	7.04 d (2.0)	118.4
2″		79.1		79.0
3″	5.64 d (10.3)	127.4	5.64 d (10.3)	127.4
4″	6.57 d (10.3)	115.6	6.57 d (10.3)	115.6
5″	1.43 s	28.5	1.44 s	28.5
6″	1.44 s	28.5	1.44 s	28.5
1‴	6.82 d (16.6)	123.7	6.85 d (16.1)	120.6
2‴	6.98 d (16.6)	133.6	6.45 d (16.1)	141.2
3‴		143.2		70.7
4‴	5.09 brs	118.0	1.35 s	30.4
	5.12 brs			
5‴	1.98 brs	18.6	1.35 s	30.4
4′-OCH_3	3.77 s	61.2	3.73 s	61.0
3′-OH	8.19 brs		7.35 brs[a]	
3‴-OH			8.11 brs[a]	
5-OH	12.55 brs		12.57 brs	

Note: 500 MHz for ^{1}H NMR and 125 MHz for ^{13}C NMR.
[a]Assignments may be interchanged.

Downloaded At: 18:52 22 January 2011

These two new compounds **1** and **2** are the rare isoflavanones, possessing both a 2,2-dimethylpyran substituent and a prenyl analog in the structure.

The antibacterial activity of the two new compounds **1** and **2** against 13 strains of MRSA was investigated using a previous procedure [8]. Compound **2** exhibited a weak anti-MRSA activity (MIC_{50}: 25 μg/ml) and compound **1** failed to inhibit the growth of all the MRSA strains at the concentration of 50 μg/ml. The new compounds isolated in the present study showed low or no anti-MRSA activity. In contrast, an isoflavanone derivative with the prenyl group on the A-ring (bidwillon B) exhibited a strong anti-MRSA activity [9]. Thus, it is considered that the presence and position of the prenyl group in the isoflavanones may play an important role in the anti-MRSA activity [9].

3. Experimental

3.1 General experimental procedures

The optical rotations were recorded at 23°C using a JASCO DIP-370 digital polarimeter. The circular dichroism (CD) spectra were measured by a JASCO J-725 spectropolarimeter. The IR and UV spectra were recorded using a JASCO IR-810 spectrophotometer and

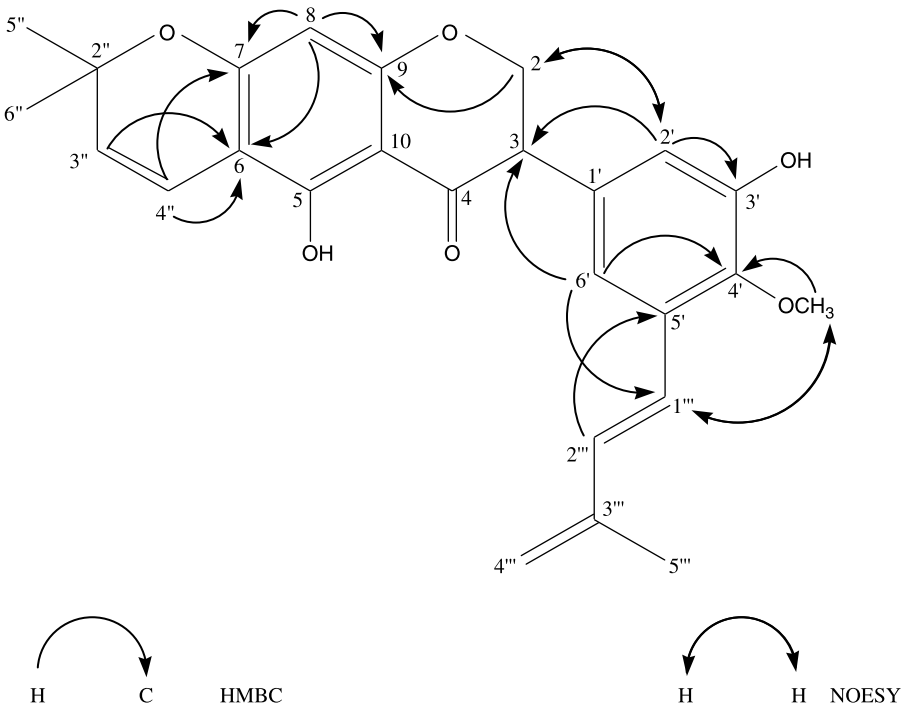


Figure 2. Key HMBC and NOESY correlations of **1**.

a Beckman DU-530 spectrophotometer, respectively. The MS spectra were determined by a JEOL JMS-SX 102A spectrometer. The ^{1}H and ^{13}C NMR spectra were measured using a JEOL ECA-500 (500 MHz for ^{1}H and 125 MHz for ^{13}C) spectrometer. Assignments of the ^{1}H and ^{13}C NMR spectroscopic signals of **1** and **2** were made on the basis of ^{1}H–^{1}H COSY, NOESY, HMQC, and HMBC spectra. Column chromatography was performed using Merck silica gel (230–400 mesh). The minimum inhibitory concentrations (MICs) and minimum bactericidal concentrations for the new compounds **1** and **2** against the 13 MRSA strains were investigated as previously reported [8].

3.2 Plant material

The stems of *Erythrina costaricensis* were collected in the Prov. de Cocle, Panama, in November 2001, and identified by Dr Yoichi Tateishi (one of the authors). A voucher specimen (Tateishi & Kajita 0111053) has been deposited in the Herbarium, Faculty of Education, University of the Ryukyus.

3.3 Extraction and isolation

The dried powder of the stems (460 g) was macerated with acetone (3 × 3 l) for 2 days and the solvent was removed to produce a dark-green residue. The residue (26.4 g) was divided into *n*-hexane-, CH_2Cl_2-, and EtOAc-soluble fractions. The CH_2Cl_2-soluble fraction (10.6 g) was first applied to column chromatography on silica gel eluting with $CHCl_3$–acetone (10:1 → 3:1 → 1:1) (each 200 ml) to afford eight fractions. Fraction 2 (1.28 g) was purified by repeated silica gel column chromatography using *n*-hexane–acetone (5:1) and benzene-EtOAc (40:1) to give **1** (34.8 mg). Fraction 6 (980 mg) was separated by careful silica gel column chromatography using *n*-hexane–acetone (2:1) and benzene–EtOAc (3:1) to yield **2** (17.7 mg), cristacarpin (5.2 mg) and euchrenone b_{10} (7 mg).

Downloaded At: 18:52 22 January 2011

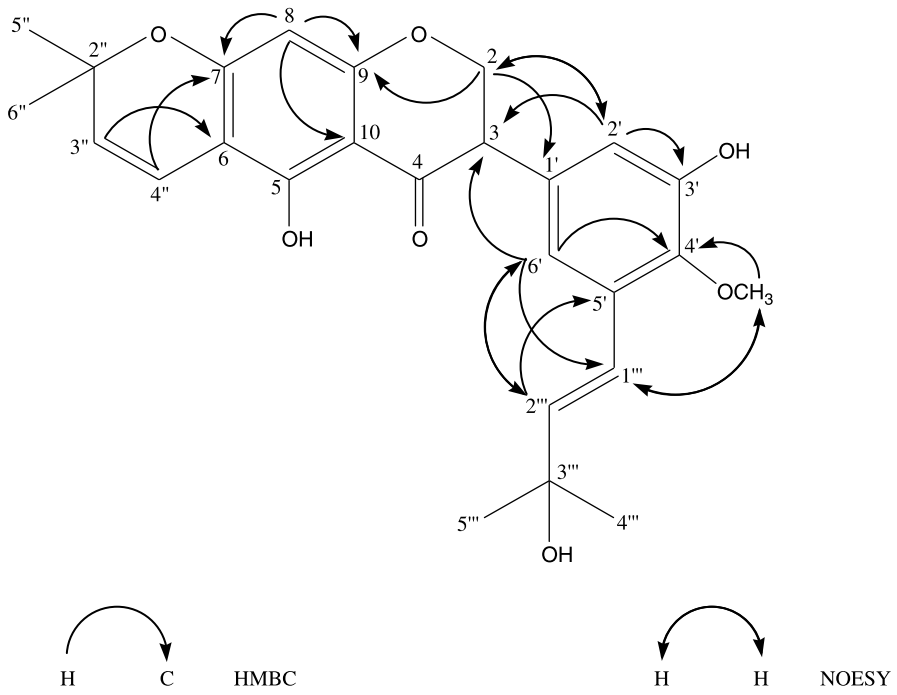


Figure 3. Key HMBC and NOESY correlations of **2**.

3.3.1 *Compound **1***

Amorphous powder. $[\alpha]_D$ 0 (*c* 0.1, MeOH); CD (*c* 2.39 × 10^{-5}, MeOH): no Cotton effect; UV (MeOH) λ_{max} (log ε) nm: 300 sh (4.38), 273 (4.66), 228 (4.39), 207 (4.32); IR (KBr) ν_{max} cm^{-1}: 3340, 1640; ^{1}H NMR, and ^{13}C NMR spectral data (see Table 1); EIMS: *m/z* (rel. int.) 434 ($[M]^+$, 31), 419 (100), 405 (18), 338 (11), 231 (12), 203 (38), 187 (12); HREIMS: *m/z* 434.1722 $[M]^+$ (calcd for $C_{26}H_{26}O_6$, 434.1728).

3.3.2 *Compound **2***

Amorphous powder. $[\alpha]_D$ 0 (*c* 0.1, MeOH); CD (*c* 2.23 × 10^{-5}, MeOH): no Cotton effect; UV (MeOH) λ_{max} (log ε) nm: 307 (4.07), 296 (4.13), 271 (4.56), 223 (4.47); IR (KBr) ν_{max} cm^{-1}: 3440, 1640; ^{1}H NMR and ^{13}C NMR spectral data (see Table 1); FABMS (positive mode): *m/z* (rel. int.) 453 ($[M + H]^+$, 32), 435 (100), 203 (22); HRFABMS (positive mode): *m/z* 453.1906 $[M + H]^+$ (calcd for $C_{26}H_{29}O_7$, 453.1912).

References

[1] L.A. Mitscher, S. Drake, S.R. Gollapudi, and S.K. Okwute, *J. Nat. Prod.* **50**, 1025 (1987).
[2] H. Tanaka, H. Hattori, M. Sato, R. Yamaguchi, T. Fukai, T. Tanaka, and E. Sakai, *Heterocycles* **71**, 1779 (2007).
[3] K. Folkers, J. Shavel, Jr., and F. Koniuszy, *J. Am. Chem. Soc.* **63**, 1544 (1941).
[4] H. Tanaka, T. Tanaka, and H. Etoh, *Phytochemistry* **42**, 1473 (1996).
[5] H. Tanaka, M. Doi, H. Etoh, N. Watanabe, H. Shimizu, M. Hirata, M. Ahmad, I. Qurashi, and M.R. Khan, *J. Nat. Prod.* **64**, 1336 (2001).
[6] N.C. Veitch, *Nat. Prod. Rep.* **24**, 417 (2007).
[7] M. Takayama, T. Fukai, Y. Hano, and T. Nomura, *Heterocycles* **33**, 405 (1992).
[8] H. Tanaka, M. Hirata, H. Etoh, M. Sako, M. Sato, J. Murata, H. Murata, D. Darnaedi, and T. Fukai, *Chem. Biodiv.* **1**, 1101 (2004).
[9] M. Sato, H. Tanaka, R. Yamaguchi, K. Kato, and H. Etoh, *Int. J. Antimicrob. Agents* **24**, 241 (2004).

Downloaded At: 18:52 22 January 2011