Introduction

*Ilicium merrillianum* is a small tree or shrub which is endemic to southwestern China and Burma. Besides using the bark, root bark and fruit of this shrub in Traditional Chinese Medicine (TCM) for treating rheumatism,¹ it is also found to possess a vast plethora of structurally diverse and unique bioactive natural products.² Since the onset of the 21st century, Fukuyama and co-workers have been actively engaged in the isolation and bioactivity screening of several anislate-type sesquiterpenes, allo-cedrane-type sesquiterpenes and seco-priziaane type sesquiterpenoids from *I. merrillianum* and other *Ilicium* species.² Indeed, their pioneering efforts in this arena led to the discovery and bioactivity screening of several anislate-type sesquiterpenes, allo-cedrane-type sesquiterpenes and seco-priziaane type sesquiterpenoids from *I. merrillianum* and other *Ilicium* species.²

Further, in continuous pursuit for new bioactive compounds as potential leads for drug discovery, very recently Zhang et al. got interested in exploring the leaves and branches of *I. merrillianum* which ended up with the isolation of some unique abietane diterpenoids⁶ as well as some bioactive quinoid natural products.⁷ Perhaps, it was the bioactivity of the (+) antipode of merrilliaquinone (1), Fig. 1, reported by them and accessed via chiral HPLC separation from the racemic natural product that caught our attention. Interestingly, the (+) antipode of merrilliaquinone was found to be several fold more potent and selective towards human hepatoma cells over normal hepatic cells in comparison to the (−) antipode or the racemic form of the natural product.⁸ Another, interesting fact related to 1 is, it was also reported in the racemic form by Lu et al. as acortatarinowin H from the rhizomes of *Acorus tatarinowii* Schott just after the report by Zhang et al.⁹ Further, we were pleasantly surprised to learn that there exist structurally closely related quinones such as 2–4 and neolignans 5, 6 as captured in Fig. 1, all having their origins from herbs used in TCM. For instance, quinones 2 and 3 were of late isolated in optically pure form from the rhizomes of *Acorus gramineus*, and reported to exhibit decent anti-inflammatory as well as cytotoxicity against certain human cancer cell lines.¹⁰ For convenience sake, we have preferred to refer them as gramineusquinone A and B respectively instead of the conventional...
name assigned by Lee. et al. On the other hand, with no bioactivity so far reported gracillisquinone (4) was isolated not long ago from Spallendorcarpus gracilli. While among the neo-
lignan 5 and 6, magnosphinin with prominent anti-inflammatory
activity was reported in 1983 after its isolation from the flower
buds of Magnolia salicifolia, more famous as “Shin-i” in TCM. Whereas, asarolignan G (6) with anti-neuroinflammatory
activity is a very recently surfaced neolignan from the
rhizomes of Acorus tatarinowii.

The impressive bioactivity profile exhibited by 1 though in
one of its enantiomeric pure form, as well as close structural
resemblance with quinones 2–4, together with a strong prospect to
elaborate them to neolignans 5 and 6 engaged our interest
towards these natural products. Further, the fact that except for
5 (ref. 16a–c) there exists no synthetic endeavors towards any of
these natural products motivated us to embark on a synthetic
journey directed towards the racemic total syntheses of these
bioactive quinones and neolignans to access them in substan-
tial quantities for thorough clinical assessment. Moreover,
initially we aimed to develop a concise unified approach based
on [4 + 2] cycloaddition strategy taking inspiration from our
earlier success in application of similar approach in context of
syntheses of quinoid natural products such as acremine G and
allomicrophyllone.

Results and discussion
To test the viability of the approach we had in mind, we initially
chose to focus on the development of a racemic synthesis for 1, 3
and 5 before targeting other interested natural product depicted
in Fig. 1. In this context, our retrosynthetic plan is as outlined in
Scheme 1, which hinges on a Diels–Alder coupling of quinone 9
with either of the arylated diene 10a/b to arrive at the [4 + 2]
cycloadduct 11a/b in a highly regioselective fashion. While, the
two coupling partner 9 and 10 were envisioned to be accessed
through a common and readily available cheap starting material
in the form of quinol 7 or its corresponding dimethyl ether 8. A
4–6 step synthetic manipulation on 8 was expected to offer the
dienes 10a/b in contrast to a single step access of 9 from 7/8
through known protocol. We anticipated the cycloadduct 11a/
b to hold immense potential in context of its elaboration to the
targeted natural product. As a simple oxidation of the dihy-
droquinone in 11b to quinone would end up in the acquisition
of 14 isomeric to 1, having C8=C8' bond position instead of the
C7=C7' bond position present in 1, whereas a straightforward
oxidative aromatization in the quinone fused cyclohexene ring of
11b would lead to the natural quinone 3. While, reductive
methylation and then selective benzylic methylene oxidation at
C-7 position of 11a followed by stereoselective installation of the
methyl group at C-8' position was the route we had in mind to
arrive at an intermediate like 12 for accessing 5. Similarly,
reductive silylation and then selective benzylic methylene
oxidation at C-7 position of 11b followed by stereoselective C-8,
C-8' double bond reduction was the route planned to access the
functionally well placed intermediate like 13 which could be
readily elaborated to either of the natural product 1 or 5 through
some straightforward synthetic maneuvers.

Towards the realization of the retrosynthetic plan as outlined
in Scheme 1, we commenced our foray with the synthesis of the
two coupling partners 9 and 10a. The known quinone 9 (ref. 19)
was accessed both via hypervalent iodine mediated oxidation on
8 as well as through NaIO4 mediated oxidation of 7, with
comparatively better yields observed in case of latter. While, the
synthetic sequence towards the crafting of diene component
10a as depicted in Scheme 2 emanates from the known alde-
hyde 15 (ref. 20) obtained through a Vilsmeier-Haack for-
mulyation on 8. Wittig–Horner olefination of 15 with (carbethoxymethylene)triphenylphosphorane smoothly fur-
nished the trans-cinnamate ester 16 exclusively, which on
addition of excess methylolithium resulted in the formation of

Scheme 1 Retrosynthetic plan towards 1, 3 and 5.

Scheme 2 Synthesis of the diene (10a) and dienophile (9).
the cinnamyl alcohol 17. Then, a careful dehydration on 17 in the presence of mesyl chloride and Et₃N as the base furnished the desired diene 10a in excellent yield.

With both diene and dienophile in hand the next task was to execute the [4 + 2] coupling between the two. Indeed, to our delight as highlighted in Scheme 3, the Diels–Alder coupling between 9 and 10a turned out to be quite eventful as the modest thermal activation of the diene and dienophilic component in dry toluene at 50 °C afforded a readily separable mixture of the bicyclic quinone 18 and naphthoquinone 19 in the ratio of ~2.5 : 1 and in 59% overall yield. The formation of 18 and 19 is clearly attributable to the spontaneous concomitant partial and complete oxidation in the quinone fused cyclohexene ring of the [4 + 2] cycloadduct 11a respectively. While the structure of 18 was secured through 2D NMR analysis with the key HMBC and nOe correlations as indicated in red and blue arrows respectively (Scheme 3), the close spectral resemblance of naphthoquinone 19 with that of gramineusquinone B (3) hinted it to be the desmethyl derivative of the natural product 3.

Encouraged by the outcome of the D–A reaction depicted in Scheme 3, we next turned our attention towards the functionalization of the quinone 18 for its elaboration to the natural products merrilliaquinone (1) and magnoshinin (5). In this regard, we thought of accessing 12/13 by first oxidizing the C-7 methylene position in 18 to arrive at an enone for executing the stereoselective installation of the methyl group at C-8’ position via Gilman-type addition after masking the quinone in the form of methyl/silyl protected quinol. However, failure in our attempts to oxidize the C-7 methylene position both on 18 as well as 18 derived 20, accessed via one-pot reductive methylation of 18 thwarted our plan of synthesizing 12/13. Nevertheless, in our attempts to relocate the double bond from C-8, C-8’ to C-7, C-8 position we explored a modified strategy as depicted in Scheme 4. Indeed, subjection of 18 to the m-CPBA mediated epoxidation offered the epoxy quinone 21 in a diastereoselective manner and in decent yield. But then, the nucleophilic methyl mediated epoxide ring opening on 22 accessed from 21 via reductive methylation as well as via diastereoselective epoxidation of 20 turned out to be a difficult proposition as it failed to offer the desired ring opened product 23 for its further elaboration to 2-epi-magnoshinin (24).

Undeterred by our failures in elaborating the cycloadduct 18 to any of the targeted natural product, we next thought of revisiting the strategy in order to access cycloadduct 11b with a pre-installed methyl group at C-8’ position. In this context, through a similar synthetic sequence as earlier demonstrated for preparation of diene 10a (Scheme 2), the diene 10b was synthesized from 15 via the cinnamate ester 25 and tertiary alcohol 26 as depicted in Scheme 5. With access to diene 10b in good yield we readily executed its [4 + 2] coupling with 9 under similar coupling condition as that used for 10a in Scheme 3, but to our surprise with observation of a slight different outcome in terms of product profile. Contrary to the D–A reaction involving 10a, the D–A reaction in case of 10b afforded a mixture of quinone 14 and bicyclic quinol 27 in the ratio of ~2.6 : 1 respectively and in an overall yield of 66%. Though 14 could be carefully separated from 27, 17, 18 and 19 respectively, we could execute the [4 + 2] cycloaddition on 10b with the diene 9 to arrive at the desired diene 22 in good yield.

Scheme 3 Tandem [4 + 2] cycloaddition and oxidation leading to racemic 18 and desmethyl gramineusquinone B (19).

Scheme 4 Efforts towards the elaboration of 18 to racemic 2-epi-magnoshinin (24).
but the tendency of the quinol 27 to readily undergo spontaneous partial conversion to the quinone form 14 made it difficult to isolate it in the purest form. However, it didn’t turn out to be a serious concern as exposure of the mixture of 14 and 27 to NaIO₄ afforded a single product 14 which was better serviceable in context of further elaboration to the targeted natural products. Further, the structure of 14 was secured through comparison of its spectral data (¹H and ¹³C NMR) with that of related quinone 18, however for sake of unambiguity we also confirmed the structure through X-ray crystallographic analysis.

Towards the end game, foremost keeping in mind the close proximity of 14 to natural product 3, the former was readily subjected to a DDQ mediated aromatization in the quinone fused cyclohexene ring to arrive at gramineusquinone B, 3 in good yields, Scheme 6. The synthetic sample of 3 was found to be spectroscopically (¹H and ¹³C NMR) identical to the reported natural product.¹² Then, efforts were channelized towards elaboration of 14 as well as 14 derived 28 (isomeric to magnoshinin, 5) to an intermediate like 12/13 in context of its elaboration to natural product 1 and 5 as per the retrosynthetic plan envisioned in Scheme 1. But this time again, all our investigated conditions proved ineffective in oxidizing the C-7 methylene position in 14 as well as the 14 derived 28. Also, attempts to isomerise the double bond position in 14 as well as 28 proved unfruitful. After repeatedly failing in our attempts to unsymmetrically functionalize the C₈=C₈ bond both in 14 and 28, we then executed a rather straightforward catalytic hydrogenation on iso-magnoshinin 28 with the hope of accessing the dihydro version of the natural product 5. Indeed the double bond reduction on 28 turned out to be stereoselective offering 29 in decent yields but deviant from the desired stereochemistry at C-8’ position in context of 5. 2D NMR analysis of 28 confirmed the delivery of the two H-atoms on the C₈=C₈ bond from the side opposite to the phenyl ring at the C-7’ position and hinted 29 to be 8’-epi-7,8-dihydro-magnoshinin or 2-epi-3,4-dihydro-magnoshinin as per the numbering given to the natural product in the isolation paper.¹⁴

Conclusions

In conclusion, we have successfully demonstrated the syntheses of gramineusquinone B, iso-merrilliaquinone and iso-
magnoshinin as well as 2-epi-3,4-dihydro-magnoshinin from readily accessible fragments through a straightforward Diels–Alder strategy. Efforts are currently underway to overcome the difficulties encountered in the present route for the total syntheses of merrilliaquinone and magnoshinin which may eventually pave the way for other interested bioactive quinones and neolignans.

**Experimental**

All the reagents were purchased from Sigma-Aldrich and other commercial suppliers and used without further purification. While most of the desired solvents supplied by commercial suppliers were dried using the standard drying procedures. All nonaqueous reactions were executed under nitrogen atmosphere. Melting points were determined on a Buchi M-560 apparatus and are uncorrected. The $^1$H and $^{13}$C NMR spectra were recorded on 400 and 100 MHz Bruker spectrometer respectively using TMS as an internal standard. The following abbreviations are used for spin multiplicity: $s$ = singlet, $d$ = doublet, $t$ = triplet, $q$ = quartet, $p$ = quintet/pentet, $dd$ = doublet of doublet and $m$ = multiplet. The chemical shifts are reported as $\delta$ values (ppm) and the coupling constants ($J$) values are reported in Hz. High Resolution Mass Spectra (HRMS) were obtained using electron spray ionization (ESI) technique and as TOF mass analyzer. IR spectra were recorded on a Bruker FT/IR-460 Plus spectrometer. Reactions monitoring were done using precoated SiO$_2$-gel GF254 glass TLC plates while spot visualizations were done under UV light and spot developing stains like $\text{GF}_254$ while spot visualizations were done.

**Methanol-6-methyl-8-(2,4,5-trimethoxyphenyl)naphthalene-1,4-dione (18)**

Brown-red solid, mp: 138.6–139.4°C. IR (neat): $r_{\text{max}}$ 2936, 1673, 1649, 1608, 1510, 1440, 1314, 1221, 1206, 1032 cm$^{-1}$; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 6.50 (s, 1H), 6.45 (s, 1H), 5.88 (s, 1H), 5.48 (d, $J = 2.0$ Hz, 1H), 4.89 (dd, $J_1 = 5.6$ Hz, $J_2 = 10.4$ Hz, 1H), 3.86 (s, 3H), 3.83 (s, 3H), 3.75 (s, 3H), 3.73 (s, 3H), 3.08 (dd appearing as $t$, $J = 7.0$ Hz, 2H), 1.77 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 187.49, 180.85, 158.53, 151.31, 148.67, 143.39, 140.57, 139.91, 128.10, 123.18, 122.06, 113.25, 106.82, 98.81, 57.25, 56.92, 56.10 (2C), 35.25, 29.13, 22.70. HRMS (ESI) $m/z$ calcd for C$_{22}$H$_{25}$O$_6$ (M + H$^+$): 371.1489; found: 371.1487.

To a solution of dienophile 9 (294 mg, 2.130 mmol) in toluene (5 mL), diene 10a (797 mg, 3.408 mmol) was added and allowed to stir at 50 °C for 6 h. On complete consumption of starting material by TLC analysis the reaction was worked up by evaporating out the entire toluene under reduced pressure and subjecting the resultant crude residue to SiO$_2$ gel column chromatographic purification using petroleum ether/ethyl acetate (7:3) as the eluent to first isolate the partially oxidised DA adduct 18 (332 mg, 0.896 mmol, 42% yield) followed by the aromatized naphthoquinone derivative 19 (135 mg, 0.366 mmol, 17%) with an overall yield of 59% for the D-A coupling.

**Procedure for the Diels–Alder reaction of 9 and 10a**

To a solution of dienophile 9 (294 mg, 2.130 mmol) in toluene (5 mL), diene 10a (797 mg, 3.408 mmol) was added and allowed to stir at 50 °C for 6 h. On complete consumption of starting material by TLC analysis the reaction was worked up by evaporating out the entire toluene under reduced pressure and subjecting the resultant crude residue to SiO$_2$ gel column chromatographic purification using petroleum ether/ethyl acetate (7:3) as the eluent to first isolate the partially oxidised DA adduct 18 (332 mg, 0.896 mmol, 42% yield) followed by the aromatized naphthoquinone derivative 19 (135 mg, 0.366 mmol, 17%) with an overall yield of 59% for the D-A coupling.

2-Methoxy-6-methyl-8-(2,4,5-trimethoxyphenyl)naphthalene-1,4-dione (18)

Brown-red solid, mp: 138.6–139.4°C. IR (neat): $r_{\text{max}}$ 2936, 1673, 1649, 1615, 1595, 1516, 1465, 1215, 1033, 852 cm$^{-1}$; $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.94 (dd, $J_1 = 1.6$ Hz, 1H), 7.31 (dd, $J_1 = 1.5$ Hz, 1H), 6.68 (s, 1H), 6.57 (s, 1H), 6.10 (s, 1H), 3.94 (s, 3H), 3.84 (s, 6H), 3.65 (s, 3H), 2.49 (s, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 185.44, 179.56, 161.10, 150.64, 149.23, 144.42, 143.05, 139.78, 137.89, 133.07, 127.02, 126.47, 121.37, 113.07, 108.27, 97.37, 56.61, 56.36, 56.32, 56.20, 21.77. HRMS (ESI) $m/z$ calcd for C$_{22}$H$_{25}$O$_6$ (M + H$^+$): 371.1433; found: 369.1366.

5,7,8-Trimethoxy-3-methyl-1-(2,4,5-trimethoxyphenyl)-1,4-dihydronaphthalene (20)

To a stirred solution of 18 (20 mg, 0.054 mmol) in THF (2 mL) containing n-Bu$_2$NBr (43.51 mg, 0.135 mmol) at 0 °C were added 30% aq. Na$_2$S$_2$O$_4$ (2.5 mL, 4.310 mmol), MeI (0.42 mL, 6.756 mmol) and aqueous KOH (1 mL) sequentially. After 5 min, the mixture was allowed to warm to rt, and stirring was continued for 1.5 h at the same temperature when complete consumption of starting material along with formation of a new spot was indicated by TLC analysis. The reaction was worked up by extracting it in ethyl acetate followed by drying of the separated organic phase over Na$_2$SO$_4$. Removal of the solvent under reduced pressure afforded a residue which was purified by SiO$_2$...
To a cooled solution of 18 (15 mg, 0.040 mmol) in DCM (2 mL), mCPBA (9.3 mg, 0.053 mmol) was added portion wise and allowed to stir for 12 h at 0 °C until complete consumption of starting material along with formation of a new spot was indicated by TLC analysis. The reaction was worked up by evaporating DCM and the resultant crude residue was purified by SiO₂ gel column chromatography using hexane/ethyl acetate (3: 2) as the eluent to arrive at the epoxide 21 (14 mg, 0.036 mmol, 89% yield) as a pale yellow solid, mp: 139.7–140.8 °C. IR (neat): νmax 2936, 1674, 1655, 1611, 1511, 1461, 1314, 1221, 1032, 806 cm⁻¹; ¹H NMR (400 MHz, CDCl₃) δ 7.66 (s, 1H), 6.48 (s, 1H), 5.85 (s, 1H), 4.66 (d, J = 1.6 Hz, 1H), 3.85 (s, 3H), 3.82 (s, 3H), 3.80 (s, 3H), 3.73 (s, 3H), 3.22 (dd, J₁ = 1.2 Hz, J₂ = 2.4 Hz, J₃ = 20.0 Hz, 1H), 1.36 (s, 1H), 1.28 (dd, J₄ = 2.4 Hz, J₅ = 20.0 Hz, 1H), 1.47 (s, 3H), 1.53 (s, 1H), 13C NMR (100 MHz, CDCl₃) δ 187.20, 181.05, 158.52, 149.39, 143.12, 138.53, 137.20, 116.60, 115.04, 106.96, 97.67, 61.44, 57.40, 56.79, 56.38, 56.18, 56.13, 37.58, 29.08, 22.57. HRMS (ESI) m/z calcd for C₂₁H₂₃O₂ (M + H)⁺: 387.1438; found: 387.1423.

3,5,6-Trimethoxy-1a-methyl-7-(2,4,5-trimethoxyphenyl)-1a,2,7,7a-tetrahydroxytriphenalen-2,3,5-dione (22)

The compound 22 was obtained in 76% yield (11.9 mg, 0.028 mmol) via epoxidation of 20 (15 mg, 0.038 mmol) using mCPBA (8.0 mg, 0.048 mmol) and employing similar epoxidation procedure as that described for 21. Alternatively it was also obtained in 65% yield (7.0 mg, 0.017 mmol) by reductive methylation of 21 (10 mg, 0.026 mmol) using 30% aq. Na₂SO₄ (1.26 mL, 2.172 mmol), MeI (0.2 mL, 3.238 mmol) and aqueous KOH (1 mL) employing similar procedure as that described for 20. IR (neat): νmax 2924, 2851, 1680, 1650, 1612, 1462, 1214, 1034, 850 cm⁻¹; ¹H NMR (400 MHz, CDCl₃) δ 6.62 (s, 1H), 6.31 (s, 1H), 5.19 (d, J = 2.0 Hz, 1H), 3.87 (s, 3H), 3.86 (s, 3H), 3.84 (s, 3H), 3.81 (s, 3H), 3.64 (s, 3H), 3.42 (d, J = 19.0 Hz, 1H), 3.41 (s, 3H), 3.25 (dd, J = 2.0, 1.0 Hz, 1H), 2.78 (d, J = 18.0 Hz, 1H), 1.43 (s, 3H); 13C NMR (100 MHz, CDCl₃) δ 153.07, 151.67, 151.32, 148.63, 143.13, 141.06, 130.12, 121.48, 114.06, 113.78, 98.10, 96.06, 62.08, 60.26, 57.02, 56.89, 56.76, 56.16, 56.09, 55.74, 35.53, 28.51, 22.93. HRMS (ESI) m/z calcd for C₂₁H₂₃O₂ (M + H)⁺: 387.1908; found: 387.1941.
mixture was then allowed to warm to rt and stirred for another 5 h until complete consumption of starting material and formation of a new spot was indicated by the TLC analysis. The reaction was worked up by removing the solvent under reduced pressure and then subjecting the resultant residue to SiO2 gel column chromatographic purification using hexane/ethyl acetate (7:3) as the eluent to arrive at 3 (9 mg, 0.023 mmol, 91% yield) as a red solid, mp: 172.6–173.3 °C. IR (neat): 3397, 3084, 2924, 2841, 1733, 1602, 1509, 1462, 1439, 1376, 1238, 1103 cm⁻¹;1H NMR (400 MHz, CDCl₃) δ 7.96 (s, 1H), 6.63 (s, 1H), 6.40 (s, 1H), 6.06 (s, 1H), 3.95 (s, 3H), 3.80 (s, 3H), 3.76 (s, 3H), 3.65 (s, 3H), 2.45 (s, 3H), 2.01 (s, 3H);13C NMR (100 MHz, CDCl₃) δ 185.52, 179.83, 160.77, 150.39, 149.84, 143.80, 143.76, 143.63, 139.41, 130.74, 127.21, 127.04, 120.48, 117.22, 108.03, 97.91, 56.57, 56.43, 56.23, 56.16, 21.47, 16.92. HRMS [ESI] m/z calculated for C₂₂H₂₃O₆ (M + H)⁺: 383.1489; found: 383.1481.

5,7,8-Trimethoxy-2,3-dimethyl-1-(2,4,5-trimethoxyphenyl)-1,4-dihydropaphthalen (iso-magnoshinin, 28)

Reductive methylation on 14 (20 mg, 0.052 mmol) using 30%aq. Na₂S₂O₄ (2.5 mL, 4.310 mmol), MeI (0.42 mL, 6.756 mmol) and aqueous KOH (1 mL) through similar procedure as described for preparation of 20, afforded compound 28 (20 mg, 0.048 mmol, 92% yield) as pale yellow solid. IR (neat): 3394, 3082, 2924, 2841, 1733, 1602, 1509, 1462, 1336, 1316, 1238, 1203, 1033 cm⁻¹;1H NMR (400 MHz, CDCl₃) δ 6.51 (s, 1H), 6.41 (s, 1H), 6.40 (s, 1H), 5.04 (br s, 1H), 3.87 (br s, 3H), 3.85 (s, 3H), 3.84 (s, 3H), 3.82 (s, 3H), 3.64 (s, 3H), 3.32 (s, 3H), 3.30 (br s, 2H), 1.78 (s, 3H), 1.64 (s, 3H);13C NMR (100 MHz, CDCl₃) δ 152.27, 151.23, 150.78, 147.61, 143.20, 140.03, 134.46, 127.73, 127.11, 122.74, 116.70, 113.73, 97.90, 95.21, 59.81, 56.96, 56.55, 56.22, 56.04, 55.68, 39.47, 30.98, 19.03, 16.66. HRMS [ESI] m/z calculated for C₂₂H₂₃O₆N₂ (M + H)⁺: 383.1489; found: 383.1481.

Notes and references


21 CCDC 1548143 contain the crystallographic information for 14.