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Note

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N-acylation of oxazolidinones via aerobic oxidative NHC catalysis

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KEYWORDS: N-heterocyclic carbene, Aerobic, Oxidation, Oxazolidinone, N-Acylation, ETM, Organocatalysis.

ABSTRACT: The first *N*-acylation of synthetically useful oxazolidinones with aldehydes using aerobic oxidative NHC catalysis is reported. The reaction offers a broad scope of functionalized oxazolidinones in good to excellent yields. Careful choice of electron transfer mediators (ETMs) proved pivotal to achieve efficient aerobic *N*-acylation, which have previously proven difficult using NHC-catalysis. The methodology allows a mild entry to acylated oxazolidinones avoiding the use of hazardous and reactive prefunctionalized substrates.

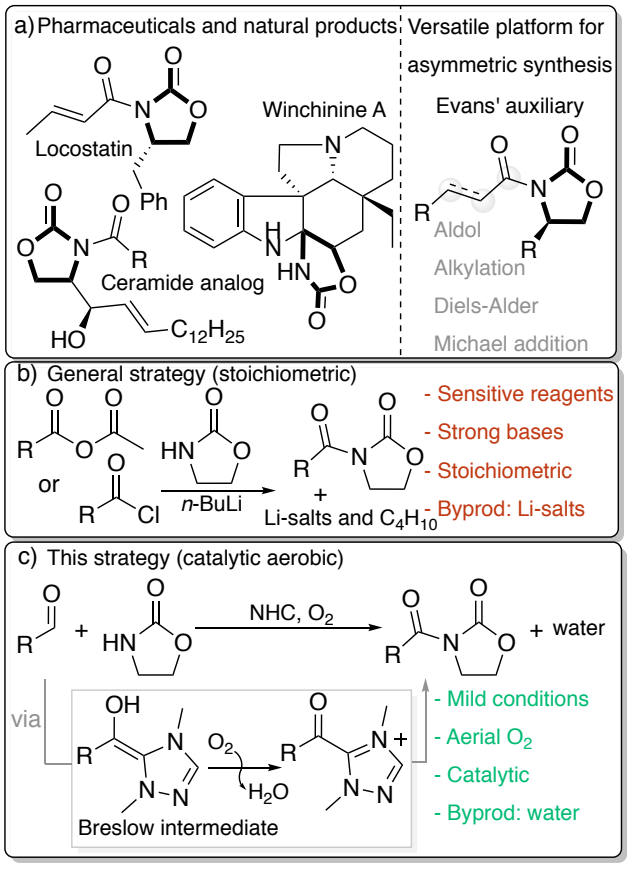
Functionalized oxazolidinones are important organic molecules that exhibit interesting biological activities. The oxazolidinone-moiety can, for example, be found in pharmaceuticals, such as Locostatin, a Raf-kinase inhibitor and natural products (Scheme 1a).[1-5] Synthetically, *N*-acylated oxazolidinones have mostly been used as chiral auxiliaries, first popularized by Evans and have been employed in different asymmetric transformations[6-8] such as aldol,[9] alkylation,[10] Diels-Alder reactions[11] and Michael additions[12] and in total synthesis[13-14] (Scheme 1a) and still attracts considerable attention within the synthetic community today.[15-20]

The general synthesis of *N*-acylated oxazolidinones proceeds by deprotonation normally using a strong base, such as *n*-BuLi, in combination with an acid chloride or anhydride (Scheme 1b). However, the use of highly reactive substrates, which requires special precautions as well as the usage of strong bases, capable of epimerizing chiral oxazolidinones at the C-5 position limits these protocols.[21] Alternative methods includes the use of coupling reagents,[22] acyl fluorides,[23] carbonylazoles,[24] DMAP,[25] metal catalysis,[26] and electrochemistry.[27] However, these procedures still requires highly reactive reagents, coupling reagents, high reaction temperatures and reagents in excess in order to drive the reaction to completion. Clearly, a more benign, atom economical and facile acylation of oxazolidinones would be highly desirable (Scheme 1c).

The use of *N*-heterocyclic carbene (NHC) catalysis has emerged as an environmentally friendly method *in lieu* of transition metal catalysis, and displays a plethora of reaction pathways taking the field of organic synthesis forward.[28-31] In combination with an oxidant, NHC catalysis can utilize readily available aldehydes as acyl donors *via* the acyl azolium intermediate (Scheme 1c), thus circumventing the need to generate sensitive activated acyl-donors in advance.

The acyl azolium intermediate is generally formed *via* internal oxidation of the Breslow intermediate or by addition of an external oxidant, such as the Kharasch oxidant **8** (Table 1). Conventional methods has enabled the formation of numerous novel methodologies,[32-34] where *O*-nucleophiles are well investigated,[34-38] on the contrary, methodologies for acylation of *N*-nucleophiles remain scarce.[39-45] These methodologies suffer

Scheme 1. a) Various uses for functionalized oxazolidinones. b) Previous reports for *N*-acylation of oxazolidinones. c) This approach.



from using **8** in stoichiometric amounts, generating stoichiometric quantities of waste in the downstream process.

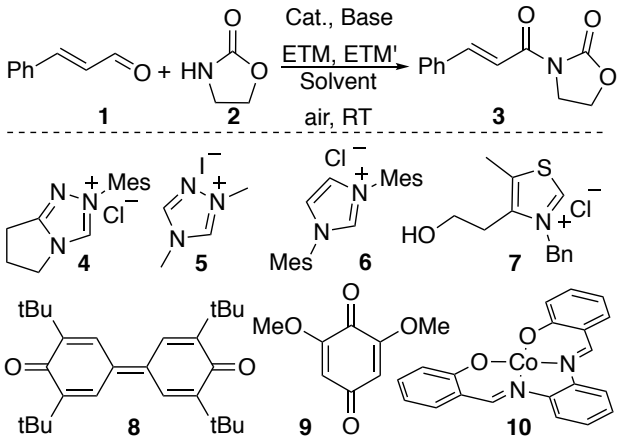
Recently, we have shown that **8** can be replaced with aerial O_2, an oxidant that generates water as the sole by-product, using a system of electron transfer mediators (ETMs) for the synthesis of various esters and dihydropyranones.[46-48] The system of ETMs circumvents the high energy barriers normally associated

with direct aerobic oxidation by creating a low energy pathway for the electrons to flow from the substrate to oxygen.[49-54] It is worth noting, that by using an ETM-system, one can typically avoid side-reactions associated with aerobic NHC catalysis, such as, acid formation, homo-coupling and internal redox reactions. This selectivity can be attributed to a kinetic preference for oxidation of the homoenolate to the acyl azolium by the ETMs.

To combine NHC-catalyzed *N*-acylation and aerobic oxidation have proven cumbersome, as noted in the reports by Connon and co-workers, where aerobic esterifications are possible but amidations require the addition of a stochiometric oxidant to be efficient.[55] This incompatibility was also noted in the oxidative acylation of indoles previously reported by our group, where aerobic oxidation was only possible for one entry and required high loading of the ETM (25 mol%).[45] Herein, we report the aerobic oxidative NHC-catalyzed *N*-acylation of oxazolidinones using aldehydes as mild acylation reagents.[56] The reaction can be carried out under ambient reaction conditions and offers a broad scope of synthetically useful acylated oxazolidinones.

The starting point for this study was a survey of different NHC-precatalysts. Triazolium salts **4** and **5** were both good candidates (Table 1, entry 1 and 2) with **5** delivering **3** in slightly higher yields (53% vs. 47%). Imidazolium salt **6** (entry 3) was not as efficient in comparison (32%) and thiazolium salt **7** (entry 4) showed no activity in the reaction. Next, evaluations of different solvents were made. Ethyl acetate (EtOAc) gave comparable results with acetonitrile (MeCN) delivering the product in 55% yield (entry 6). On the other hand, dichloromethane (DCM) (entry 7) and methyl ethyl ketone (MEK) (entry 8) resulted in lower yields As EtOAc is considered a more sustainable and greener solvent alternative,[57] it became the solvent of choice. At this point the system was still not efficient enough. The isolation of side-products such as γ-butyrolactone[58] the saturated *N*-acyloxazolidinone as well as cinnamic acid, indicated a slow oxidation of the Breslow intermediate (Scheme 1c). Further optimization with different bases and ETM-systems were investigated. The most effective base proved to be DBU (entry 9) capable of delivering **3** in 90% yield, while the weaker organic base, triethylamine (TEA) (entry 10) failed to generate any product at all. We also noted that it was possible to lower the amount of NHC catalyst (from 5 mol% to 1 mol%), base (from 0.5 eq. to 0.2 eq.). Furthermore, the reaction seemed to be sensitive to changes in concentration; doubling the amount of EtOAc (3.2 ml, 77% yield) give lower yields in comparison with the optimized amount (1.6 ml, 90% yield). Different ETM-systems (entry 11–12) were tested and showed that **8** together with FePc were the most suited combination. With a stoichiometric amount of **8** the product was obtained in 84% yield, less efficient in comparison with our developed aerobic method (entry 13). Reactions performed by excluding the different ETMs and O_2 showed that they are essential for an efficient reaction (for full optimization of reaction conditions, see SI). The generality of the reaction was first investigated with regard to the aldehyde reaction partner (Scheme 2). α,β-unsaturated aldehydes works well with both electron donating groups (compounds **11–13**, **16**) and electron withdrawing groups (compounds **14**, **15**, and **17**) with both *para*- and *orto*-substitution on the aromatic ring giving good yields. A gram-scale synthesis of **3** was also viable and could be obtained in 76% yield without using any

Table 1. Screening of reaction conditions.



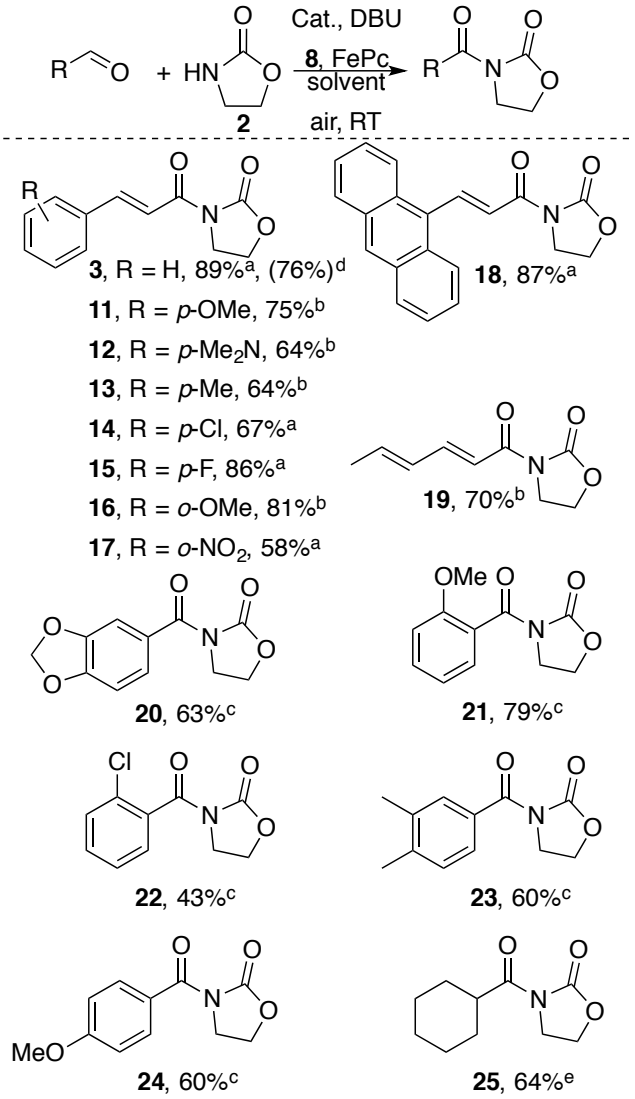
Entry	Cat.	Solvent	Base	ETM	ETM'	Yield
1.[a]	**4**	MeCN	TBD	**8**	FePc	47
2.[a]	**5**	MeCN	TBD	**8**	FePc	53
3.[a]	**6**	MeCN	TBD	**8**	FePc	32
4.[a]	**7**	MeCN	TBD	**8**	FePc	0
5.[a]	**5**	Anisole	TBD	**8**	FePc	24
6.[a]	**5**	EtOAc	TBD	**8**	FePc	55
7.[a]	**5**	DCM	TBD	**8**	FePc	35
8.[a]	**5**	MEK	TBD	**8**	FePc	32
9.[b]	**5**	EtOAc	DBU	**8**	FePc	90/89[c]
10.[b]	**5**	EtOAc	TEA	**8**	FePc	0
11.[b]	**5**	EtOAc	DBU	**8**	**10**	39
12.[b]	**5**	EtOAc	DBU	**9**	FePc	78
13.[b,d]	**5**	EtOAc	DBU	**8** (1 eq.)	-	84

Reaction conditions: [a]**1** (1 eq.), **2** (1.5 eq.), cat (5 mol%), base (0.5 eq.), ETM (5 mol%), ETM' (3 mol%), solvent (0.16 M). [b]With cat (1 mol%), base (0.2 eq.), ETM (3 mol%), ETM' (2 mol%), solvent (0.31 M). [c]Isolated yield, **2** (1.3 eq.). [d]Performed under N_2 with **8** (1 eq). Yield (%) was determined by ^{1}H NMR with durene as internal standard. FePc = Iron(II)phthalocyanine, TBD = 1,5,7-triazabicyclo[4.4.0]dec-5-ene, DBU = 1,8-diazabicyclo[5.4.0]undec-7-ene.

chromatography. An aldehyde bearing an anthracene-moiety was converted to compound **18** in 87% yield. Moreover, a non-aromatic α,β-unsaturated aldehyde was viable, generating **19** in 70% yield. It was also noted that α,β-unsaturated aldehydes with electron donating groups on the aromatic ring required a more electron-rich catalyst **4** to furnish the products. The benzaldehydes, being less activated than their α,β-unsaturated counterpart, required slightly higher loadings of catalyst **4**. Good yields were obtained with benzaldehydes containing electron donating groups (**20**, **21**, **23**, and **24**) whereas electron poor aldehyde gave compound **22** in acceptable yield (43%). The low yield was attributed to the formation of the benzoic acid *via* direct oxygenative oxidation of the Breslow intermediate with O_2.[33] Saturated aliphatic aldehydes have proven difficult to incorporate in NHC-catalyzed *N*-acylations,[39, 43-45, 55] however, it was found that with an increased loading of DBU (0.8 eq.) cyclohexanecarboxaldehyde reacted smoothly delivering product **25** in 64% yield.

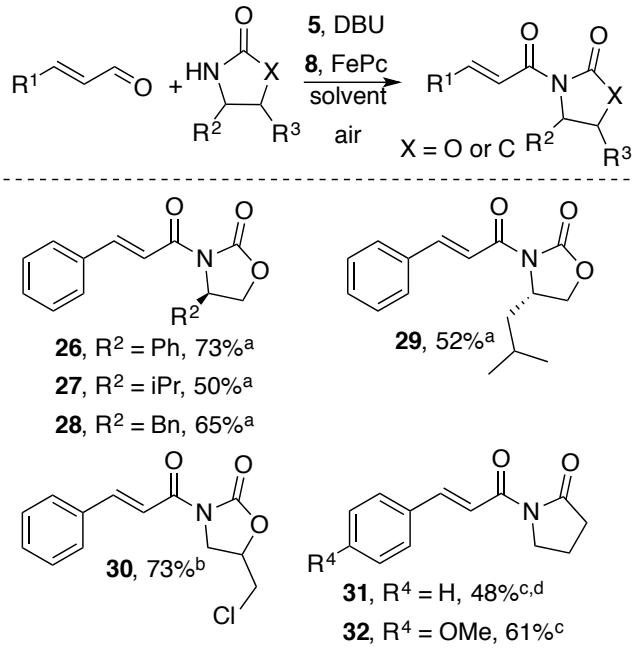
Next the oxazolidinone-part was investigated (Scheme 3). Different chiral and achiral oxazolidinones were tested. The *N*-acylation of chiral oxazolidinones substituted at C-4 position (compounds **26**–**29**) gave products in good yields. Due to the steric nature of the substituents, the reaction required an elevation of reaction temperature (60 °C) and a slight increase of base. Reaction between the C-5 substituted oxazolidinone and cinnamaldehyde delivered product **30** in 73% yield under normal reaction condition, leaving the primary alkyl chloride unscathed. Furthermore, it was also possible to incorporate 2-pyrrolidinone as nucleophile for the synthesis of two natural products, Piperlotine F (**31**) and Piperlotine G (**32**), a Nrf2 activator, in moderate to good yields.[59-60] Acyclic amides failed to deliver the *N*-acylated product under the developed reaction conditions.[61]

Scheme 2. The scope of the reaction with different aldehydes.



Reaction conditions: [a]With cat **5** (1 mol%). [b]With cat **4** (1 mol%). [c]With cat **4** (4 mol%). [d]Gram-scale synthesis. [e]With cat **4** (5 mol%) and DBU (0.8 eq.).

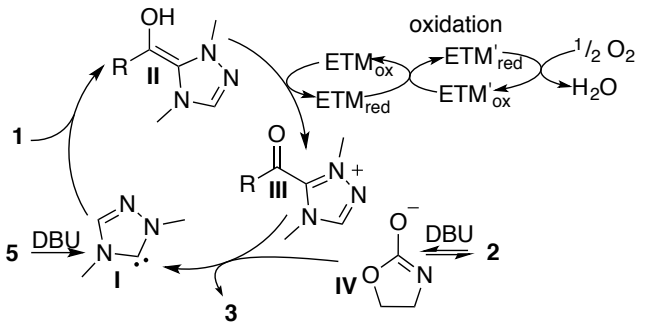
Scheme 3. The scope of the reaction with different nucleophiles.



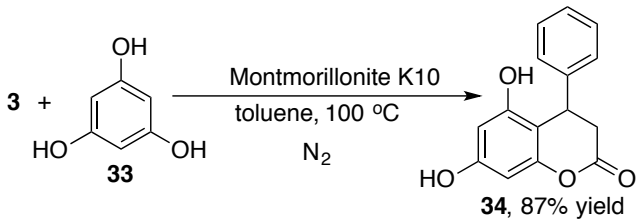
Reaction conditions: [a]With cat **5** (1 mol%), DBU (0.4 eq.), 60 °C. [b]With cat **5** (1 mol%). [c]With cat **5** (1 mol%), **8** (5 mol%), DBU (1.5 eq.), aldehyde (1 eq.), 2-pyrrolidinone (2 eq.). [d]With molecular sieves (4 Å, 0.2 g)

The postulated catalytic cycle (Scheme 4) starts with deprotonation of the NHC-precatalyst forming the active carbene species **I**. The catalyst then adds to cinnamaldehyde **1** to give Breslow intermediate **II**. With the help of the linked ETM-system, the Breslow intermediate is subsequently oxidized by O_2 *via* a multistep electron transfer step, to form the acyl azolium intermediate **III**. In the last step, the deprotonated oxazolidinone **IV** reacts with acyl azolium **III** forming **3** and regenerating the catalyst. The synthetically useful *N*-acylated oxazolidinones were also applied in the synthesis of a 2-chromanone-scaffold found in the natural products of the calomelanol family (Scheme 5).[62-63] Compound **3** was reacted with phloroglucinol (**33**) in toluene at 100 °C using montmorillonite K10 as catalyst giving compound **34** in 87% yield through a tandem Friedel–Crafts alkylation lactonization.[64-65]

Scheme 4. The proposed mechanism.



Scheme 5. Synthesis of a dihydrocoumarin scaffold from 3 and phloroglucinol.



Reaction conditions: **3** (0.3 mmol), K10 (95.1 mg), phloroglucinol **33** (1.1 eq.), PhMe (0.3 ml), 100 °C for 16 h.

In summary, the first aerobic oxidative NHC-catalyzed *N*-acylation of oxazolidinones and pyrrolidinone has been reported. In combination with an ETM system the reaction uses molecular oxygen as a terminal oxidant in an atom efficient manner. The reaction has a high functional group compatibility, providing a broad scope of *N*-acylated oxazolidinones. The method was also used for the synthesis of two natural products, Piperlotine F and Piperlotine G. The acylated oxazolidinones were further modified in the synthesis of a 2-chromanone using montmorillonite K10 as catalyst. The developed methodology offers a sustainable way of using readily available aldehydes as acylation reagents circumventing the need for highly reactive prefunctionalized substrates.

EXPERIMENTAL SECTION

General considerations. All solvents and reagents were purchased from commercial suppliers and used without modifications unless otherwise stated. NHC-precatalyst **4**,[66] and **5**,[67] were synthesized according to literature procedures. Oxidant 3,3',5,5'-tetra-tert-butyldiphenoquinone (**8**) was synthesized according to literature procedure.[68] 4-Methylcinnamaldehyde[69] and ETM **10**[70-71] were synthesized according to literature procedures.

Purification was performed by an automated column chromatography Biotage Isolera™ Spektra One with Biotage SNAP®-10 g KP-sil column together with a 1 g samplet® cartridge. Thin layer chromatography (TLC) was performed on Merck TLC plates pre-coated with silica gel 60 F_{254} (Art 5715, 025 mm) and was visualized with UV-light (254 nm) or Hanessian's stain. NMR-spectra, ^{1}H NMR (400 MHz), ^{13}C NMR (101 MHz) and ^{19}F NMR (376 MHz) were recorded on Varian 400. The chemical shifts for ^{1}H and ^{13}C NMR spectra are reported in parts per million (ppm) relative to the residual peak from solvent $CDCl_3$ or DMSO-d_6 as the internal standard; ^{1}H NMR at δ 7.26 ppm and ^{13}C NMR at δ 77.16 ppm for $CDCl_3$, and ^{1}H NMR at δ 2.50 ppm and ^{13}C NMR at δ 39.52 ppm for DMSO-d_6. All coupling constants (*J*) are reported in Hertz (Hz) and multiplicities are indicated by s (singlet), d (doublet), dd (doublet of a doublet), appd (apparent doublet), t (triplet), appt (apparent triplet) and m (multiplet).

FT-ATR-IR spectra were recorded on a Perkin-Elmer Spectrum Frontier infrared spectrometer with pike-GladiATR™ module and reported in wavenumber (cm−1) as follows: very strong (vs), s (strong) and m (medium). Melting points were recorded on a Büchi Melting Point B-545.High-resolution mass spectrometry (HRMS) was performed on an Agilent 1290 infinity LC system equipped with an autoSampler tandem to an Agilent 6520 Accurate Mass Q-TOF LC/MS. HRMS was analyzed with a column, with a 0.3 ml/min flow rate using an isocratic method (10% MPA/90% MPB (Mobile Phase A: Water with 0.04 % formic acid, Mobile Phase B: MeCN with 0.04% formic acid)). All samples were initially analyzed using an ESI source in positive mode (scan range 100–1700 m/z). The samples were diluted to ca 10 µg/ml in MeCN. Ion source parameters were as follows: drying gas 10 L/min and temperature 275 °C and nebulizer pressure 40 psig.

General procedure 1. To a 4 ml vial equipped with a magnetic stir bar were added 1,4-dimethyl-4H-1,2,4-triazol-1-ium iodide (cat **5**) (1.1 mg, 0.005 mmol, 0.01 eq.), iron(II)phthalocyanine (FePc) (5.7 mg, 0.01 mmol, 0.02 eq.), 3,3',5,5'-tetra-tert-butyldiphenoquinone (**8**) (6.1 mg, 0.015 mmol, 0.03 eq.), 2-oxazolidinone (52 mg, 0.59 mmol, 1.3 eq.), cinnamaldehyde (62.1 mg, 0.47 mmol, 1 eq.), 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU) (15.4 µl, 0.10 mmol, 0.2 eq.) and ethyl acetate (1.6 ml). The reaction mixture was stirred at room temperature, open to the atmosphere, monitored by ^{1}H NMR until the reaction had reached completion. The product was purified with the biotage using petroleum ether (40–60 °C)/ethyl acetate and dichloromethane gradient. (25ml/min, 100% petroleum ether → 20% ethyl acetate →100% petroleum ether →100% dichloromethane). The product was obtained as a lightly yellow solid (90.6 mg, 0.42 mmol, 89% yield). This procedure was used for compounds **3**, **14**, **15**, **17**, **18**, **30**.

General procedure 2. For the cinnamaldehydes containing electron donating substituents, 2-mesityl-6,7-dihydro-5*H*-pyrrolo[2,1-*c*][1,2,4]triazol-2-ium chloride (cat **4**) (1.4 mg, 0.005 mmol, 0.01 eq.) was used instead, for aromatic aldehydes 0.04 eq. of cat **4** was used. To a 5 ml pear shaped flask was added 2-mesityl-6,7-dihydro-5*H*-pyrrolo[2,1-*c*][1,2,4]triazol-2-ium chloride (cat **4**) (5.28 mg, 0.02 mmol, 0.04 eq.), iron(II)phthalocyanine (FePc) (5.7 mg, 0.01 mmol, 0.02 eq.), 3,3',5,5'-tetra-tert-butyldiphenoquinone (**8**) (10.2 mg, 0.025 mmol, 0.05 eq.), 2-oxazolidinone (52.3 mg, 0.60 mmol, 1.2 eq.), 2-methoxybenzaldehyde (68.1 mg, 0.50 mmol, 1 eq.), 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU) (14.9 µl, 0.10 mmol, 0.2 eq.) and ethyl acetate (1.6 ml). The reaction mixture was stirred at room temperature, open to the atmosphere, monitored by ^{1}H NMR until the reaction had reached completion. The product was purified with the biotage using petroleum ether (40–60 °C)/ethyl acetate and dichloromethane gradient. (25ml/min, 100% petroleum ether → 20% ethyl acetate →100% petroleum ether →100% dichloromethane). The product was obtained as a lightly yellow solid (87.9 mg, 0.397 mmol, 79% yield). This procedure was used for compounds **11**–**13**, **16**, **19**–**25**.

General procedure 3. To a 5 ml pear shaped flask equipped with a magnetic stir bar were added 1,4-dimethyl-4*H*-1,2,4-triazol-1-ium iodide (cat **5**) (1.5 mg, 0.007 mmol, 0.001 eq.), iron(II)phthalocyanine (FePc) (6 mg, 0.01 mmol, 0.02 eq.), 3,3',5,5'-tetra-tert-butyldiphenoquinone (**8**) (7.2 mg, 0.018 mmol, 0.03 eq.), (R)-(−)-4-phenyl-2-oxazolidinone (82.4 mg, 0.51 mmol, 1 eq.), cinnamaldehyde (104.8 mg, 0.79 mmol, 1.6 eq.), 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU) (30.2 µl, 0.20 mmol, 0.4 eq.) and ethyl acetate (1.6 ml). The reaction mixture was stirred at 60 °C, open to the atmosphere, monitored by ^{1}H NMR until the reaction had reached completion. The product was purified with the biotage using petroleum ether (40–60 °C)/ethyl acetate and dichloromethane gradient. (25ml/min, 100 % petroleum ether → 20% ethyl acetate →100% petroleum ether →100% dichloromethane). The product was obtained as a yellow solid (107.9 mg, 0.37 mmol, 73%). This procedure was used for compounds **26**–**29**.

General procedure 4. To a microwave vial was added 1,4-dimethyl-4H-1,2,4-triazol-1-ium iodide (cat **5**) (13.5 mg, 0.06 mmol, 0.01 eq.), iron(II)phthalocyanine (FePc) (68.2 mg, 0.12 mmol, 0.02 eq.), 3,3',5,5'-tetra-tert-butyldiphenoquinone (**8**) (80.2 mg, 0.20 mmol, 0.03 eq.), 2-pyrrolidinone (85.1 mg, 1 mmol, 2 eq.), 4-methoxycinnamaldehyde (81.1 mg, 0.5 mmol, 1 eq.), 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU) (111.9 µl, 0.750 mmol, 1.5 eq.) and ethyl acetate (1.6 ml). The reaction mixture was stirred at 60 °C, open to the atmosphere, monitored by ^{1}H NMR until the reaction had reached completion. The product was purified with the biotage using petroleum ether (40–60 °C)/ethyl acetate and dichloromethane gradient. (25ml/min, 100 % petroleum ether → 20% ethyl acetate →100% petroleum ether →100% dichloromethane). The product was obtained as a yellow solid (74.2 mg, 0.303 mmol, 61% yield). This procedure was used for Piperlotine F and Piperlotine G.

Gram-scale synthesis of 3.To a 50 ml pear shaped flask (opening 14/23) was added 1,4-dimethyl-4H-1,2,4-triazol-1-ium iodide (cat **5**) (1.1 mg, 0.005 mmol, 0.01 eq.), iron(II)phthalocyanine (FePc) (8.53 mg, 0.02 mmol, 0.03 eq.), 3,3',5,5'-tetra-tert-butyldiphenoquinone (**8**) (10.2 mg, 0.025 mmol, 0.05 eq.), 2-oxazolidinone (639.8 mg, 7.35 mmol, 1.2 eq.), cinnamaldehyde (797.3 mg, 6.0 mmol, 1 eq.), 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU) (179.1 µl, 1.2 mmol, 0.2 eq.) and ethyl acetate (15 ml).The mixture was stirred overnight at ambient temperature in contact with air. A crude ^{1}H NMR showed complete consumption of aldehyde and clean formation of the product (a copy of the crude ^{1}H NMR can be found in the Supporting information). The mixture was diluted with ethyl acetate (30 ml) and washed with water (3×20 ml). The organic phase was collected and the volatiles were removed under reduced pressure. The resulting solid was recrystallized from heptane/ethyl acetate (1:1) yielding the product as a yellow solid (995.1 mg, 4.5811 mmol, 76%).

Synthesis of 5,7-dihydroxy-4-phenylchroman-2-one (34). To a microwave vial was added phloroglucinol (39.2 mg, 0.311 mmol, 1.1 eq.), 3-cinnamoyloxazolidin-2-one **3** (59.0 mg, 0.272 mmol, 1.0 eq.) and montmorillonite K10 (95.1 mg) with a magnetic stir bar. The vial was capped and evacuated and backfilled with N_2 (×5 times). To this was added toluene (0.3 ml) and the vial was then heated to 100 °C. After 16 h the mixture was cooled to r.t. and subsequently filtered on a frit to remove montmorillonite k10 and washed with EtOAc. The filtrate was washed with water (3×10 ml). The organic phase was collected and the volatiles were removed under reduced pressure yielding an oil. Two drops of DCM were added to induce precipitation. The resulting solid was washed with DCM and water and then dried *in vacuo*. The product was obtained as a white solid (60.8 mg, 0.237 mmol, 87%). The NMR matches reported values.[64] **^{1}H NMR (400 MHz, DMSO-d6) δ** 9.76 (s, 1H), 9.57 (s, 1H), 7.30–7.23 (m, 2H), 7.22–7.16 (m, 1H), 7.10–7.04 (m, 2H), 6.17 (d, *J* = 2.2 Hz, 1H), 6.03 (d, *J* = 2.1 Hz, 1H),4.47–4.40 (m, 1H), 3.20 (dd, *J* = 15.9, 7.1 Hz, 1H), 2.86–2.77 (m, 1H). **^{13}C NMR (101 MHz, DMSO-d6) δ** 167.8, 157.9, 155.4, 153.0, 142.5, 128.6, 126.7, 126.6, 103.0, 98.7, 94.7, 37.1, 33.7.

Synthesis of Chiral Oxazolidinone, (*S*)-4-isobutyloxazolidin-2-one. To a microwave vial equipped with a magnetic stir bar was added *L*-leucinol (474 µl, 3.56 mmol, 1 eq.) 1,5,7-triazabicyclo[4.4.0]dec-5-ene (TBD) (102.1 mg, 0.73 mmol, 0.2 eq.) and dimethylcarbonate (7 ml) which was sealed. The mixture was stirred to yield a homogeneous solution and was heated to 100 °C. After 20 h the reaction mixture was allowed to cool to room temperature and was washed with HCl (1M) (10 ml), water (15 ml) and brine (15 ml). The organic phase was dried over Na_2SO_4 and filtrated. The filtrate was concentrated to yield the crude product as a yellow oil. The crude was purified using the biotage using petroleum ether (40–60 °C)/ethyl acetate solvent mixture (petroleum ether 100% →70 % ethyl acetate). Obtained as a colorless oil (350.8 mg, 2.45 mmol, 69% yield). The obtained data match the reported ones reported in literature.[72]

Characterization of Products

3-cinnamoyloxazolidin-2-one (3): Was synthesized according to the general procedure 1 with cinnamaldehyde (62.1 mg, 0.470 mmol, 1 eq.). The product was obtained as faintly yellow solid (90.6 mg, 0.417 mmol, 89%). The NMR matches reported values.[73] **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.92 (d, *J* = 15.7 Hz, 1H), 7.87 (d, *J* = 15.7 Hz, 1H), 7.64–7.60 (m, 2H), 7.43–7.37 (m, 3H), 4.49–4.44 (m, 2H), 4.17–4.12 (m, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 165.5, 15.7, 146.4, 134.6, 130.8, 129.0, 128.8, 116.7, 62.2, 43.0.

(E)-3-(3-(4-methoxyphenyl)acryloyl)oxazolidin-2-one (11): Was synthesized according to the general procedure 2 with 4-methoxycinnamaldehyde (82.7 mg, 0.499 mmol, 1 eq.) and catalyst 4. The product was obtained as white solid (93.2 mg, 0.377 mmol, 75%). (stirred for 23 h).The NMR matches reported values.[73] **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.84 (d, J = 15.7 Hz, 1H), 7.77 (d, J = 15.7 Hz, 1H), 7.62–7.54 (m, 2H), 6.95–6.88 (m, 2H), 4.49–4.40 (m, 2H), 4.18–4.09 (m, 2H), 3.85 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 165.7, 161.9, 153.8, 146.2, 130.6, 127.5, 114.5, 114.2, 62.2, 55.5, 43.0.

(*E*)-3-(3-(4-(dimethylamino)phenyl)acryloyl)oxazolidin-2-one (12): Was synthesized according to the general procedure 2 with 4-(dimethylamino)cinnamaldehyde (90.3 mg, 0.505 mmol, 1 eq.) and catalyst **4**. The product was obtained as a red/brown solid (83.7 mg, 0.322 mmol, 64%), mp: 228–229 °C. **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.84 (d, *J* = 15.6 Hz, 1H), 7.68 (d, *J* = 15.6 Hz, 1H), 7.57–7.49 (m, 2H), 6.71–6.64 (m, 2H), 4.46–4.39 (m, 2H), 4.17–4.09 (m, 2H), 3.04 (s, 6H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 166.1, 153.9, 152.2, 147.3, 130.7, 122.6, 111.8, 110.9, 62.1, 43.1, 40.3. **HRMS (ESI/Q-TOF)** m/z $[M+H]^+$ calcd for $C_{14}H_{17}N_2O_3$ 261.1239, found: 261.1241. **FTIR-ATR (ν_{max}/cm^{-1}):** 1765 (s) (CO), 1661 (m) (CO).

(*E*)-3-(3-(*p*-tolyl)acryloyl)oxazolidin-2-one (13):
Was synthesized according to the general procedure 2 with 4-methylcinnamaldehyde (74.1 mg, 0.507 mmol, 1 eq.) and catalyst **4**. The product was obtained as a yellow solid (75.3 mg, 0.326 mmol, 64%), mp: 172–173 °C. **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.86 (s, 2H), 7.52 (appd, *J* = 8.1 Hz, 2H), 7.20 (appd, *J* = 8.1 Hz, 2H), 4.49–4.41 (m, 2H), 4.17–4.09 (m, 2H), 2.38 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 165.7, 153.8, 146.5, 141.4, 131.9, 129.8, 128.8, 115.6, 62.2, 43.0, 21.7. **HRMS (ESI/Q-TOF)** m/z $[M+H]^+$ calcd for $C_{13}H_{14}NO_3$ 232.0974; found 232.0973. **FTIR-ATR (ν_{max}/cm^{-1}):** 1767 (vs) (CO), 1674 (vs) (CO).

(*E*)-3-(3-(4-chlorophenyl)acrloyl)oxazolidin-2-one (14):
Was synthesized according to the general procedure 1 with 4-chlorocinnamaldehyde (83.2 mg, 0.499 mmol, 1 eq.). The product was obtained as a white solid (83.8 mg, 0.333 mmol, 67%), mp: 178–180 °C. **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.87 (d, *J* = 15.7 Hz, 1H), 7.79 (d, *J* = 15.8 Hz, 1H), 7.57–7.51 (m, 2H), 7.39–7.33 (m, 2H), 4.49–4.42 (m, 2H), 4.16–4.10 (m, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 165.3, 153.7, 144.9, 136.7, 133.1, 129.9, 129.3, 117.2, 62.3, 42.9. **HRMS (ESI/Q-TOF)** m/z $[M+H]^+$ calcd for $C_{12}H_{11}ClNO_3$ 252.0427; found 252.0428. **FTIR-ATR (ν_{max}/cm^{-1}):** 1766 (s) (CO), 1679 (s) (CO).

(*E*)-3-(3-(4-fluorophenyl)acryloyl)oxazolidin-2-one (15):
Was synthesized according to the general procedure 1 with 4-fluorocinnamaldehyde (86.8 mg, 0.550 mmol, 1 eq.). The product was obtained as a white solid (110.5 mg, 0.470 mmol, 86%), mp: 200–202 °C. The NMR matches reported values.[74] **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.84 (s, 2H), 7.65–7.58 (m, 2H), 7.13–7.05 (m, 2H), 4.50–4.43 (m, 2H), 4.18–4.11 (m, 2H).**^{13}C NMR (101 MHz, $CDCl_3$) δ** 165.4, 164.4 (d, $^1J_{C\text{-}F}$=250 Hz), 153.8, 145.1, 131.0 (d, $^4J_{C\text{-}F}$=3.5 Hz), 130.8 (d, $^3J_{C\text{-}F}$=8.6 Hz), 116.5 (d, $J_{C\text{-}F}$=2.2 Hz), 116.2 (d, $^2J_{C\text{-}F}$=22 Hz), 62.3, 43.0. **^{19}F NMR (376 MHz $CDCl_3$) δ** −108.85.

(*E*)-3-(3-(2-methoxyphenyl)acryloyl)oxazolidin-2-one (16):
Was synthesized according to the general procedure 2 with 2-methoxycinnamaldehyde (81.6 mg, 0.503 mmol, 1 eq.) and catalyst **4** with exclusion of light. The product was obtained as yellow solid (100.8 mg, 0.407 mmol, 81%). The NMR matches reported values.[73] **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.20 (d, *J* = 15.9 Hz, 1H), 7.97 (d, *J* = 15.9 Hz, 1H), 7.66–7.60 (m, 1H), 7.40–7.33 (m, 1H), 7.00–6.89 (m, 2H), 4.48–4.40 (m, 2H), 4.17–4.10 (m, 2H), 3.90 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 166.0, 158.8, 153.8, 141.7, 132.1, 129.5, 123.7, 120.8, 117.0, 111.3, 62.2, 55.7, 43.0.

(*E*)-3-(3-(2-nitrophenyl)acryloyl)oxazolidin-2-one (17):
Was synthesized according to the general procedure 1 with 2-nitrocinnamaldehyde (90.3 mg, 0.510 mmol, 1 eq.). The product was obtained as yellow solid (78.0 mg, 0.298 mmol, 58%), mp: 177–178 °C. **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.27 (d, *J* = 15.9 Hz, 1H), 8.06–8.04 (m, 1), 7.82 (d, *J* = 16.0), 7.76–7.74 (m, 1H), 7.68–7.64 (m, H1), 7.57–7.53 (m, 1H), 4.49 (t, *J* = 7.9 Hz, 2H), 4.16 (*J* = 7.8). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 164.4, 153.7, 148.6, 141.4, 133.7, 130.8, 130.6, 129.7, 125.0, 121.6, 62.4, 42.9. **HRMS (ESI/Q-TOF)** m/z $[M+H]^+$ calcd for $C_{12}H_{11}N_2O_5$ 263.0668; found 263.0668. **FTIR-ATR (ν_{max}/cm^{-1}):** 1772 (s) (CO), 1718 (s) (CO).

(*E*)-3-(3-(anthracen-9-yl)acryloyl)oxazolidin-2-one (18):
Was synthesized according to the general procedure 1 with 3-(9-anthryl)acrolein (116 mg, 0.499 mmol, 1 eq.). The product was obtained as yellow solid (137.9 mg, 0.435 mmol, 87%), mp: 194–196 °C. **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.84 (d, *J* = 16.0 Hz, 1H), 8.48 (s, 1H), 8.38–8.27 (m, 2H), 8.04–7.98 (m, 2H), 7.85 (d, *J* = 16.0 Hz, 1H), 7.55–7.45 (m, 4H), 4.54 (t, *J* = 8.0 Hz, 2H), 4.24 (t, *J* = 8.0 Hz, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 165.2, 153.7, 143.2, 131.3, 129.7, 129.4, 129.0, 128.8, 126.6, 125.7, 125.5, 125.3, 62.4, 43.0. **HRMS (ESI/Q-TOF)** m/z $[M+H]^+$ calcd for $C_{20}H_{16}NO_3$ 318.1130; found 318.1129. **FTIR-ATR (ν_{max}/cm^{-1}):** 1764 (vs) (CO), 1684 (s) (CO).

3-((2*E*,4*E*)-hexa-2,4-dienoyl)oxazolidin-2-one (19):
Was synthesized according to the general procedure 2 with sorbic aldehyde (58.1 µl, 0.500 mmol, 1 eq.) and catalyst **4** (0.02 eq.). The product was obtained as a white solid (63.5 mg, 0.351 mmol, 70%). The NMR matches reported values.[75] **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.45 (dd, *J* = 15.2, 10.5 Hz, 1H), 7.20 (d, *J* = 15.1 Hz, 1H), 6.37–6.17 (m, 1H), 4.46–4.38 (m, 2H), 4.12–4.04 (m, 2H), 1.88 (d, *J* = 6.2 Hz, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 165.9, 153.7, 146.9, 141.4, 130.5, 117.6, 62.1, 42.9, 19.0.

3-(benzo[d][1,3]dioxole-5-carbonyl)oxazolidin-2-one (20):
Was synthesized according to the general procedure 2 with piperonal (75.1 mg, 0.500 mmol, 1 eq.). The product was obtained as white solid (74.1 mg, 0.315 mmol, 63%), mp: 150–153 °C. **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.31–7.29 (m, 1H), 7.16–7.14 (m, 1H), 6.85–6.83 (m, 1H), 6.04 (s, 2H), 4.48 (t, *J* = 7.8 Hz, 2H), 4.14 (t, *J* = 7.8 Hz, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 168.9, 153.6, 151.6, 147.4, 126.2, 125.6, 109.8, 107.8, 102.0, 62.4, 44.1. **HRMS (ESI/Q-TOF)** m/z $[M+H]^+$ calcd for $C_{11}H_9NO_5$ 236.0559; found 236.0558. **FTIR-ATR (ν_{max}/cm^{-1}):** 1794 (s) (CO), 1671 (vs) (CO).

3-(2-methoxybenzoyl)oxazolidin-2-one (21):
Was synthesized according to the general procedure 2 with 2-methoxybenzaldehyde (68.1 mg, 0.500 mmol, 1 eq.). The product was obtained as light yellow solid (87.9 mg, 0.397 mmol, 79%). The NMR matches reported values.[76] **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.47–7.40 (m, 1H), 7.35–7.30 (m, 1H), 7.04–6.98 (m, 1H), 6.94–6.89 (m, 1H), 4.44–4.36 (m, 2H), 4.18–4.11 (m, 2H), 3.81 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 167.8, 156.9, 152.5, 132.3, 128.7, 123.8, 120.5, 110.9, 62.1, 55.8, 42.9.

3-(2-Chlorobenzoyl)oxazolidin-2-one (22):
Was synthesized according to the general procedure 2 with 2-chlorobenzaldehyde (70.4 mg, 0.500 mmol, 1 eq.). The product was obtained as faintly yellow solid (48.0 mg, 0.213 mmol, 43%), mp: 97–98 °C. **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.44–7.38 (m, 2H), 7.36–7.30 (m, 2H), 4.51(t, *J* = 7.9 Hz, 2H), 4.22 (t, *J* = 7.79 Hz, 2H) **^{13}C NMR (101 MHz, $CDCl_3$) δ** 167.0, 152.3, 134.1, 131.5, 130.8, 129.5, 128.2, 126.9, 62.4, 42.6. **HRMS (ESI/Q-TOF)** m/z $[M+H]^+$ calcd for $C_{10}H_9ClNO_3$ 226.0271; found 226.0273. **FTIR-ATR (ν_{max}/cm^{-1}):** 1775 (vs) (CO), 1686 (vs) (CO).

3-(3,4-Methylbenzoyl)oxazolidin-2-one (23):
Was synthesized according to the general procedure 2 with 3,4-dimethylbenzaldehyde (67.1 mg, 0.500 mmol, 1 eq.). The product was obtained as faintly yellow solid (65.5 mg, 0.300 mmol, 60%), mp: 143–145 °C. **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.45 (s, 1H), 7.43–7.39 (m, 1H), 7.20–7.16 (m, 1H), 4.49 (t, *J* = 7.8 Hz, 2H), 4.16 (t, *J* = 7.7 Hz, 2H), 2.31 (s, 3H), 2.29 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 170.0, 153.5, 142.1, 136.5, 130.4, 130.1, 129.2, 127.0, 62.3, 44.0, 20.2, 19.8. **HRMS (ESI/Q-TOF)** m/z $[M+H]^+$ calcd for $C_{12}H_{13}NO_3$ 220.0974; found 220.0974. **FTIR-ATR (ν_{max}/cm^{-1}):** 1758 (vs) (CO), 1671 (vs) (CO).

3-(4-Methoxybenzoyl)oxazolidin-2-one (24):
Was synthesized according to the general procedure 2 with 4-methoxybenzaldehyde (69.7 mg, 0.512 mmol, 1 eq.). The product was obtained as white solid (72.7 mg, 0.329 mmol, 64%). The NMR matches reported values.[76] **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.73–7.66 (m, 2H), 6.9–6.88 (m, 2H), 4.48 (t, *J* = 7.9 Hz, 2H), 4.15 (t, *J* = 7.9 Hz, 2H), 3.86 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 169.2, 163.4, 153.7, 132.0, 124.6, 113.4, 62.4, 55.6, 44.1.

3-(Cyclohexanecarbonyl)oxazolidin-2-one (25): Was synthesized according to a modified general procedure 2, with cyclohexanecarboxaldehyde (56.1 mg, 0.500 mmol, 1.0 eq.), 2-mesityl-6,7-dihydro-5*H*-pyrrolo[2,1-*c*][1,2,4]triazol-2-ium chloride (cat **4**) (6.7 mg, 0.025 mmol, 0.05 eq) and 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU) (60 µl, 0.40 mmol, 0.8 eq.). The product was obtained as a faintly yellow oil (63.2 mg, 0.320 mmol, 64%).**^{1}H NMR (400 MHz, $CDCl_3$) δ** 4.39 (t, J = 8.2 Hz, 2H), 4.00 (t, J = 8.2 Hz, 2H), 3.54–3.46 (m, 1H), 1.91–1.85 (m, 2H), 1.81–1.75 (m, 2H), 1.72–1.66 (m, 1H), 1.47–1.33 (m, 4H), 1.29–1,21 (m, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 176.9, 153.3, 62.0, 42.9, 42.0, 29.2, 25.9, 25.6. **HRMS (ESI/Q-TOF)** m/z $[M+H]^+$ calcd for $C_{10}H_{16}NO_3$ 198.1130; found: 198.1125 . **FTIR-ATR (ν_{max}/cm^{-1}):** 1771 (vs)(CO), 1692 (vs) (CO).

(*R*)-3-cinnamoyl-4-phenyloxazolidin-2-one (26):
Was synthesized according to the general procedure 3 with (*R*)-(−)-4-phenyl-2-oxazolidinone (82.4 mg, 0.505 mmol, 1 eq.). The product was obtained as a yellow solid (107.9 mg, 0.368 mmol, 73%).The NMR matches reported values.[77] **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.94 (d, *J* = 15.8 Hz, 1H), 7.79 (d, *J* = 15.7 Hz, 1H), 7.63–7.55 (m, 2H), 7.44–7.30 (m, 8H), 5.56 (dd, *J* = 8.7, 3.9 Hz, 1H), 4.75 (t, *J* = 8.8 Hz, 1H), 4.33 (dd, *J* = 8.9, 3.9 Hz, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 164.8, 153.8, 146.7, 139.0, 134.5, 130.7, 129.2, 128.9, 128.7, 128.6, 126.0, 116.8, 70.0, 57.9. $[\alpha]_D^{20}$ = −5.8 (*c* 0.01, $CHCl_3$)

(*R*)-3-cinnamoyl-4-isopropyloxazolidin-2-one (27):
Was synthesized according to the general procedure 3 with (*R*)-(+)-4-isopropyl-2-oxazolidinone (67.3 mg, 0.511 mmol, 1 eq.). The product was obtained as a yellow oil (66.8 mg, 0.258 mmol, 50%). The NMR matches reported values.[23] **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.93 (d, *J* = 15.7 Hz, 1H), 7.85 (d, *J* = 15.7 Hz, 1H), 7.65–7.59 (m, 2H), 7.43–7.36 (m, 3H), 4.60–4.52 (m, 1H), 4.35–4.22 (m, 2H), 2.52–2.40 (m, 1H), 0.96 (d, *J* = 7.0 Hz, 3H), 0.92 (d, *J* = 6.9 Hz, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 165.3, 154.3, 146.3, 134.7, 130.7, 129.0, 128.7, 117.2, 63.5, 58.8, 28.6, 18.2, 14.8. $[\alpha]_D^{20}$ = −89.2 (*c* 0.01, $CHCl_3$)

(*R*)-4-benzyl-3-cinnamoyloxazolidin-2-one (28):
Was synthesized according to the general procedure 3 with (*R*)-(+)-4-benzyl-2-oxazolidinone (81.7 mg, 0.461 mmol, 1 eq.). The product was obtained as off-white solid (91.9 mg, 0.299 mmol, 65%). The NMR matches reported values.[23] **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.93 (d, *J* = 1.5 Hz, 2H), 7.67–7.62 (m, 2H), 7.44–7.39 (m, 3H), 7.38–7.32 (m, 2H), 7.31–7.27 (m, 1H), 7.26–7.22 (m, 2H), 4.85–4.76 (m, 1H), 4.29–4.19 (m, 2H), 3.38 (dd, *J* = 13.4, 3.3 Hz, 1H), 2.86 (dd, *J* = 13.4, 9.5 Hz, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 165.3, 153.7, 146.6, 135.5, 134.7, 130.9, 129.6, 129.1, 129.1, 128.8, 127.5, 117.1, 66.3, 55.6, 38.1. $[\alpha]_D^{20}$ = −63.3 (*c* 0.01, $CHCl_3$).

(*S*)-3-cinnamoyl-4-isobutyloxazolidin-2-one (29):
Was synthesized according to the general procedure 3 with (S)-(+)-4-isobutyl-2-oxazolidinone (63.1 mg, 0.441 mmol, 1 eq.). The product was obtained as a yellow oil (62.7 mg, 0.229 mmol, 52%). The NMR matches reported values.[78] **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.90 (d, *J* = 15.7 Hz, 1H), 7.83 (d, *J* = 15.8 Hz, 1H), 7.65–7.56 (m, 2H), 7.43–7.34 (m, 3H), 4.65–4.56 (m, 1H), 4.42 (ddd, *J* = 8.7, 7.8, 0.9 Hz, 1H), 4.14 (dd, *J* = 8.7, 2.9 Hz, 1H), 1.91–1.82 (m, 1H), 1.70–1.60 (m, 1H), 1.58–1.48 (m, 1H), 1.02–0.95 (m, 6H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 165.2, 153.8, 146.2, 134.7, 130.7, 129.0, 128.7, 117.2, 67.8, 53.4, 41.7, 25.0, 23.6, 21.8. $[\alpha]_D^{20}$ = +88.0 (*c* 0.01, $CHCl_3$).

5-(chloromethyl)-3-cinnamoyloxazolidin-2-one (30):
Was synthesized according to the general procedure 1 with cinnamaldehyde (103 mg, 0.0777 mmol, 1.5 eq.) and 5-chloromethyl-2-oxazolidinone (70.3 mg, 0.503 mmol, 1 eq.). The product was obtained as a yellow solid (98.1 mg, 0.369 mmol, 73%), mp: 134–136 °C. **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.89 (s, 2H), 7.66–7.59 (m, 2H), 7.43–7.38 (m, 3H), 4.92–4.83 (m, 1H), 4.23 (dd, *J* = 11.6, 8.9 Hz, 1H), 4.06 (dd, *J* = 11.5, 5.8 Hz, 1H), 3.81–3.72 (m, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 165.3, 152.6, 146.9, 134.6, 131.0, 129.1, 128.8, 116.5, 71.7, 45.9, 44.7. **HRMS (ESI/Q-TOF)** m/z $[M+H]^+$ calcd for $C_{13}H_{12}ClNO_3$ 266.0584; found 266.0584. **FTIR-ATR (ν_{max}/cm^{-1}):** 1771 (vs) (CO), 1679 (s) (CO).

Piperlotine-F, 1-cinnamoylpyrrolidin-2-one (31):
Was synthesized according to the general procedure 4 with cinnamaldehyde (66.1 mg, 0.500 mmol, 1 eq.) and molecular sieves (4Å, 0.2 g). The product was obtained as faintly yellow solid (51.6 mg, 0.240 mmol, 48%). The NMR matches reported values.[60] **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.93 (d, *J* = 16.0 Hz, 1H), 7.84 (d, *J* = 16.0 Hz. 1H), 7.65–7.58 (m, 2H), 7.40–7.35 (m, 3H), 3.92 (t, *J* = 7.5 Hz, 2H), 2.65 (t, *J* = 8.0, 2H), 2.11–2.01 (m, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 175.8, 166.4, 145.6, 135.0, 130.5, 129.0, 128.6, 119.1, 46.0, 34.1, 17.3.

Piperlotine-G, 1-(4-methoxycinnamoyl)pyrrolidin-2-one (32):
Was synthesized with 4-methoxycinnamaldehyde (81.1 mg, 0.500 mmol, 1 eq.). The product was obtained as faintly yellow solid (74.2 mg, 0.303 mmol, 61%). The NMR matches reported values.[60] **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.82 (s, 2H), 7.59–7.55 (m, 2H), 6.92–6.89 (m, 2H), 3.92 (appt, *J* = 7.2 Hz, 2H), 3.84 (s, 3H), 2.65 (t, *J* = 8.1 Hz, 2H), 2.11–2.03 (m, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 175.8, 166.9, 161.6, 145.5, 130.4, 127.8, 116.6, 114.4, 55.5, 46.0, 34.2, 17.3.

ASSOCIATED CONTENT

Supporting Information

The Supporting Information is available free of charge on the ACS Publications website, including full optimization table and copies of ^{1}H NMR, ^{13}C NMR, ^{19}F NMR, COSY NMR, HSQC NMR, and HMBC NMR.

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Notes

The authors declare no competing financial interest.

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