Constituents of *Caesalpinia crista* from Indonesia

Suresh AWALE,[a] Thein Zaw LINN,[a] Yasuhiro TEZUKA,[a] Surya Kant KALAUNI,[a] Arjun Hari BANSKOTA,[a] Faisal ATTAMIMI,[b] Jun-ya UEDA,[a] and Shigetoshi KADOTA*,[a]

[a] *Institute of Natural Medicine, University of Toyama; 2630 Sugitani, Toyama 930–0194, Japan: and* [b] *Faculty of Mathematics and Natural Sciences, Hasanuddin University; Makassar, Indonesia.*

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Ten new furanocassane-type diterpenes named, caesalpinins H—P (1—9) and norcaesalpinin F (10), were isolated from the CH_2Cl_2 extract of the seed kernels of *Caesalpinia crista*, together with 13 known diterpenes. Their structures were determined based on the spectroscopic analysis. Among the isolated compounds, caesalpinin N (7) represents the first example of furanocassane-type diterpene possessing an aldehyde group at C-14.

Key words *Caesalpinia crista*; Fabaceae; cassane-type diterpene; norcassane-type diterpene

Caesalpinia crista LINN. (Fabaceae) is a popular medicinal plant widely distributed throughout the tropical and subtropical regions of Southeast Asia. In Indonesia, it is commonly known as "Bagore" and the decoction of root has been praised for its important health benefits such as in the treatment of rheumatism, backache and as a tonic. Its seed kernels have been used by the people of local communities as an antimalarial and anthelmenthic drug.[1)] In Myanmar, this plant is locally known as "Ka-Lain" and its seeds are used as anthelmintic, antipyretic, anti-inflammatory, and antimalarial drug.[2)] As a part of exploration on the medicinal plant resources from Southeast Asia, we observed the significant antimalarial activity of the CH_2Cl_2 extract of the seed kernels of *C. crista* in mice infected with *Plasmodium berghei*.[3)] This inspired us to carry out detail phytochemical investigation of this plant species from different geographical origins. In this regard, we reported 10 new diterpenes from the Indonesian *Caesalpinia crista* and 20 new diterpenes from Myanmar.[3—7)] In our continued work on this plant from Indonesia led the isolation of 10 more new diterpenes named caesalpinins H—P (**1**—**9**) and norcaesalpinin F (**10**) together with 13 known diterpenes. In this paper, we report the isolation and structure elucidation of these new diterpenes.

Results and Discussion

Air-dried seed kernels of *Caesalpinia crista* LINN. were extracted with CH_2Cl_2 by overnight percolation at room temperature. The CH_2Cl_2 extract was then fractionated by silica gel column chromatography with a benzene/EtOAc gradient system into nine fractions. The fractions 6—8 were further subjected to repeated silica gel column chromatography, followed by normal- and reversed-phase preparative TLC, to afforded caesalpinins H—P (**1**—**9**) and norcaelsalpinin F (**10**) together with 13 known diterpenes, caesalpinin C,[4)] caesalpinin D,[4)] norcaesalpinin E,[4)] 2-acetoxyl-3-deacetoxycaesaldekarin e,[8)] caesaldekarin e,[9)] caesalmin E,[10)] 1-deacetoxy-1-oxocaesalmin C,[11)] 2-acetoxycaesaldekarin e,[12)] 3-deacetoxy-6-acetoxycaesaldekarin e,[13)] α-caesalpin,[13)] and bonducellpins A—C.[14)]

Caesalpinin H (**1**) was isolated as a colorless amorphous solid with an $[\alpha]_D^{25}$ +67.5° ($CHCl_3$). It showed the quasimolecular ion at *m/z* 405.1915 $(M+H)^+$ in HR-FAB-MS, which corresponds to the molecular formula $C_{22}H_{28}O_7$. The IR spectrum of **1** showed absorptions of hydroxyl (3575 cm^{-1}), lactone carbonyl (1750 cm^{-1}), and ester carbonyl (1735 cm^{-1}) groups. The ^{1}H-NMR spectrum of **1** exhibited signals due to three tertiary methyls (δ_H 1.16, 1.13, 1.11), three oxygen-substituted methines (δ_H 5.57, 4.75, 3.70), and three methylenes (δ_H 2.35, 2.06; δ_H 1.66, 1.20; δ_H 2.77, 2.54), together with two protons of a 1,2-disubstituted furan ring (δ_H 7.30, 6.60) and an acetyl methyl (δ_H 2.15) (Table 1). Moreover, its ^{13}C-NMR spectrum revealed the signals of four olefinic carbons (δ_C 151.9, 141.7, 113.8, 107.8), four oxygen-substituted carbons (δ_C 84.4, 82.8, 72.9, 72.5), a lactone carbonyl (δ_C 173.6), and an ester carbonyl (δ_C 169.7) (Table 2). These ^{1}H- and ^{13}C-NMR data were similar to those of caesalpinin D (**11**),[4)] but they were characterized by the lack of one of the two acetyl groups in **11**. Analysis of the correlation spectroscopy (COSY) and heteronuclear multiple-quantum coherence (HMQC) spectra indicated a highfield shift of H-1 (**1**, δ_H 3.70; **11**, δ_H 4.90). Thus, **1** was assumed to be 1-*O*-deacetylcaesalpinin D, which was confirmed by a heteronuclear multiple-bond connectivity (HMBC) spectral analysis as depicted in Fig. 1a.

The relative stereochemistry of **1** was assigned on the basis of coupling constants and the results of difference nuclear Overhauser effect (NOE) experiments. Irradiation of the methyl protons at δ_H 1.11 (H_3-20) in a difference NOE experiment caused NOE enhancements at H-1, H-2_{ax}, H-6_{ax}, H-8, and H-11_{ax}, suggesting β-orientation of H-1, H_3-19, H_3-20, H-6, and H-8 and chair conformation of rings A and B with a *trans*-fused ring junction. Similarly, irradiation of H-9 and H-14 caused the NOE enhancements of H-7 and H-11_{eq} indicated that H-9, H-7, and H-14 should be α-axially oriented. Thus, caesalpinin H was determined as 1-*O*-deacetylcaesalpinin D (**1**).

Caesalpinin I (**2**) was also isolated as a colorless amorphous solid and its molecular formula $C_{22}H_{26}O_7$ was determined by HR-FAB-MS. The ^{1}H-NMR data (Table 1) were similar to those of caesalpinin H (**1**), except for the disappearance of signal due to one oxymethine proton assigned to H-1 in **1**. On the other hand, its ^{13}C-NMR spectrum indicated the presence of a ketone functionality (δ_C 212.5) (Table 2). Thus, the presence of a ketone instead of the hydroxyl substituent at C-1 was assumed, which was confirmed by the HMBC correlations of C-1 with H_2-2, H_2-3, and H_3-20 in its HMBC spectrum. The relative stereochemistry of **2** was determined on the basis of coupling constants and the analysis

* To whom correspondence should be addressed. e-mail: kadota@ms.toyama-mpu.ac.jp

Table 1. ^{1}H-NMR (400 MHz) Data (δ) for Compounds **1**—**10** in $CDCl_3$ (*J* Values in Parentheses)

Position	**1**	**2**	**3**	**4**	**5**
1	3.70 br s			4.9 t (2.7)	4.90 br s
2	2.35 m	2.63 ddd (17.9, 13.7, 5.4)	2.67 ddd (15.5, 8.2, 5.4)	1.94 m	1.92 m
	2.06 m	2.43 dt (17.9, 4.3)	1.84 m	1.73 m	1.75 m
3	1.66 m	2.06 m	2.45 m	1.74 m	1.98 m
	1.20 m	1.65 m	1.84 m	1.15 m	1.13 m
6	5.57 d (9.5)	5.45 d (9.2)	5.47 d (9.5)	2.12 dd (13.1, 5.7)	2.24 dd (13.5, 5.8)
				1.63 ddd (13.1, 10.7, 2.7)	1.67 dd (13.5, 11.5)
7	4.75 dd (11.5, 9.5)	4.52 dd (11.8, 9.2)	5.32 t (9.5)	4.20 td (10.7, 5.7)	5.60 td (11.5, 5.8)
8	2.09 m	2.10 m	2.44 m	2.77 m	2.12 m
9	3.17 m	2.84 m	2.74 ddd (12.5, 11.2, 4.6)	2.67 ddd (12.1, 10.5, 6.7)	2.67 td (11.5, 5.8)
11	2.77 m	3.33 m	3.42 m	2.43 td (16.5, 10.5)	2.53 dd (16.0, 11.5)
	2.54 m	2.77 m	2.41 m	2.28 dd (16.5, 6.7)	2.29 dd (16.0, 5.8)
14	3.30 br d (13.2)	3.31 d (13.2)	3.41 d (9.3)	3.10 quint (6.4)	
15	6.60 d (1.9)	6.58 d (1.9)	6.09 d (2.0)	6.21 d (1.7)	6.40 d (1.9)
16	7.30 d (1.9)	7.29 d (1.9)	7.21 d (2.0)	7.23 d (1.7)	7.25 d (1.9)
17				1.11 d (6.4)	1.42 s
18	1.13 s	1.22 s	1.13 s	1.07 s	1.07 s
19	1.16 s	1.30 s	1.26 s	1.11 s	1.09 s
20	1.11 s	1.39 s	1.52 s	1.03 s	1.20 s
1-OAc				2.10 s	2.10 s
6-OAc	2.15 s	2.18 s	2.06 s		
7-OAc			1.95 s		2.09 s
5-OH	3.98 s	2.47 s	2.50 s	2.98 d (2.7)	2.97 br s
OCH_3			3.69 s		

Position	**6**	**7**	**8**	**9**	**10**
1	4.87 t (2.5)	4.93 br s	4.87 br s	5.26 br s	
2	1.94 m	1.96 m	2.09 m	5.32 m	2.67 m
	1.73 m	1.78 m	1.71 m		2.43 dt (15.3, 7.1)
3	1.78 m	1.78 m	1.80 m	2.03 m	1.83 t (7.1)
	1.18 m	1.15 m	1.18 m	1.39 m	1.83 t (7.1)
6	3.92 t (11.7)	2.06 m	4.18 d (9.0)	1.77 m	5.44 d (9.7)
		1.69 m		1.74 m	
7	5.28 dd (11.7, 9.5)	4.08 td (10.4, 5.6)	4.60 dd (10.2, 9.0)	1.70 m	4.20 td (9.7, 1.5)
8	2.55 m	2.09 m	2.03 m	1.98 m	2.50 dd (13.3, 9.7)
9	2.66 td (11.7, 5.3)	2.65 td (11.6, 4.4)	2.80 td (13.4, 4.1)	2.64 dd (11.7, 3.1)	2.67 m
11	2.45 dd (16.6, 11.7)	2.49 dd (16.0, 11.6)	2.53 dd (16.2, 13.4)	2.49 dd (16.5, 11.7)	3.70 dd (16.9, 11.7)
	2.29 dd (16.6, 5.3)	2.33 dd (16.0, 4.4)	2.50 dd (16.2, 4.1)	2.39 dd (16.5, 3.1)	3.14 dd (16.9, 4.2)
14	3.41 d (10.5)	3.31 m	3.28 br s		
15	6.11 d (1.9)	6.14 d (1.9)	6.60 d (2.0)	6.43 d (2.0)	6.62 d (2.2)
16	7.23 d (1.9)	7.28 d (1.9)	7.30 d (2.0)	7.22 d (2.0)	7.33 d (2.2)
17		9.41 d (4.9)		4.91 s	
				5.11 s	
18	1.26 s	1.06 s	1.34 s	1.11 s	1.15 s
19	1.23 s	1.11 s	1.28 s	1.20 s	1.32 s
20	1.21 s	1.20 s	1.15 s	1.26 s	1.53 s
1-OAc	2.10 s	2.11 s	2.17 s	2.11 s	
2-OAc				1.97 s	
6-OAc					2.18 s
7-OAc	2.05 s				
5-OH	2.95 br s				2.34 br s
7-OH					4.61 d (1.5)
17-OMe	3.72 s				

of the rotating-frame Overhauser enhancement spectroscopy (ROESY) spectrum. The large *J* value between H-6 and H-7 (9.2 Hz) indicated that they should be *axial*, while the large *J* value for H-14 (13.2 Hz) suggested that H-14 is also *axial*. The ROESY correlations H-6/H_3-19, H-6/H_3-20, H-2/H_3-19, H-11/H_3-20, H-8/H_3-20, and H_3-18/5-OH indicated that rings A and B should be *trans*-fused with β-axial orientation of H-2 and H-6 and that both rings have a chair conformation. Thus, caesalpinin I was determined as **2**.

Caesalpinin J (**3**) was isolated as colorless amorphous solid and its molecular formula was determined to be $C_{25}H_{32}O_9$ by HR-FAB-MS. The ^{1}H- and ^{13}C-NMR spectra of **3** were similar to those of bonducellpin B (**12**),[14] except for the presence of signals due to an additional acetyl group. The location of the additional acetyl group was determined to be at C-7 from the lowfield shift of H-7 (**3**: δ_H 5.32; **12**: δ_H 3.75) and the HMBC correlations (Fig. 1b) of the ester carbonyl carbon (δ_C 170.6) with the acetyl methyl (δ_H 1.95) and H-7. The relative stereochemistry of caesalpinin J (**3**) was confirmed to be the same as that of **12** by the ROESY spec-

Table 2. ^{13}C-NMR (100 MHz) Data (δ) for Compounds **1**—**10** in $CDCl_3$

Position	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	72.5	212.5	211.5	75.9	75.5	75.7	75.5	75.0	74.8	212.3
2	25.6	34.5	35.2	22.5	22.4	22.3	22.5	22.6	67.5	35.4
3	32.2	36.5	38.4	30.0	29.8	32.1	29.9	32.6	35.8	38.4
4	39.5	38.7	38.7	38.5	38.4	38.9	38.4	39.6	40.2	38.7
5	84.4	84.0	82.3	78.6	78.0	79.5	78.7	83.6	77.2	81.8
6	72.9	73.9	74.6	35.4	31.7	74.6	35.7	73.4	25.6	75.3
7	82.8	82.3	77.2	67.8	72.9	79.4	72.4	85.5	23.6	70.5
8	47.5	44.4	38.6	42.6	47.0	38.2	40.4	44.3	35.0	50.1
9	32.1	34.5	37.4	31.9	36.2	36.0	36.0	32.5	39.2	39.5
10	44.5	58.3	55.6	43.5	43.5	44.6	43.3	47.1	45.1	55.3
11	21.2	24.4	24.0	22.0	21.4	21.0	21.5	21.3	22.5	25.8
12	151.9	152.9	151.2	148.4	147.6	149.7	151.1	151.6	151.3	168.7
13	113.8	112.6	112.0	122.2	124.2	113.0	110.6	114.0	119.0	119.2
14	41.5	41.2	45.6	27.4	72.3	45.7	53.5	41.6	142.5	197.0
15	107.8	107.5	108.1	109.8	107.5	108.3	109.0	107.8	106.2	106.2
16	141.7	141.6	141.4	140.8	141.7	141.7	141.7	141.9	141.7	143.3
17	173.6	173.2	174.3	17.1	26.2	174.3	201.5	173.7	104.4	
18	30.4	27.6	28.6	28.1	28.0	31.0	28.0	30.9	28.2	28.7
19	24.2	27.3	26.5	25.2	25.2	24.7	25.0	24.5	26.0	26.2
20	16.8	14.3	15.4	17.8	17.8	16.8	17.6	17.0	17.5	15.8
1-OCO$\underline{C}H_3$				21.5	21.7	21.4	21.6	21.3	21.6	
1-O$\underline{C}OCH_3$				169.0	169.7	171.7	169.0	168.9	169.2	
2-OCO$\underline{C}H_3$									21.0	
2-O$\underline{C}OCH_3$									170.4	
6-OCO$\underline{C}H_3$	21.6	21.4	21.4							21.7
6-O$\underline{C}OCH_3$	169.7	168.6	169.4							169.9
7-OCO$\underline{C}H_3$			20.7		22.0	21.4				
7-O$\underline{C}OCH_3$			170.6		168.9	169.0				
17-OMe			52.1							

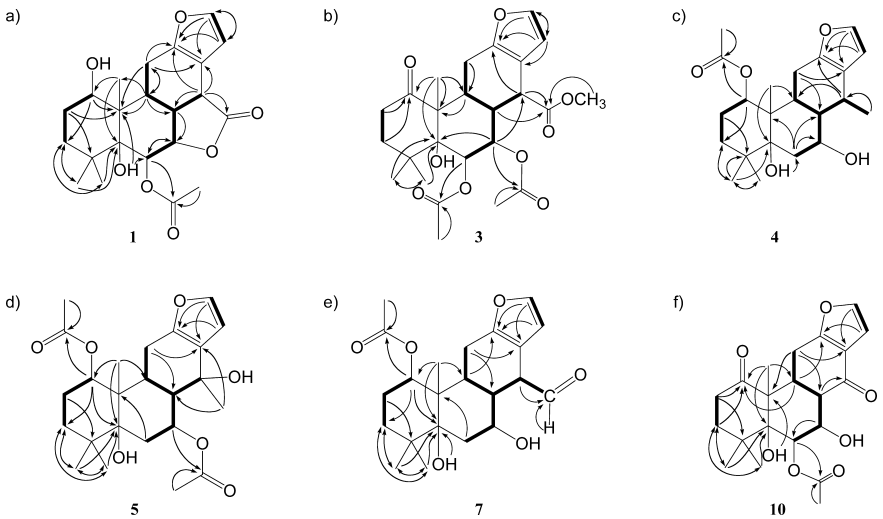
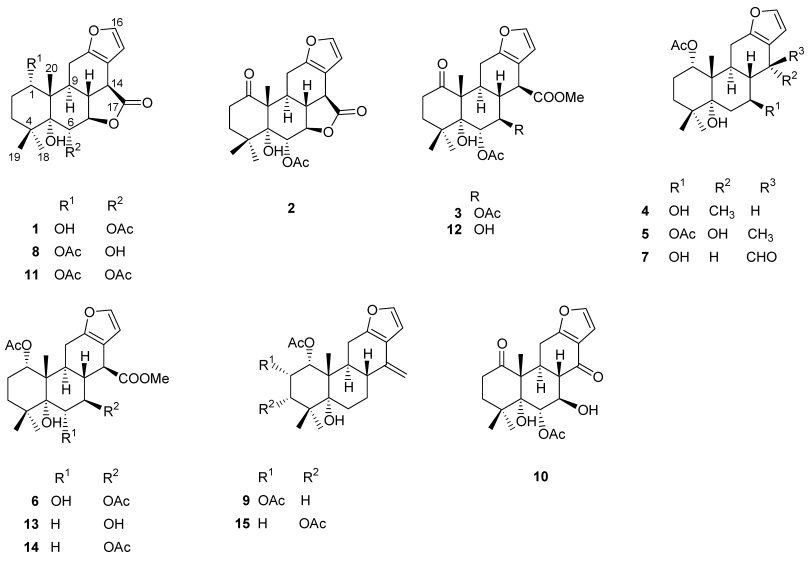


Fig. 1. Connectivies (Bold Lines) Deduced by the COSY Spectrum and Key HMBC Correlations (Arrows) Observed in **1**, **3**, **4**, **5**, **7** and **10**

tral analysis and coupling constant data. The correlations of H-14 with H-7 and H-9 indicated that they were α-oriented. On the other hand, the large J value for H-14 ($J_{14,8}$=9.3 Hz) indicated that H-14 should be *axial*. Thus, caesalpinin J was concluded as 7-*O*-acetylbonducellpin B (**3**).

Caesalpinin K (**4**) was isolated as colorless amorphous solid with $[\alpha]_D^{22}$ +51.5° ($CHCl_3$). The absorption bands at 3575 and 1730 cm^{-1} in its IR spectrum indicated the presence of hydroxyl and ester groups, respectively. The molecular formula of **4** was determined to be $C_{22}H_{32}O_5$ by HR-FAB-MS. The ^{1}H- (Table 1) and ^{13}C-NMR (Table 2) spectra of **4** were similar to those of bondcucellpin C (**13**),[14] except for the disappearance of signals due to a carbomethoxy substituent assigned to C-17 and appearance of signals due to one secondary methyl (δ_H 1.11). The secondary methyl was determined to be located at C-14 from the COSY and HMBC spectral analysis (Fig. 1c). The relative stereochemistry of the secondary methyl was determined to be α based on the NOE enhancement at H-8 on irradiation of H-14. Thus, caesalpinin K was determined as **4**.

The HR-FAB-MS of caesalpinin L (**5**) showed the quasi-molecular ion at m/z 435.2336 $(M+H)^+$, consistent with the molecular formula $C_{24}H_{34}O_7$. The IR spectrum of **5** was similar to that of caesalpinin K (**4**) and showed absorptions of hy-



droxyl and ester carbonyl groups. The ^{1}H-NMR spectrum of **5** also closely resembled those of **4**, but they were characterized by the presence of signals due to one more acetyl methyl (δ_H 2.09) and dissaperance of a methine signal assigned for H-14 (δ_H 3.10) in **4** (Table 1). The location of the additional acetyl substituent in **5** was determined to be at C-7 based on the downfield shift of H-7 (δ_H 5.60), which was confirmed by the HMBC spectrum (Fig. 1d). On the other hand, its ^{13}C-NMR spectrum (Table 2) indicated the presence of one more oxymethine carbon with the disappearance of one sp^3 carbon assigned for C-14 in **4**, indicating the presence of a hydroxyl group at C-14. The relative stereochemistry of **5** was assigned by the ROESY experiment, which indicated rings A and B to have the same stereochemistry as those of **4** and the hydroxyl substituent at C-14 to be β-equitorial. Thus, the structure of caesalpinin L was determined as **5**.

Caesalpinin M (**6**) was isolated as colorless amorphous solid with $[\alpha]_D^{22}$ +47.1° ($CHCl_3$). The absorptions at 3575 and 1735 cm^{-1} in its IR spectrum indicated the presence of hydroxyl and ester groups, respectively. The molecular formula of **6** was determined to be $C_{25}H_{34}O_9$ by HR-FAB-MS. The ^{1}H- and ^{13}C-NMR spectra of **6** were similar to those of 7-acetoxybonducellpin C (**14**),[14] except for the presence of a signal due to an oxymethine instead of those of a methylene CH_2-6 in **14**. Thus, **6** was assumed to be 7-acetoxy-6-hydroxybonducellpin C, which was confirmed by the COSY, HMQC, HMBC, and difference NOE spectra.

The ^{1}H- and ^{13}C-NMR spectra of caesalpinin N (**7**) were closely resembled those of caesalpinin K (**4**), but they were characterized by the disappearance of signals due to one of three tertiary methyls with the appearance of signals of an aldehydic group. The COSY correlation between the aldehydic proton (δ_H 9.41) and the tertiary methine at δ_H 3.31 (H-14) and the HMBC correlations between the aldehydic proton with C-14 (δ_C 53.5) suggested the position of aldehyde group to be C-17. The relative stereochemistry of **7** was determined to be the same as **4**, based on the results of the NOE difference experiment; NOEs from H-14 to H-7$_{ax}$ and *vice versa* indicated the aldehyde group (C-17) to be β-oriented. Thus, structure of caesalpinin N was concluded as **7**.

The molecular formula of caesalpinin O (**8**) was determined from HR-FAB-MS to be $C_{22}H_{28}O_7$. The ^{1}H- and ^{13}C-NMR spectra of **8** resembled those of caesalpinin D (**11**)[4] but they were characterized by the lack of one of two acetyl groups. Analysis of the COSY and HMQC spectra indicated a highfield shift of H-6 (δ_H 4.18), compared to that of **11** (δ_H 5.61). Thus, caesalpinin O (**8**) was assumed to be 6-*O*-deacetylcaesalpinin D, which was confirmed by the HMBC spectral analysis. The relative stereochemistry of **8** was determined by difference NOE experiments to be the same as that of caesalpinin D (**11**).

The HR-FAB-MS of caesalpinin P (**9**) showed the quasi-molecular ion at *m*/*z* 391.2096 $(M+H)^+$, consistent with the molecular formula $C_{22}H_{30}O_6$. The IR spectrum of **9** closely resembled that of caesalpinin C (**15**)[4] and showed absorptions of hydroxyl and ester carbonyl groups. The ^{1}H- and ^{13}C-NMR spectra of **9** were also similar to those of **15** (Tables 1, 2), but analysis of the COSY and HMQC spectra showed the lowfield shift of H-2 (δ_H 5.32) and highfield shift of H-3 (δ_H 2.03, 1.39), compared to those of **15** (H-2: δ_H 2.37, 2.15; H-3: δ_H 4.95), suggesting the location of an acetoxyl substituent to be at C-2, not at C-3 in **15**. This was further confirmed by the HMBC correlations of the ester carbonyl carbon at δ_C 170.4 (2-OCO) with the protons at δ_H 1.97 (2-OCOCH_3) and H-2. The relative stereochemistry of **9** was confirmed to be the same as **15** based on the coupling constants and the results of difference NOE experiments.

Norcaesalpinin F (**10**) was isolated as colorless amorphous solid and its IR spectrum indicated the presence of hydroxyl, ester, and ketone groups. Its molecular formula was determined to be $C_{21}H_{26}O_7$ by HR-FAB-MS. The ^{1}H- and ^{13}C-NMR spectra of **10** were similar to those of bonducellpin B (**12**),[14] except for the lack of the signals due to the carbomethoxy group and the methine CH-14 (δ_H 3.51) in **12**. Moreover, its ^{13}C-NMR spectrum indicated the presence of only 19 carbons, including two ketone carbonyls (δ_C 212.3, 197.0), in its main carbon framework (Table 2). Thus, **10** should be a nor-type diterpene having a ketone functonality instead of the carbomethoxyl group at C-14, which was confirmed by the HMBC correlations (Fig. 1f). The relative stereochemistry of **10** was determined by difference NOE experiment to be as shown. Thus, the structure of norcae-

Table 3. Antimalarial Activity of the Isolated Compounds

Compounds	IC_{50} (μM)
1	5.2
2	>10
3	1.0
4	0.4
6	>10
7	0.12
8	>10
9	1.7
10	0.14

salpinin F was concluded as 14-decarbomethoxy-14-oxobonducellpin B (**10**).

In this paper, we have reported 10 new diterpenes, caesalpinins H—P (**1**—**9**) and norcaesalpinin F (**10**). All the isolated diterpenes possessed a characteristic furan ring in its structure, which is the main character of compounds isolated from the genus *Caesalpinia*. Among them, the presence of an aldehyde group at C-14 in caesalpinin N (**7**) was observed for the first time having cassane skeleton among the diterpenes isolated from the *Caesalpinia* genus.

All the newly isolated compounds, except for **5**,[15] were tested for their inhibitory activities against growth of *P. falciparum* FCR-3/A2 *in vitro*.[16] All of them displayed different potency activity in a dose dependent manner. Among the newly isolated compounds, caesalpinin K (**4**) and norcaesalpinin F (**10**) showed the most potent inhibitory activity with an IC_{50} value of 120 and 140 nM (Table 3), respectively, and were less than that reported for a well known antimalarial drug, chloroquine (IC_{50}, 283—291 nM).[17,18]

Experimental

General Experimental Procedure Optical rotations were recorded on a JASCO DIP-140 digital polarimeter. IR spectra were measured with a Shimadzu IR-408 spectrophotometer in $CHCl_3$ solutions. NMR spectra were taken on a JEOL JNM-LA400 spectrometer with tetramethylsilane (TMS) as an internal standard, and chemical shifts are expressed in δ values. HR-FAB-MS measurements were carried out on a JEOL JMS-700T spectrometer and glycerol was used as matrix. Column chromatography was performed with BW-802MH silica gel (Fuji Silysia, Aichi, Japan). Analytical and preparative TLC were carried out on precoated silica gel $60F_{254}$ and RP-$18F_{254}$ plates (Merck, 0.25 or 0.50 mm thickness).

Plant Material Seed kernels of *Caesalpinia crista* Linn. were collected at district of Polewali Mamasa, South Sulawesi Province, Indonesia in 2001, September by one of the authors (F.A.). A voucher specimen (TMPW 21499) is preserved in the Museum for Materia Medica, Analytical Research Center for Ethnomedicines, Institute of Natural Medicine, University of Toyama, Toyama, Japan.

Extraction and Isolation A powder of air-dried seed kernels of *C. crista* (1.0 kg) was extracted with CH_2Cl_2 (3 l×2) at room temperature, overnight. The CH_2Cl_2 extract (151 g) was separated by silica gel column chromatography (8.5×45.0 cm) with a benzene–EtOAc gradient system to give nine fractions. Previously, we reported 10 new and 8 known diterpenens from fractions 2—5.[3,4]

Fraction 6 (1.7 g) was rechromatographed (3.5×22.8 cm) with a hexane–EtOAc gradient system to afford four subfractions. Subfractions 6-1 (348 mg) and 6-2 (89.2 mg) were subjected to preparative TLC with 1.5% acetone–$CHCl_3$ to give caesalpinin H (**1**, 16.5 mg), caesalpinin D (**11**, 0.9 mg), norcaesalpinin E (3.8 mg), and 2-acetoxyl-3-deacetoxycaesaldekarin e (1.6 mg), and caesalpinin I (**2**, 3.5 mg) and norcaesalpinin E (2.5 mg), respectively. Subfraction 6-3 (646 mg) was rechromatographed (1.5×20.0 cm) with 10% acetone–$CHCl_3$ to afford two subfractions. Subfraction 6-3-1 (178 mg) was separated by reversed-phase preparative TLC with MeOH–H_2O (3 : 2) to give caesalpinin I (**2**, 4.2 mg), caesalpinin J (**3**, 5.6 mg), caesalpinin K (**4**, 2.9 mg), and norcaesalpinin F (**10**, 3.7 mg), while subfraction 6-3-2 (38.2 mg) was subjected to preparative TLC with 4% MeOH–$CHCl_3$ to give **2** (9.5 mg) and **3** (3.1 mg). Subfraction 6-4 (316 mg) was also rechromatographed (1.5×21.5 cm) with hexane–EtOAc (3 : 2), followed by preparative TLC with 5% MeOH–$CHCl_3$, to give **3** (20.3 mg), **4** (65.4 mg), and caesalpinin C (**15**, 1.6 mg).

Fraction 7 (5.8 g) was rechromatographed (3×30 cm) with a hexane–EtOAc gradient system to afford two subfractions. Subfraction 7-1 (700 mg) was rechromatographed (1.5×28.5 cm) with 15% acetone–$CHCl_3$, followed by preparative TLC with hexane–EtOAc (3 : 2), to give **4** (9.1 mg), caesalpinin L (**5**, 25.3 mg), caesalpinin M (**6**, 21.4 mg), caesalpinin N (**7**, 21.7 mg), caesalpinin O (**8**, 5.6 mg), caesalpinin P (**9**, 9.6 mg), **15** (4.7 mg), caesaldekarin e (2.6 mg), and caesalmin E (43.6 mg). Subfraction 7-2 (5.1 g) was also rechromatographed (3×30.0 cm) with 15% acetone–$CHCl_3$, followed by preparative TLC with 10% acetone–$CHCl_3$, to give 14(17)-dehydro-α-caesalpin (44.6 mg), 2-acetoxycaesaldekarin e (8.6 mg), caesalmin E (50.7 mg), 3-deaceoxy-6-acetoxycaesaldekarin e (2.3 mg), and α-caesalpin (22.7 mg).

Fraction 8 (4.88 g) was rechromatographed (3×32 cm) with a hexane–EtOAc gradient system to afford two subfractions. Subfraction 8-1 (3.32 g) was rechromatographed (3×28.5 cm) with 15% acetone–$CHCl_3$, followed by preparative TLC with 3% acetone–$CHCl_3$, to give norcaesalpinin A (2.5 mg), α-caesalpin (4.9 mg), 2-acetoxycaesaldekarin e (9.6 mg), bonducellpin A (4.7 mg), bonducellpin B (**12**, 109 mg), bonducellpin C (**13**, 12.4 mg), and caesaldekarin e (3.6 mg). Subfraction 8-2 (1.56 g) was rechromatographed (3×26.5 cm) with 15% acetone–$CHCl_3$, followed by preparative TLC with 20% EtOAc–toluene, to give **15** (5.1 mg), caesaldekarin e (23.0 mg), 2-acetoxycaesaldekarin e (10.0 mg), and caesalpinin C (15.3 mg).

Caesalpinin H (**1**): Colorless amorphous solid; $[\alpha]_D^{25}$ +67.5° (c=0.057, $CHCl_3$). IR ($CHCl_3$) cm^{-1} 3575, 1750, 1735. ^{1}H- and ^{13}C-NMR ($CDCl_3$): see Tables 1 and 2. HR-FAB-MS m/z: 405.1915 $[M+H]^+$ (Calcd for $C_{22}H_{29}O_7$ 405.1913).

Caesalpinin I (**2**): Colorless amorphous solid; $[\alpha]_D^{22}$ +59.7° (c=0.053, $CHCl_3$). IR ($CHCl_3$) cm^{-1} 3600, 1755, 1710. ^{1}H- and ^{13}C-NMR ($CDCl_3$): see Tables 1 and 2. HR-FAB-MS m/z: 403.1792 $[M+H]^+$ (Calcd for $C_{22}H_{27}O_7$ 403.1757).

Caesalpinin J (**3**): Colorless amorphous solid; $[\alpha]_D^{22}$ +42.0° (c=0.088, $CHCl_3$). IR ($CHCl_3$) cm^{-1} 3575, 1735, 1715. ^{1}H- and ^{13}C-NMR ($CDCl_3$): see Tables 1 and 2. HR-FAB-MS m/z: 477.2130 $[M+H]^+$ (Calcd for $C_{25}H_{33}O_9$ 477.2124).

Caesalpinin K (**4**): Colorless amorphous solid; $[\alpha]_D^{22}$ +51.5° (c=0.151, $CHCl_3$). IR ($CHCl_3$) cm^{-1} 3575, 1730. ^{1}H- and ^{13}C-NMR ($CDCl_3$): see Tables 1 and 2. HR-FAB-MS m/z: 377.2314 $[M+H]^+$ (Calcd for $C_{22}H_{33}O_5$ 377.2328).

Caesalpinin L (**5**): Colorless amorphous solid; $[\alpha]_D^{22}$ +37.8° (c=0.171, $CHCl_3$). IR ($CHCl_3$) cm^{-1} 3575, 1735. ^{1}H- and ^{13}C-NMR ($CDCl_3$): see Tables 1 and 2. HR-FAB-MS m/z: 435.2336 $[M+H]^+$ (Calcd for $C_{24}H_{35}O_7$ 435.2383).

Caesalpinin M (**6**): Colorless amorphous solid; $[\alpha]_D^{22}$ +47.1° (c=0.074, $CHCl_3$). IR ($CHCl_3$) cm^{-1} 3575, 1735. ^{1}H- and ^{13}C-NMR ($CDCl_3$): see Tables 1 and 2. HR-FAB-MS m/z: 479.2272 $[M+H]^+$ (Calcd for $C_{25}H_{35}O_9$ 479.2281).

Caesalpinin N (**7**): Colorless amorphous solid; $[\alpha]_D^{22}$ +28.8° (c=0.195, $CHCl_3$). IR ($CHCl_3$) cm^{-1} 3575, 1735, 1715. ^{1}H- and ^{13}C-NMR ($CDCl_3$): see Tables 1 and 2. HR-FAB-MS m/z: 391.2096 $[M+H]^+$ (Calcd for $C_{22}H_{31}O_6$ 391.2121).

Caesalpinin O (**8**): Colorless amorphous solid; $[\alpha]_D^{22}$ +56.8° (c=0.078, $CHCl_3$). IR ($CHCl_3$) cm^{-1} 3575, 1750, 1735. ^{1}H- and ^{13}C-NMR ($CDCl_3$): see Tables 1 and 2. HR-FAB-MS m/z: 405.1929 $[M+H]^+$ (Calcd for $C_{22}H_{29}O_7$ 405.1913).

Caesalpinin P (**9**): Colorless amorphous solid; $[\alpha]_D^{22}$ +11.6° (c=0.074, $CHCl_3$). IR ($CHCl_3$) cm^{-1} 3575, 1730. ^{1}H- and ^{13}C-NMR ($CDCl_3$): see Tables 1 and 2. HR-FAB-MS m/z: 417.2294 $[M+H]^+$ (Calcd for $C_{24}H_{33}O_6$ 417.2277).

Norcaesalpinin F (**10**): Colorless amorphous solid; $[\alpha]_D^{22}$ +80.4° (c=0.091, $CHCl_3$); IR ($CHCl_3$) cm^{-1} 3600, 1740, 1710. ^{1}H- and ^{13}C-NMR ($CDCl_3$): see Tables 1 and 2. HR-FAB-MS m/z: 391.1749 $[M+H]^+$ (Calcd for $C_{21}H_{27}O_7$ 391.1757).

Antimalarial Activity Antimalarial activity of the isolated compounds was determined by the previously described procedure by Budimulja *et al.*[16] In brief, each compound were separately dissolved in DMSO to obtain a 10^{-2} M stock and kept at −20 °C until used. The malarial parasite, *P. falciparum* FCR-3/A2 clone, was propagated in a 24-well culture plate in the presence of wide concentration range of each compound. The parasite growth was monitored by making a blood smear every day. The concentra-

tion response parasite growth data were analyzed by a linear regression function using the Sigma-plot 2000 computer program to determine the 50% inhibitory concentration (IC_{50}). The IC_{50} value is defined as that concentration of compound producing 50% growth inhibition relative to untreated control.

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