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# A Thorough Study on the Photoisomerization of Ferulic Acid Derivatives

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*Dedicated to Prof. Franco Cozzi on his 70th birthday.*

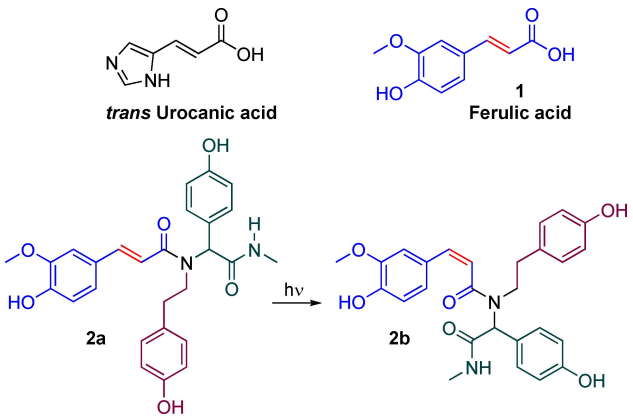
A thorough study on the (*E*) to (*Z*) photoisomerization of ferulic acid derivatives (esters, amides of all types, and ketones) was carried out. At the photostationary state, only aliphatic or benzylic tertiary amides reach a nearly complete conversion of (*E*) isomers into the (*Z*) ones, whereas for esters, primary and secondary amides or aromatic tertiary amides mixtures of (*Z*)/(*E*) ranging from 7:93 to 72:28 are observed. Ketones show rather limited photoisomerization. However, (*Z*) ketones may be obtained by the reaction of organometal compounds with an isomerized (*Z*) Weinreb amide.

## Introduction

Ferulic acid **1** (Scheme 1) is a phenylpropanoid, which was first isolated from *Ferula Foetida* in 1886. It is a ubiquitous natural product, which is found in many plants, such as seed plants (e.g., rice, wheat, and oat), vegetables (e.g., tomato and carrot), and fruits (e.g., pineapple and orange).[1] It is also a component of lignin,[2] and an intermediate in the biosynthesis of other plant phenols.[3]

Ferulic acid can be conveniently extracted from many sources,[2] including waste, and thus it represents one of the most valuable biobased building block either for direct applications as an ingredient for cosmetics[4] and nutraceutical products,[1c,5] as well as for the synthesis of fine chemicals from renewable starting materials. Ferulic acid and its esters, like other natural phenols, are very well-known anti-oxidants,[6] but they can also act as solar screens. During the exposure of skin to radiation, interaction with *trans*-urocanic acid generates singlet oxygen that can activate the entire oxygen free radical cascade with oxidation of proteins, nucleic acids and lipids. Ferulic acid is a strong UV absorber with a structure similar to tyrosine, and thus it is believed to inhibit melanin formation through competitive inhibition with tyrosine.[7]

Apart from ferulic acid itself and its esters, some derivatives/conjugated compounds have been studied as potential drugs,[8] whereas various feruloyl amides have been recently found in nature.[3,9]




**Scheme 1.** *trans* Urocanic acid, ferulic acid, and complete *E* to *Z* isomerization of a complex tertiary amide derived from it.

We have recently reported on the properties of several polyphenolic feruloyl amides obtained in a diversity-oriented manner through the Ugi multicomponent reaction, as inhibitors of beta-amyloid aggregation,[10] or as anti-oxidant and lipid-lowering compounds.[11] During those works, we made a serendipitous discovery. A sample of one of our feruloyl amides, namely **2a**, left for few days in solution in a glass NMR tube near a window, turned out to be isomerized at 94% to the (*Z*) stereoisomer **2b**.

Intrigued by this unexpected finding, we did a thorough literature search and found that photoisomerization of ferulic acid[12] or its esters[13] was already known for a long time. More recently, photoisomerization of feruloyl amides (primary or secondary) was also reported.[14] This is a property also displayed by cinnamic acids, esters, and amides.[12b,15] However, in all previous reports regarding ferulic acid derivatives, isomerization was only partial and, either starting from the (*E*) or from

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the (*Z*) isomers, a photostationary state was reached, with a diastereomeric ratio typically not higher than 70:30.

Thus, the observed nearly complete (*E*) to (*Z*) photoisomerization of a feruloyl amide was unprecedented. Since it was not clear whether this outcome was due to the particular structure of polyphenol **2a**, or it was a more general behavior of tertiary amides of ferulic acid, we were prompted to start a thorough study on the dependence of photoisomerization of ferulic acid derivatives on their chemical structure.

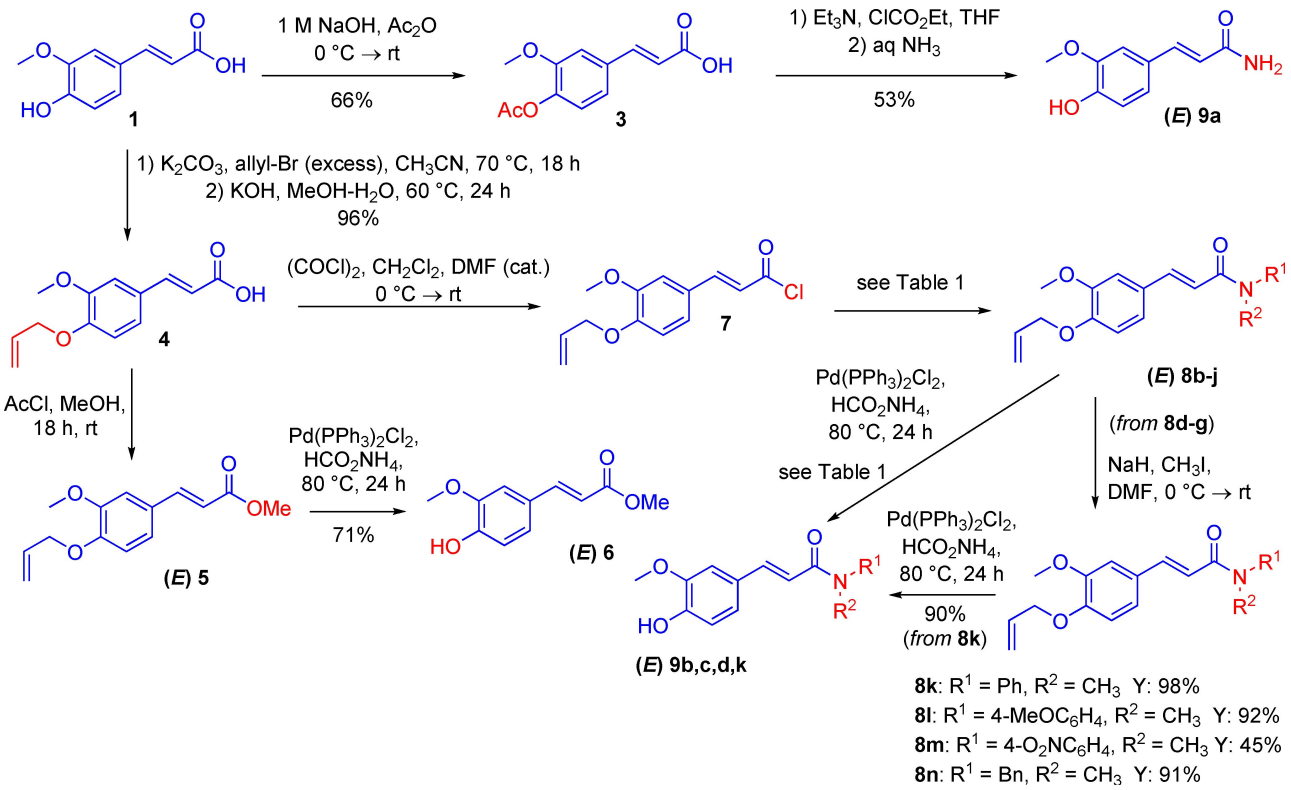
## Results and Discussion

### Synthesis

Towards this goal, we decided to prepare a series of amides of ferulic acid. Initially, we tried a direct synthesis starting from unprotected **1**. However, either going through a mixed anhydride[16] or using typical coupling agents such as dicyclohexylcarbodiimide (DCC) or carbonyl diimidazole (CDI), the yields were unsatisfactory. Details of these attempts are reported in the S.I. Thus, to avoid side reactions caused by the free phenol, we decided to start with a protected ferulic acid (Scheme 2). Following a reported procedure, we converted **1** into acetate **3**, and hence into known primary amide **9a** via a mixed anhydride.[17] The direct formation of unprotected **9a** proved that the acetate is unstable under the amidation conditions.

Therefore, for preparing other amides, we preferred to use a more stable protecting group able to survive to more harsh conditions, such as the use of strong bases and nucleophiles, and that could be selectively removed to allow the study of the (*E*)/(*Z*) photoisomerization on the free phenolic group. Among possible protections, we chose the allyl ether, which was extensively used by us in our previous polyphenol synthesis.[10a] Thus **1** was converted, in high yield, into *O*-allyl ferulic acid **4**.[10a]

For converting **4** into various amides **8b–j**, the best method turned out to be the one going through the acyl chloride **7**, generated by the reaction of **1** with oxalyl chloride in the presence of catalytic DMF. In the reaction of **7** with aliphatic primary and secondary amines, triethylamine performed well as base (Table 1). However, with aromatic amines, surprisingly, product **8** was contaminated by products of a Michael addition to the conjugated double bond of the amide. This problem was solved by substituting $Et_3N$ with pyridine. However, the synthesis of Weinreb amide **8j** gave an unsatisfactory yield both with $Et_3N$ and with pyridine. After optimization, we found that imidazole was the best base, allowing us to obtain excellent yields. This method is in our opinion superior to the one reported by Stevens for the preparation of MEM-protected Weinreb amides of ferulic acid.[18] Apart from the better yield, it avoids the use of expensive benzotriazole and pyrophoric $Me_3Al$. Other tertiary amides **8k–n** were prepared by methylation of the aromatic or benzylic secondary amides **8d–g**.

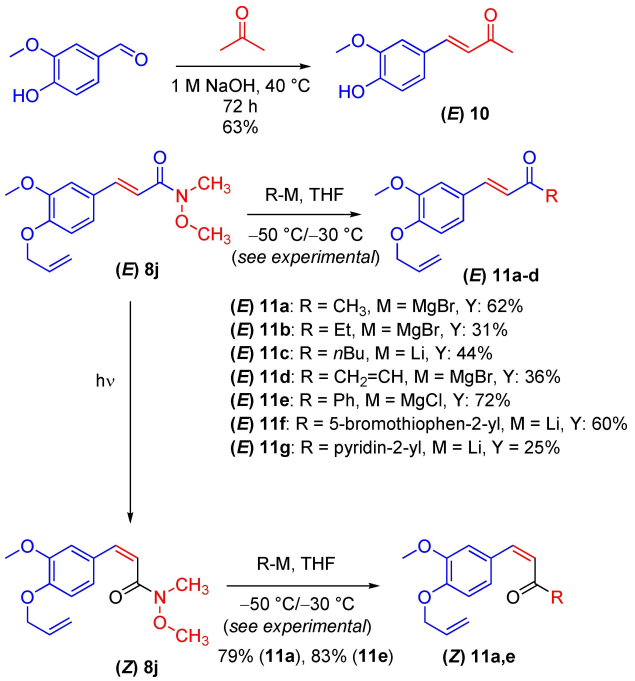



**Scheme 2.** Synthesis of amides **8b–n**, amides **9a–d,k**, and esters **5**, **6**

**Table 1.** Synthesis of amides **8** and **9**[a]

| Amide | $R^1$ | $R^2$ | Base for the synthesis of **8** | Yield [%] of **8**[b] | Yield [%] of **9**[c] |
|---|---|---|---|---|---|
| **8b** | *n*Bu | H | $Et_3N$ | 75 | 99 |
| **8c** | *n*Bu | *n*Bu | $Et_3N$ | 83 | 96 |
| **8d** | Ph | H | $Et_3N$ | 32 | – |
| **8d** | Ph | H | pyridine | 89 | 97 |
| **8e** | 4–$MeOC_6H_4$ | H | pyridine | 82 | – |
| **8f** | 4–$O_2NC_6H_4$ | H | pyridine | 92[d] | – |
| **8g** | Bn | H | pyridine | 78 | – |
| **8h** | Bn | Bn | pyridine | 87 | – |
| **8i** | $HOCH_2CH_2$ | $CH_3$ | pyridine | 85 | – |
| **8j** | $CH_3O$ | $CH_3$ | pyridine | 52 | – |
| **8j** | $CH_3O$ | $CH_3$ | imidazole | 85 | – |

[a] Conditions for the synthesis of **8** from **7**: base, $R^1R^2NH$, $CH_2Cl_2$, 0 °C→rt. [b] Isolated yield from **4**. [c] Isolated yield from **8**. [d] The isolated product was contaminated with some 4-nitroaniline. The yield was calculated from $^1H$ NMR.




**Scheme 3.** Preparation of ketones **10** and **11**.

In order to compare the photochemical behavior of amides with that of esters, we also prepared the known compound (*E*) **5**.[19]

Finally, we removed in excellent yields the allyl protection from some of the amides **8** (**8b,c,d,k**) to give feruloyl amides **9b**,[20] **9c**, **9d**,[21] and **9k**, whereas ester **5** was deprotected to give known methyl ferulate **6**.[22] We did not deprotect all the amides, since preliminary photoisomerization experiments (see below) pointed out that there was no difference between compounds bearing a protected or unprotected phenol. Thus, we preferred to carry out our photoisomerization studies directly on the allylated feruloyl amides.

In order to have a complete overview of the dependence of photoisomerization on the structure of the ferulic derivatives, we also prepared several ketones of different nature: saturated, unsaturated, aromatic, or heteroaromatic (Scheme 3). The simple unprotected methyl ketone **10** was conveniently synthesized from vanillin through a previously described crotonic condensation.[23]

Other ketones (this time *O*-allylated) were prepared from Weinreb amide (*E*) **8j**, by reaction with some organometal compounds.[18] The yields of these syntheses are not optimized. Interestingly, with EtMgBr, but not with MeMgBr or PhMgBr, the yield was lowered by the formation of side-products derived from Michael addition of the organometal compound to the double bond of the Weinreb amide and/or by demethoxylation processes.[24] Unexpected behavior was noticed during the synthesis of ketone (*E*) **11f**. The needed organolithium derivative was prepared by treatment of 2-bromothiophene with *n*-butyllithium. However, instead of halogen-metal exchange, butyllithium deprotonated the thiophene ring at carbon 5, and thus the final product contained the intact bromine atom. The structure was demonstrated by HPLC-MS and NMR (HMBC) experiments. Although apparently surprising to us, the selective lithiation at position 2 (instead of lithium-halogen exchange) is not unprecedented.[25]

As better described in the next section, it is possible to photoisomerize Weinreb amide (*E*) **8j** to the (*Z*) isomer. Although isomerization is not complete, leading to a 77:23 (*Z*)/(*E*) mixture, the two isomers can be conveniently separated by column chromatography. This offers the opportunity to synthesize ferulic-derived (*Z*) ketones, which are not accessible by photoisomerization (see below) and which can not be obtained by olefination (Horner-Wadsworth-Emmons) or crotonic condensation from vanillin. As shown in Scheme 3, the reaction of (*Z*) **8j** with organometal compounds is indeed possible, with yields higher than with the (*E*) isomer, and with no *retro*-isomerization observed under these conditions.

## Photoisomerization

Photoisomerization experiments were carried out on deuterated methanol solutions (except for **8l** and **8m** when we used $CDCl_3$ for solubility problems) directly in a NMR tube, and the (*Z*)/(*E*) ratios were determined by $^1H$ NMR over time (see Figure 1 as example). The full kinetic charts and $^1H$ NMR spectra are

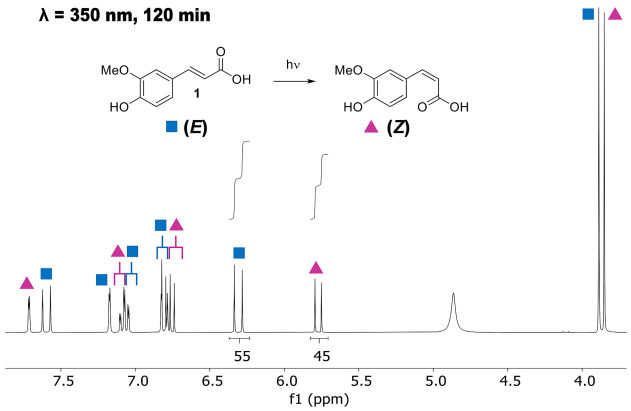



**Figure 1.** $^1$H NMR spectrum of a 70 mM solution of **1** in $CD_3OD$ recorded after irradiation at 350 nm for 120 min. Blue squares indicate the signals of the (*E*) isomer, while purple triangles indicate the signal of the (*Z*) isomer. The integration showing the (*E*)/(Z) ratio is reported.

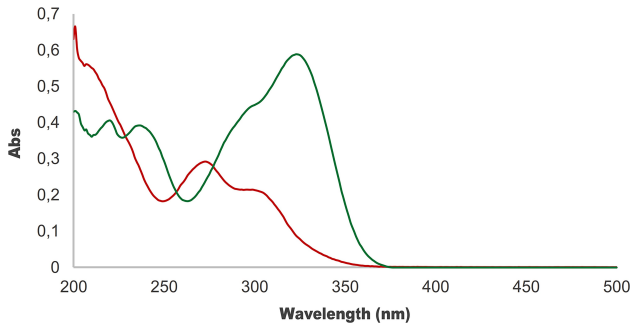



**Figure 3.** Comparison of UV spectra at 25 μM in MeOH of (***E***) **8c** (green) and (***Z***) **8c** (red).

reported in the S.I., whereas we show here only some selected diagrams in Figure 2 and Figure 5, and the final photostationary state ratios for all compounds in Table 2 and Table 3. We used two different wavelengths: 300 and 350 nm.

Comparison of both UV spectra and the kinetic charts of photoisomerization between free phenols **1**, **6**, **9b**, and **9c** and the corresponding *O*-allylated compounds **4**, **5**, **8b**, and **8c** showed an identical behavior (see S.I.). Evidently, the free phenol group has no influence on these phenomena. For this reason, a comprehensive study was carried out only on the allylated compounds. From the results reported in Table 2, it is clear that the carboxylic acid **1**, **4** the ester **5**, **6**, and the primary amide **9a** undergo, at 300 nm, only a partial isomerization close to 6:4 at the photostationary state. Increasing the wavelength to 350 nm has no effect on the primary amide, but lowers the amount of (*Z*) isomer in the acids and in the esters.

With aliphatic secondary amides (**9b**, **8b**, **8g**) again the wavelength has little influence, but the (*Z*)/(*E*) ratio is increased to about 7:3. With aliphatic tertiary amides (**9c**, **8c**, **8h**, **8i**, **8n**) a nearly complete isomerization to the (*Z*) stereoisomer is achieved at 350 nm (>95:5), whereas at 300 nm conversion is lower and the ratios remain around 8:2. This nearly complete isomerization seems pretty general for aliphatic tertiary amides and it is not influenced by the presence of an aryl group (**8h**, **8n**) or of an alcoholic moiety (**8i**). For Weinreb amide **8j**, unfortunately, the conversion is not complete, arriving only at 77:23. However, the two diastereomers can be separated by chromatography and the (*Z*) isomer is quite stable towards retro-isomerization. Thus, from a preparative point of view, this allows the easy synthesis of (*Z*) ferulic derived ketones (Scheme 3)

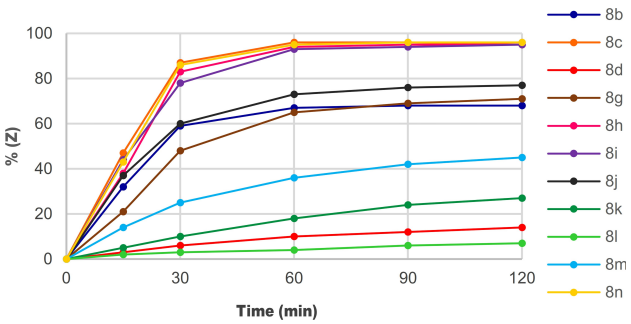


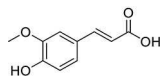
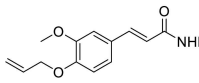
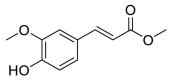
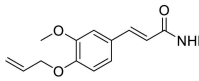
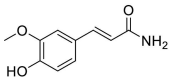
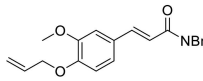
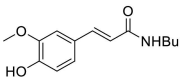
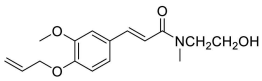
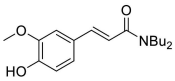
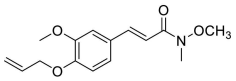
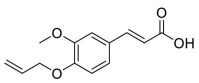
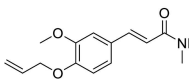
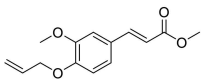
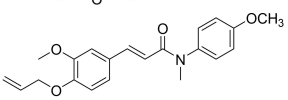
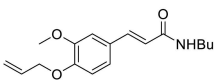
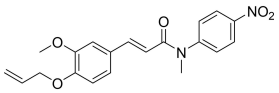
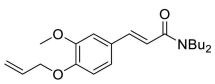
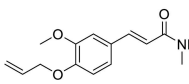

**Figure 2.** Photoisomerization at 350 nm for some feruloyl amides. For compounds **8g**, **8k**, **8l** and **8m** the kinetic studies were extended up to 180 min in order to confirm that the photostationary state was reached after 120 min (see SI).

Aromatic amides show different behavior with respect to other amides. As for the aliphatic ones, the tertiary amides afford more (*Z*) isomer than the secondary ones upon photoisomerization (**8d** *vs.* **8k**), but the % of (*Z*) compounds remains below 50%, with a strong influence on the electronic nature of the substituent. Isomerization is nearly absent with an electron-donating substituent (**8l**), whereas it increases much more with an electron-withdrawing one (**8m**). Photoisomerization also seems slower than that of other amides (see Figure 2).

Figure 3 shows a comparison of the UV spectra of the (*E*) and (*Z*) isomers of **8c**. This striking difference in UV spectra is also common to **8h**, **8i**, **8n**. It is clear that the (*Z*) isomer does not absorb at 350 nm, whereas the (*E*) counterpart has a $\lambda_{max}$ around 325 nm, but still has a significant absorbance at 350 nm. We think that the remarkable behavior of tertiary amides is due to this hypsochromic shift of the wavelength of maximum absorbance in the (*Z*) isomers. In fact, if (*Z*) isomers do not absorb, the Z→E isomerization can not take place. On the contrary, for ferulic acid, its esters, primary amides, and secondary amides, the UV spectra after isomerization are quite similar, according to the spectra of partially isomerized mixtures (see S.I. Figure S2).

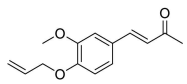
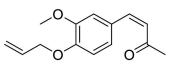
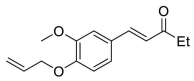
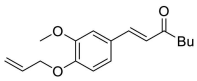
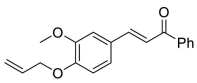
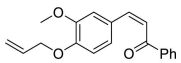
In (*E*) cinnamamides, the preferred conformation of the enone system was previously demonstrated by crystallographic and NMR studies to be *s*-cis, and the three planes of the aryl ring, the double bond, and the amide are expected to be nearly coplanar (dihedral angles $\leq 15°$).[15f] On the other hand, for (*Z*) cinnamamides, a preference for the *s*-trans conformation was suggested.[15f] In such conformations, coplanarity of the three planes would place one of the two groups bound to nitrogen too close to the aromatic ring. When this substituent is H, as in primary and secondary amides, this can be tolerable, but even a

**Table 2.** (*Z*)/(*E*) ratios of ferulic acid, esters, and amides at photostationary state after photoisomerization.[a]

| Compound | Structure | λ = 300 [nm] (*Z*)/(*E*) ratio | λ = 350 [nm] (*Z*)/(*E*) ratio | Compound | Structure | λ = 300 [nm] (*Z*)/(*E*) ratio | λ = 350 [nm] (*Z*)/(*E*) ratio |
|---|---|---|---|---|---|---|---|
| **1** |  | 59:41 | 45:55 | **8d** |  | 7:93 | 14:86 |
| **6** |  | 56:44 | 45:55 | **8g** |  | 72:28 | 71:29 |
| **9a** |  | 65:35 | 60:40 | **8h** |  | 83:17 | **95:5** |
| **9b** |  | 70:30 | 68:32 | **8i** |  | 80:20 | **95:5** |
| **9c** |  | 82:18 | **96:4** | **8j** |  | 68:32 | 77:23 |
| **4** |  | 59:41 | 47:53 | **8k** |  | 20:80 | 27:73 |
| **5** |  | 56:44 | 45:55 | **8l** |  | 8:92 | 7:93 |
| **8b** |  | 72:28 | 68:32 | **8m** |  | 46:54 | 45:55 |
| **8c** |  | 83:17 | **96:4** | **8n** |  | 84:16 | **96:4** |

[a] Experiments were carried out in MeOH-*d4* (in $CDCl_3$ in the case of **8l** and **8m** for solubility problems) at rt for 120 minutes. However, in most cases, photostationary state was reached after 60–90 minutes in all cases (see S.I.).

**Table 3.** (*Z*)/(*E*) ratios of ferulic acid derived ketones **11a–c,e** after photoisomerization at 350 nm.[a]

| Compound | (*Z*)/(*E*) ratio | Compound | (*Z*)/(*E*) ratio |
|---|---|---|---|
| **(*E*) 11a**  | 19:81 | **(*Z*) 11a**  | 20:80 |
| **(*E*) 11b**  | 24:76 | **(*E*) 11c**  | 22:78 |
| **(*E*) 11e**  | 2:98[b] | **(*Z*) 11e**  | 2:98 |

[a] Experiments were carried out in MeOH-*d4* at rt for 120 minutes. However, in most cases, photostationary state was reached after 60–90 minutes in all cases (see S.I.). [b] In this case $^1$H NMR showed the appearance of signals due to [2 + 2] cycloaddition reaction.

$CH_3$ group, as in **8i** and **8n**, is probably enough to induce a deviation from planarity of the system, causing this hypsochromic shift.[26] Deviation from planarity would also place the substituents on nitrogen in the shielding cone of the benzene ring, with a resulting decrease of chemical shift. This hypothesis is in accord with the $^1$H NMR spectra of (*E*) and (*Z*) **8c**, **8h**, **8i**, **8n**. For example, in **8n**, on passing from (*E*) to (*Z*) (2 conformers are visible), δ decrease from 3.14, 3.03 to 2.91, 2.87 for *N*–$CH_3$ and from 4.81, 4.69 to 4.63, 4.54 for *N*-$CH_2$Ph. Similar upfield shifts are observed in **8c**, **8h**, **8i**.

In Weinreb amide **8j**, the smallest substituent is $OCH_3$, which has a steric bias intermediate between H and $CH_3$, and we can predict that the deviation from planarity will be moderate. In fact, the UV spectrum of **(*Z*) 8j** shows a hypsochromic shift that is less pronounced than in tertiary amides. In this case, the *N*–$CH_3$ and the *O*–$CH_3$ δ change upon

isomerization from 3.31 to 3.16 ppm and from 3.77 to 3.63 ppm, respectively.

We believe that the behavior of aromatic amides can be ascribed to the lack of three-dimensionality of phenyl ring. In fact, this substituent can lie almost perpendicular to the rest of the molecule and the steric hindrance and the deviation from planarity in the (*Z*) isomer are minimized thanks to its planarity.

Figure 4 shows an interesting experiment, carried out on tertiary amide **8c**. After irradiating at 350 nm up to the steady-state, the sample was irradiated again a 300 nm. The (*Z*)/(*E*) ratio decreased reaching the same value obtained irradiating from the beginning at 300 nm. This proves that the (*Z*)/(*E*) ratio at the photostationary state depends on the absorbance of both isomers at the selected wavelength.

Then we moved on to study the photochemical behavior of ketones. The results are reported in Table 3. With methyl ketone **10** (with a free phenol) and with allylated vinyl ketone **11d** we detected no isomerization at all, either at 300 nm or 350 nm. With the other ones, isomerization was rather limited. Table 3 reports only the results at 350 nm, but at 300 nm the situation was very similar (see S.I.). With aliphatic ketones, only about 20% of (*Z*) isomer could be obtained, whereas, with the phenyl ketone, the (*E*) isomer was strongly predominant, either starting from the (*E*) or the (*Z*) isomer. Furthermore, in this case, the $^1$H NMR was rather dirty, and peaks likely due to [2+2] cycloaddition reaction were detected.[27] In the case of heteroaromatic ketones **11f** and **11g** no isomerization occurs, and again the increasing formation of saturated compounds (probably the dimers derived from [2+2] cycloaddition) could be seen at $^1$H NMR.

Figure 5 shows a comparison between the ketones that have given some degree of isomerization.

We can conclude that photoisomerization of ferulic acid derived ketones does not represent a useful synthetic method for the preparation of (*Z*) isomers, whereas the reaction of (*Z*) Weinreb amide **8j** is a valuable alternative.

Finally, we calculated the quantum yield of the *E*→*Z* photoisomerization of **(*E*) 8c**, **(*E*) 8h**, and **(*E*) 11a** and of the *Z*→*E* photoisomerization of **(*Z*) 11a** at 350 nm (see Experimental and S.I.). The quantum yield of amides **(*E*) 8c** and **(*E*) 8h** was 42% and 85%, respectively. This remarkable difference can be ascribed only to the presence of the additional phenyl rings in **(*E*) 8h**, which somehow increase the efficiency of the process. Having synthesized both isomers of ketone **11a**, we were able to compare the quantum yields of *E*→*Z* and *Z*→*E*. The calculated values were 40% and 60%, respectively, showing that there is a significant difference in the process.

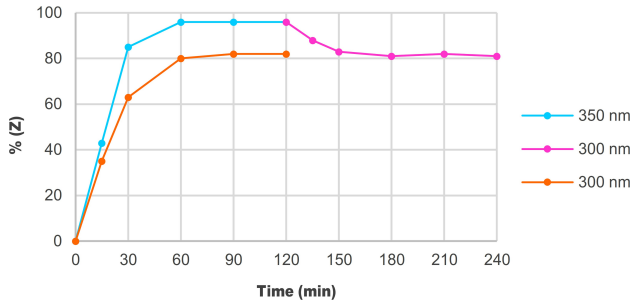



**Figure 4.** Photochemical behavior of tertiary amide **8c**.

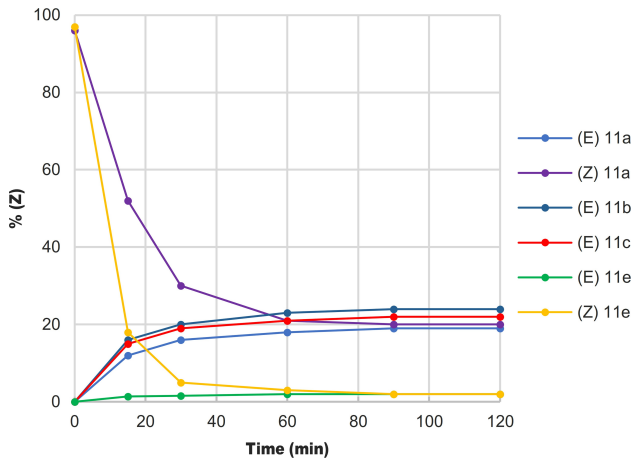
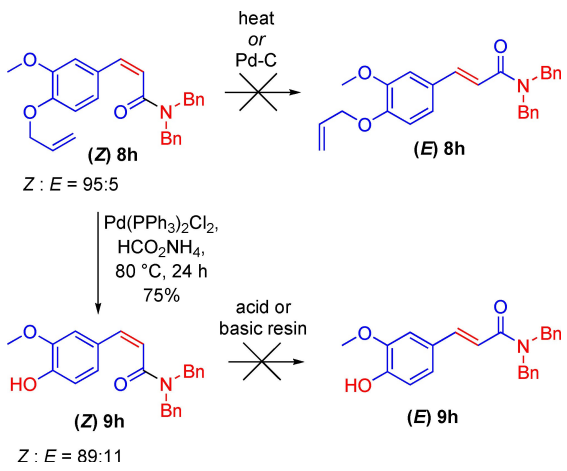



**Figure 5.** Comparison of photochemical isomerization at 350 nm of ketones **11a, b, c, e**

## Stability of *Z* Isomers

We have carried out some experiments to check the configurational stability of (*Z*) tertiary amides. These assays were done on amide **(*Z*) 8h** (Scheme 4). This amide was heated at 65 °C in methanol for 48 hours or in DMSO at 150 °C for 48 hours, but no *retro*-isomerization occurred. The same happened when exposing **(*Z*) 8h** to 10% Pd–C in methanol at rt for 48 h. Deblocking of the allyl group under our standard conditions (Pd(0) homogeneous catalysis) brought about only a very small degree of isomerization. Finally, no isomerization of free phenol **(*Z*) 9h** took place on exposure to a strong acid (Amberlite® IR 120 H) or basic (Amberlyst® A-26 OH) resin.

These experiments, along with the retention of (*Z*) configuration during the reaction of Weinreb amide **(*Z*) 8j** with




**Scheme 4.** Configurational stability of amides (*Z*) **8h** and **9h**.

organometal compounds, show that the isomerized (*Z*) feruloyl amides are configurationally pretty stable, paving the way to their further synthetic elaborations.

## Conclusion

The results described above had clearly shown that at the photostationary state nearly complete photoisomerization of ferulic acid derivatives takes place only with tertiary amides (except for the aromatic ones). On the contrary, with esters, primary amides, or secondary amides, isomerization is not complete at the photostationary state, whereas with ketones no or little photoisomerization occurs. We think that the reason for the peculiar behavior of tertiary amides is due to steric strain, which flips the amide from coplanarity with the unsaturated system, thus causing an hypsochromic shift of the maximum absorbance wavelength. It is the difference in $\lambda_{max}$ that allows, at the appropriate wavelength, to strongly shift the equilibrium to the (*Z*) isomer. Although being a sort of tertiary amide, Weinreb amide (***E***) **8j** does not reach a high degree of isomerization. However, the stereoisomers can be separated by chromatography, and this unlocks a useful access to (*Z*) ferulic derived ketones, which are not accessible by photoisomerization nor are easily accessible by other traditional chemical methodologies.

Feruloyl amides have demonstrated interesting pharmacological activities,[8c,10c,20,28] and surely the configuration of the double bond has an important influence on biological properties.[14,29] Thus, apart from the theoretical interest, the here reported study opens the way to the synthesis and the biological evaluation of (*Z*) feruloyl amides.

Moreover, we plan to exploit tertiary (*Z*) feruloyl amides for selective functionalization of the aryl ring, in order to expand the chemical space accessible from this very important, biobased and renewable, building block.

## Experimental Section

**General remarks**. All non-aqueous reactions were performed under an inert atmosphere of argon or nitrogen. Inert gases were passed over a U-tube of silica and activated 3 Å molecular sieves. Reactions were stirred magnetically and monitored by thin-layer chromatography (TLC). Analytical thin-layer chromatography was performed using MERCK Silica Gel 60 F254 0.25 mm TLC glass plates and visualized by ultraviolet light (UV, 254 nm). TLC plates were also stained with cerium ammonium molybdate (CAM, Hanessian's stain) by dipping and heating. $R_f$ values were measured after elution of 6–7 cm Concentration under reduced pressure was performed by rotator evaporation at 40 °C. Chromatographic purification was performed as flash chromatography on MERCK Geduran® Si 60 (40–63 μm) under positive pressure and the crude mixtures were loaded as solid absorbed on silica. Purified compounds were dried further under high vacuum (~$10^{-2}$ torr). All chemicals and dry or non-dry solvents were purchased from Sigma Aldrich and used as received from the vendor. Petroleum ether is 40–60 °C. Nuclear Magnetic Resonance (NMR) spectra were recorded on VARIAN MERCURY (300 MHz $^1$H and 75 MHz $^{13}$C). Experiments were carried out at the specified temperature. Chemical shifts (δ) are reported in parts per million (ppm) using as internal standard tetramethylsilane (TMS, 0.00 ppm) or the residual solvent signal ($CDCl_3$ at 77.16 ppm for $^{13}$C, DMSO-$d_6$ at 2.50 and 39.43 ppm for $^1$H and $^{13}$C, respectively). The data are reported as follow: chemical shift (sorted in ascending order), integration, multiplicity (indicated as: s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet, and combinations thereof), coupling constants (*J*) in Hertz (Hz) and assignation (when possible). Peak assignments were done with the aid of gCOSY (gradient correlation spectroscopy), gHSQC (gradient heteronuclear single-quantum correlation spectroscopy), and gHMBC (gradient heteronuclear multiple-bond correlation spectroscopy, only for **11f**). Copies of $^1$H and $^{13}$C NMR are reported in the S.I., while copies of 2D NMR data are available on request. Fourier transform infrared (FTIR) spectra were recorded on a Perkin Elmer Spectrum 65 (Perkin Elmer, Waltham, MA, USA) instrument, equipped with a universal attenuated total reflectance (ATR) sampling accessory. UV-Vis spectra were performed using Varian Cary® 50 UV-Vis Spectrophotometer. HRMS: samples were analyzed with a Synapt G2 QToF mass spectrometer (Waters, Milford, MA, USA). MS signals were acquired from 50 to 1200 m/z in either ESI positive or negative ionization mode. Photo-induced isomerizations were performed with a Southern New England Ultraviolet Company Rayonet® apparatus equipped with 8 Iles Optical lamps (300 or 350 nm). The lamps used were cylindrical with a length of 26.5 cm and a power of 8 watts. The sample was fixed at a 10 cm distance from the lamp.

**General procedure A: preparation of amides**. Freshly prepared acyl chloride **7** (2.50 mmol) was dissolved in dry DCM (5 mL) under $N_2$ atmosphere and added to a solution of $Et_3N$, or pyridine, (5.50 mmol) and the selected amine (3.00 mmol) in dry DCM (10 mL) at 0 °C. After stirring for 18 h at rt, 0.1 N HCl solution (pH 1–2) was added. The reaction mixture was extracted with EtOAc (3× 20 mL), and the organic layer was washed with 0.1 N NaOH solution (3×20 mL), brine, and dried over $Na_2SO_4$. After filtration and evaporation of the solvent, the crude was purified by chromatography to give the desired product.

**General procedure B: methylation of amides**. To a solution of amide (0.200 mmol) in dry DMF (1 mL) was added NaH (60% dispersion in mineral oil, 0.300 mmol) a 0 °C. The mixture was stirred at rt for 30 min, then MeI (0.340 mmol) was added. After 1 h 30 min at rt, $H_2O$ (10 mL) was added and the pH was adjusted to neutral with $NH_4Cl$ saturated aq. solution (5 mL) and few drops of 2 N HCl. The reaction mixture was extracted with $Et_2O$ (3×20 mL), and the organic layer was washed with brine (5×) and dried over $Na_2SO_4$. After filtration and evaporation of the solvent, the crude was purified by chromatography to give the desired product.

**General procedure C: allyl deprotection**. A mixture of the amide (0.400 mmol), ammonium formate (55 mg, 0.88 mmol) and $PdCl_2(PPh_3)_2$ (15 mg, 0.022 mmol) in dry and degassed (for 15 min) MeCN (6 mL) was stirred in a sealed tube ($N_2$ atmosphere) for 24 h at 80 °C. Then $NaHCO_3$ saturated aq. solution (15 mL) was added and the reaction mixture was extracted with EtOAc (3×15 mL). The organic layer was washed with brine and dried over $Na_2SO_4$. After filtration and evaporation of the solvent, the crude was purified by chromatography to give the desired product.

**General procedure D: preparation of ketones**. To a solution of **8j** (200 mg, 0.721 mmol) in dry THF (7 mL) was added the selected organometal reagent (1.44 mmol) at the indicated temperature under Ar. The mixture was reacted until completion and then poured into $NH_4Cl$ saturated aq. solution (15 mL) and extracted with EtOAc (3×15 mL). The organic layer was washed with brine and dried over $Na_2SO_4$. After filtration and evaporation of the solvent, the crude was purified by chromatography to give the desired product.

**methyl (*E*)-3-(4-(allyloxy)-3-methoxyphenyl)acrylate (5)**. To a solution of **4** (142 mg, 0.733 mmol) in MeOH (2 mL) was added AcCl (0.50 mL, 7.33 mmol) at rt. After stirring for 18 h, the solvent was removed and the residue (147 mg, 81 %) was used in the following step without further purification. $R_f$ 0.95 (DCM/MeOH 95:5).

**methyl (*E*)-3-(4-hydroxy-3-methoxyphenyl)acrylate (6)**. Following the general procedure C, **5** (147 mg, 0.734 mmol), $HCO_2NH_4$ (102 mg, 1.61 mmol) and $Pd(PPh_3)_2Cl_2$ (13 mg, 0.018 mmol) in dry $CH_3CN$ (5 mL) was reacted for 24 h at 80 °C. After workup and chromatography (PE/EtOAc 6:4) the desired compound was afforded as pale yellow foam (126 mg, 71 %). $R_f$ 0.23 (PE/EtOAc 6:4). **UV/Vis** (25 μM in MeOH): 218 (0.3395), 236 (0.3022), 295 (0.3527), 325 (0.5026). Others data were in accordance with the literature.[30]

**(*E*)-3-(4-(allyloxy)-3-methoxyphenyl)acryloyl chloride (7)**. To a suspension of **4** (508 mg, 2.61 mmol) in dry DCM (15 mL) were added oxalyl chloride (400 μL, 4.71 mmol) and dry DMF (8 μL, 0.105 mmol) at 0 °C under $N_2$ atmosphere. After stirring for 4 h, the solvent was removed from the resulting solution and the crude was washed with dry DCM (3×5 mL, evaporation after each step) and directly used in the following step.

**(*E*)-3-(4-(allyloxy)-3-methoxyphenyl)-*N*-butylacrylamide (8b)**. Following the general procedure A, **7** (2.57 mmol), $Et_3N$ (715 μL, 5.14 mmol) and butylamine (330 μL, 3.34 mmol) in dry DCM was reacted for 18 h. After workup and chromatography (PE/EtOAc 6:4) the desired compound was afforded as pale yellow solid (464 mg, 75 %). $R_f$ 0.38 (PE/EtOAc 6:4). **m.p**. 110.1–111.1 °C. **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 7.55 (d, *J* = 15.5, 1H, ArC*H*=CH), 7.09–6.97 (m, 2H, CH–6 + CH–2), 6.83 (d, *J* = 8.0, 1H, CH–5), 6.29 (d, *J* = 15.5, 1H, ArCH=C*H*), 6.07 (ddt, *J* = 17.2, 10.7, 5.4, 1H, $CH_2$=C*H*), 5.79 (t, *J* = 5.1, 1H, NH), 5.41 (dq, *J* = 17.3, 1.6, 1H, C$H_{trans}$H=CH), 5.30 (dq, *J* = 10.5, 1.3, 1H, CH$H_{cis}$=CH), 4.63 (dt, *J* = 5.4, 1.5, 2H, $CH_2O$), 3.87 (s, 3H, $OCH_3$), 3.38 (td, *J* = 7.1, 5.8, 2H, C$H_2$$CH_2CH_2CH_3$), 1.61–1.48 (m, 2H, $CH_2CH_2CH_2CH_3$), 1.45–1.31 (m, 2H, $CH_2CH_2CH_2CH_3$), 0.94 (t, *J* = 7.3, 3H, $CH_2CH_2CH_2CH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 166.2 (C=O), 149.6 (2×C–O), 140.6 (ArCH=CH), 133.0 ($CH_2$=CH), 128.3 (C–1), 121.7 (CH–6), 119.0 (ArCH=CH), 118.4 ($CH_2$=CH), 113.1 (CH–5), 110.2 (CH–2), 69.9 ($CH_2O$), 56.0 ($OCH_3$), 39.6 ($CH_2CH_2CH_2CH_3$), 31.9 ($CH_2CH_2CH_2CH_3$), 20.2 ($CH_2CH_2CH_2CH_3$), 13.9 ($CH_2CH_2CH_2CH_3$). **IR** ($\nu_{max}$): 604, 760, 803, 849, 933, 988, 1014, 1034, 1140, 1158, 1163, 1213, 1243, 1257, 1422, 1462, 1509, 1569, 1582, 1599, 1609, 1652, 2830, 2870, 2926, 2954, 3002, 3083, 3257. **UV/Vis** (25 μM in MeOH): 219 (0.4064), 235 (0.4097), 291 (0.4751), 316 (0.5140). **HRMS** (ESI+): calcd. for $C_{17}H_{24}NO_3$ [M + H] + 290.1756, found 290.1753.

**(*E*)-3-(4-(allyloxy)-3-methoxyphenyl)-*N*,*N*-dibutylacrylamide (8c)**. Following the general procedure A, **7** (2.61 mmol), $Et_3N$ (730 μL, 5.22 mmol) and dibutylamine (570 μL, 3.39 mmol) in dry DCM was reacted for 18 h. After workup and chromatography (PE/EtOAc 7:3) the desired compound was afforded as pale yellow oil (622 mg, 83 %). $R_f$ 0.40 (PE/EtOAc 7:3). **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 7.63 (d, *J* = 15.3, 1H, ArC*H*=CH), 7.08 (dd, *J* = 8.3, 1.8, 1H, CH–6), 7.02 (d, *J* = 1.9, 1H, CH–2), 6.87 (d, *J* = 8.3, 1H, CH–5), 6.69 (d, *J* = 15.3, 1H, ArCH=C*H*), 6.08 (ddt, *J* = 17.2, 10.7, 5.4, 1H, $CH_2$=C*H*), 5.41 (dq, *J* = 17.3, 1.6, 1H, C$H_{trans}$H=CH), 5.30 (dq, *J* = 10.5, 1.4, 1H, CH$H_{cis}$=CH), 4.64 (dt, *J* = 5.4, 1.5, 2H, $CH_2O$), 3.90 (s, 3H, $OCH_3$), 3.50–3.31 (m, 4H, 2×$CH_2CH_2CH_2CH_3$), 1.71–1.48 (m, 4H, 2×$CH_2CH_2CH_2CH_3$), 1.46–1.27 (m, 4H, 2×$CH_2CH_2CH_2CH_3$), 0.98 (t, *J* = 7.4, 3H, $CH_2CH_2CH_2CH_3$), 0.95 (t, *J* = 7.3, 3H, $CH_2CH_2CH_2CH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 166.2 (C=O), 149.5 (C–O), 149.4 (C–O), 142.1 (ArCH=CH), 133.0 ($CH_2$=CH), 128.9 (C–1), 121.3 (CH–6), 118.3 ($CH_2$=CH), 115.9 (ArCH=CH), 113.2 (CH–5), 110.7 (CH–2), 69.8 ($CH_2O$), 56.0 ($OCH_3$), 47.9 ($CH_2CH_2CH_2CH_3$), 46.7 ($CH_2CH_2CH_2CH_3$), 32.0 ($CH_2CH_2CH_2CH_3$), 30.2 ($CH_2CH_2CH_2CH_3$), 20.4 ($CH_2CH_2CH_2CH_3$), 20.2 ($CH_2CH_2CH_2CH_3$), 14.0 ($CH_2CH_2CH_2CH_3$), 13.9 ($CH_2CH_2CH_2CH_3$). **IR** ($\nu_{max}$): 605, 805, 980, 993, 1002, 1137, 1170, 1209, 1231, 1261, 1417, 1509, 1589, 1642, 2863, 2874, 2932, 2959. **UV/Vis** (25 μM in MeOH): 220 (0.2926), 236 (0.3072), 295 (0.3985), 320 (0.4781). **HRMS** (ESI+): calcd. for $C_{21}H_{32}NO_3$ [M + H] + 346.2382, found 346.2383.

**(*E*)-3-(4-(allyloxy)-3-methoxyphenyl)-*N*-phenylacrylamide (8d)**. Following the general procedure A, **7** (1.71 mmol), pyridine (270 μL, 3.42 mmol) and aniline (207 μL, 2.23 mmol) in dry DCM was reacted for 18 h. After workup and chromatography (PE/EtOAc 6:4) the desired compound was afforded as white solid (471 mg, 89 %). $R_f$ 0.45 (PE/EtOAc 6:4). **m.p**. 124.6–125.5 °C. **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 7.69 (d, *J* = 15.4, 1H, ArCH=CH), 7.62 (d, *J* = 7.9, 2H, 2×*o*-CH Ph), 7.50 (s, 1H, NH), 7.34 (t, *J* = 8.0, 2H, 2×*m*-CH Ph), 7.12 (t, *J* = 7.4, 1H, *p*-CH Ph), 7.09–7.01 (m, 2H, CH–2 + CH–6), 6.85 (d, *J* = 8.2, 1H, CH–5), 6.45 (d, *J* = 15.4, 1H, ArCH=C*H*), 6.07 (ddt, *J* = 17.2, 10.7, 5.4, 1H, $CH_2$=CH), 5.41 (dq, *J* = 17.3, 1.6, 1H, C$H_{trans}$H=CH), 5.31 (dq, *J* = 10.5, 1.3, 1H, C$H_{cis}$H=CH), 4.64 (dt, *J* = 5.4, 1.4, 2H, $CH_2O$), 3.88 (s, 3H, $OCH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 165.1 (C=O), 149.5 (C–O), 149.2 (C–O), 141.7 (ArCH=CH), 138.5 (C–NH), 132.6 ($CH_2$=CH), 128.9 (2×*m*–CH Ph), 127.8 (C–1), 124.1 (*p*-CH Ph), 121.6 (CH–6), 120.2 (ArCH=CH), 119.3 (2×*o*-CH Ph), 118.4 ($CH_2$=CH), 112.8 (CH–5), 110.3 (CH–2), 69.6 ($CH_2O$), 55.5 ($OCH_3$). **IR** ($\nu_{max}$): 610, 656, 687, 708, 733, 749, 760, 808, 849, 930, 969, 994, 1013, 1034, 1139, 1166, 1224, 1250, 1266, 1317, 1419, 1440, 1499, 1508, 1523, 1595, 1648, 2849, 2879, 2939, 2967, 3012, 3054, 3123, 3310. **UV/Vis** (25 μM in MeOH): 239 (0.3353), 299 (0.5427), 330 (0.8137). **HRMS** (ESI+): calcd. for $C_{19}H_{20}NO_3$ [M + H] + 310.1443, found 310.1440.

**(*E*)-3-(4-(allyloxy)-3-methoxyphenyl)-*N*-(4-methoxyphenyl) acrylamide (8e)**. Following the general procedure A, **7** (1.69 mmol), pyridine (272 μL, 3.38 mmol) and 4-methoxyaniline (271 mg, 2.20 mmol) in dry DCM was reacted for 18 h. After workup and the crude was triturated with $Et_2O$ (8 mL) and the desired compound was afforded as silver solid (470 mg, 82 %).$R_f$ 0.30 (PE/EtOAc 6:4). **m.p**. 158–161 °C. **$^1$H NMR** (300 MHz, DMSO-$d_6$) δ = 9.98 (s, 1H, NH), 7.66–7.56 (m, 2H, *para* syst.), 7.48 (d, *J* = 15.6, 1H, ArCH=CH), 7.20 (d, *J* = 1.9, 1H, CH–2), 7.13 (dd, *J* = 8.4, 1.9, 1H, CH–6), 6.98 (d, *J* = 8.3, 1H, CH–5), 6.93–6.84 (m, 2H, *para* syst), 6.66 (d, *J* = 15.6, 1H, ArCH=C*H*), 6.03 (ddt, *J* = 17.2, 10.5, 5.3, 1H, $CH_2$=CH), 5.38 (dq, *J* = 17.3, 1.6, 1H, C$H_{trans}$H=CH), 5.24 (dq, *J* = 10.5, 1.3, 1H, C$H_{cis}$H=CH), 4.57 (dt, *J* = 5.4, 1.5, 2H, $CH_2O$), 3.81 (s, 3H, $OCH_3$), 3.71 (s, 3H,$OCH_3$). **$^{13}$C NMR** (75 MHz, DMSO-$d_6$) δ = 163.8 (C=O), 155.6 (C–O), 149.6 (C–O), 149.5 (C–O), 140.1 (ArCH=CH), 134.0 ($CH_2$=CH), 133.1 (C–NH), 128.3 (C–1), 122.0 (CH–6), 121.0 (2×CH para syst.), 120.6 (ArCH=CH), 118.2 ($CH_2$=CH), 114.4 (2×CH para syst.), 113.7 (CH–5), 110.7 (CH–2), 69.3 ($CH_2O$), 55.9 ($OCH_3$), 55.6 ($OCH_3$). **IR** ($\nu_{max}$): 605, 685, 725, 735, 769, 803, 813, 818, 838, 844, 914, 922, 969, 991, 995, 1030, 1109, 1138, 1167, 1230, 1255, 1264, 1296, 1339, 1411, 1448, 1454, 1508, 1516, 1596, 1652, 2838, 2865, 2921, 2952, 3009, 3054, 3084, 3125, 3288. **UV/Vis** (25 μM in MeOH): 234 (0.4563), 294 (0.5075), 329 (0.8500). **HRMS** (ESI+): calcd. for $C_{20}H_{22}NO_4$ [M + H] + 340.1549, found 340.1554.

**(*E*)-3-(4-(allyloxy)-3-methoxyphenyl)-*N*-benzylacrylamide (8g)**. Following the general procedure A, **7** (0.655 mmol), pyridine (106 μL, 1.31 mmol) and benzylamine (93 μL, 0.852 mmol) in dry DCM was reacted for 18 h. After workup and chromatography (PE/EtOAc 6:4) the desired compound was afforded as white solid (165 mg, 78 %). $R_f$ 0.27 (PE/EtOAc 6:4). **m.p**. 120.0–120.5 °C. **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 7.59 (d, *J* = 15.6, 1H, ArCH=CH), 7.40–7.21 (m, 5H, Ph), 7.07–6.97 (m, 2H, CH–2 + CH–6), 6.81 (d, *J* = 8.1, 1H, CH–5), 6.33 (d, *J* = 15.5, 1H, ArCH=C*H*), 6.22 (t, *J* = 5.8, 1H, NH), 6.06 (ddt, *J* = 17.2, 10.6, 5.4, 1H, $CH_2$=CH), 5.40 (dq, *J* = 17.2, 1.5, 1H, C$H_{trans}$H=CH), 5.29 (dq, *J* = 10.5, 1.4, 1H, C$H_{cis}$H=CH), 4.61 (dt, *J* = 5.4, 1.5, 2H, $CH_2O$), 4.53 (d, *J* = 5.7, 2H, NHC$H_2$), 3.83 (s, 3H, $OCH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 166.1 (C=O), 149.5 (C–O), 149.4 (C–O), 141.1 (ArCH=CH), 138.3 ($CH_2C$), 132.8 ($CH_2$=CH), 128.7 (2×CH Ph), 128.0 (C–1), 127.8 (2×CH Ph), 127.5 (CH Ph), 121.7 (CH–6), 118.5 (ArCH=CH), 118.3 ($CH_2$=CH), 112.9 (CH–5), 110.1 (CH–2), 69.7

($CH_2O$), 55.8 ($OCH_3$), 43.8 ($NHCH_2$). **IR** ($\nu_{max}$): 612, 666, 671, 697, 741, 804, 849, 925, 968, 1008, 1028, 1135, 1171, 1211, 1240, 1254, 1332, 1513, 1546, 1599, 1614, 1652, 2585, 2843, 2868, 2920, 2939, 2962, 3030, 3059, 3276. **UV/Vis** (25 μM in MeOH): 336 (0.4262), 292 (0.4833), 318 (0.5439). **HRMS** (ESI+): calcd. for $C_{20}H_{22}NO_3$ [M+H]+ 324.1600, found 324.1598.

**(*E*)-3-(4-(allyloxy)-3-methoxyphenyl)-*N*,*N*-dibenzylacrylamide ((*E*) 8h)**. Following the general procedure A, **7** (0.655 mmol), pyridine (106 μL, 1.31 mmol) and dibenzylamine (164 μL, 0.852 mmol) in dry DCM was reacted for 18 h. After workup and chromatography (PE/EtOAc 75:25) the desired compound was afforded as white solid (236 mg, 87%). $R_f$ 0.64 (PE/EtOAc 6:4). **m.p**. 118.3–120.5 °C. **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 7.79 (d, *J* = 15.3, 1H, ArCH=CH), 7.42–7.20 (m, 10H, 2×Ph), 7.03 (dd, *J* = 8.4, 2.0, 1H, CH–6), 6.94 (d, *J* = 2.0, 1H, CH–2), 6.82 (d, *J* = 8.3, 1H, CH–5), 6.75 (d, *J* = 15.2, 1H, ArCH=*CH*), 6.06 (ddt, *J* = 17.3, 10.7, 5.4, 1H, $CH_2$=CH), 5.39 (dq, *J* = 17.3, 1.6, 1H, $CH_{trans}$H=CH), 5.29 (dq, *J* = 10.5, 1.4, 1H, $CH_{cis}$H=CH), 4.72 (s, 2H, $NCH_2$), 4.66–4.56 (m, 4H, $NCH_2$ + $OCH_2$), 3.85 (s, 3H, $OCH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 167.4 (C=O), 149.6 (C–O), 149.4 (C–O), 143.7 (ArCH=CH), 137.4 ($CH_2$*C*), 137.0 ($CH_2$*C*), 132.8 ($CH_2$=CH), 129.0, 128.6 (2×CH Ph), 128.4 (2×CH Ph), 128.4 (C–1), 128.3 (2×CH Ph), 127.7 (CH Ph), 127.4 (CH Ph), 126.6 (2×CH Ph), 121.6 (CH–6), 118.3 (*CH*$_2$=*CH*), 115.1 (ArCH=CH), 112.9 (CH–5), 110.5 (CH–2), 69.7 ($CH_2O$), 56.0 ($OCH_3$), 50.1 ($NHCH_2$), 48.9 ($NHCH_2$). **IR** ($\nu_{max}$): 627, 701, 1145, 1205, 1271, 1275, 1453, 1508, 2934, 3027, 3061. **UV/Vis** (25 μM in MeOH): 241 (0.3365), 297 (0.4199), 324 (0.5501). **HRMS** (ESI+): calcd. for $C_{27}H_{28}NO_3$ [M+H]+414.2069, found 414.2073.

**(*Z*)-3-(4-(allyloxy)-3-methoxyphenyl)-*N*,*N*-dibenzylacrylamide ((*Z*) 8h)**. A solution of **(*E*) 8h** (90 mg, 0.218 mmol) in MeOH (3 mL) was irradiated at 350 nm until the photostationary state was reached as judged by $^1$H NMR (4 h). The desired compound was directly used in the following experiments. $R_f$ 0.74 (PE/EtOAc 1:1). **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 7.43–7.20 (m, 10H, CH Ph), 7.13 (d, *J* = 2.0, 1H, CH–2), 6.93 (dd, *J* = 8.3, 1.9, 1H, CH–6), 6.71 (d, *J* = 8.4, 1H, CH–5), 6.59 (d, *J* = 12.7, 1H, ArCH=CH), 6.17–5.98 (m, 2H, $CH_2$=CH + ArCH=*CH*), 5.42 (dq, *J* = 17.3, 1.5, 1H, $CH_{trans}$H=CH), 5.37–5.26 (m, 1H, $CH_{cis}$H=CH), 4.62 (dt, *J* = 5.4, 1.3, 2H, $OCH_2$), 4.59 (s, 2H, $NCH_2$), 4.43 (s, 2H, $NCH_2$), 3.76 (s, 3H, $OCH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 169.5 (C=O), 149.2 (C–O), 148.5 (C–O), 136.8 ($CH_2$*C*), 136.4 ($CH_2$*C*), 134.4 (ArCH=CH), 133.2 ($CH_2$=CH), 128.95 (2×CH Ph), 128.85 (2×CH Ph), 128.7 (C–1), 128.7 (2×CH Ph), 127.8 (CH Ph), 127.6 (CH Ph), 127.3 (2×CH Ph), 122.1 (CH–6), 121.3 (ArCH=CH), 118.3 (*CH*$_2$=*CH*), 112.9 (CH–5), 112.2 (CH–2), 69.9 ($CH_2O$), 56.0 ($OCH_3$), 50.8 ($NCH_2$), 46.9 ($NCH_2$). **IR** ($\nu_{max}$): 624, 697, 1139, 1210, 1257, 1270, 1451, 1509, 2933, 3028, 3062. **UV/Vis** (25 μM in MeOH): 273 (0.3030), 304 (0.2306).

**(*E*)-3-(4-(allyloxy)-3-methoxyphenyl)-*N*-(2-hydroxyethyl)-*N*-methylacrylamide (8i)**. Following the general procedure A, **7** (0.653 mmol), pyridine (93 μL, 1.31 mmol) and *N*-methylethanolamine (68 μL, 0.849 mmol) in dry DCM was reacted for 18 h. After workup and chromatography (EtOAc/EtOH 96:4) the desired compound was afforded as white solid (161 mg, 85%). $R_f$ 0.28 (EtOAc/EtOH 96:4). **m.p**. 85.2–86.7 °C. **$^1$H NMR** (300 MHz, DMSO-$d_6$) δ = 7.40 (d, *J* = 15.4, 1H, ArCH=CH), 7.26 (d, *J* = 2.0, 1H, CH–2), 7.16 (dd, *J* = 8.3, 2.1, 1H, CH–6), 6.98 (d, *J* = 8.3, 1H, CH–5), 6.97 (d, *J* = 15.4, 1H, ArCH=*CH*), 6.05 (ddt, *J* = 17.4, 10.6, 5.3, 1H, $CH_2$=CH), 5.40 (dq, *J* = 17.3, 1.7, 1H, $CH_{trans}$H=CH), 5.25 (dq, *J* = 10.5, 1.5, 1H, $CH_{cis}$H=CH), 4.60 (dt, *J* = 5.3, 1.6, 2H, $OCH_2$), 4.46 (broad s, 1H, OH), 3.84 (s, 3H, $OCH_3$), 3.60 (q, *J* = 5.3, 2H, $NCH_2CH_2$), 3.56–3.49 (m, 2H, $NCH_2CH_2$), 3.07 (s, 3H, $NCH_3$). **$^{13}$C NMR** (75 MHz, DMSO-$d_6$) δ = 166.6 (C=O), 150.2 (C–O), 149.8 (C–O), 141.0 (ArCH=CH), 134.2 ($CH_2$=CH), 129.5 (C–1), 121.9 (C-6), 117.80 and 117.76 (*CH*$_2$=*CH* + ArCH=CH), 114.9 (CH–5), 112.8 (CH–2), 69.9 ($CH_2O$), 59.7 ($NCH_2CH_2$), 56.7 ($OCH_3$), 51.5 ($NCH_2CH_2$), 35.6 ($NCH_3$). **IR** ($\nu_{max}$): 607, 815, 843, 920, 988, 1012, 1032, 1061, 1111, 1145, 1206, 1258, 1405, 1418, 1444, 1508, 1584, 1641, 2603, 2882, 2907, 2940, 2962, 2994, 3042, 3079, 3384. **UV/Vis** (25 μM in MeOH): 219 (0.3233), 235 (0.3449), 298 (0.4479), 320 (0.5375). **HRMS** (ESI+): calcd. for $C_{16}H_{22}NO_4$ [M+H]+ 292.1549, found 292.1545.

**(*E*)-3-(4-(allyloxy)-3-methoxyphenyl)-*N*-methoxy-*N*-methylacrylamide ((*E*) 8j)**. Freshly prepared acyl chloride **7** (5.12 mmol) was dissolved in dry DCM (30 mL) under $N_2$ atmosphere and imidazole (1045 mg, 15.36 mmol) and *N*,*O*-dimethylhydroxylamine hydrochloride (650 mg, 6.66 mmol) were added at 0 °C. After stirring for 18 h at rt, 0.1 N HCl solution (pH 1–2) was added. The reaction mixture was extracted with EtOAc (3×20 mL), and the organic layer was washed with 0.1 N NaOH solution (3×20 mL), brine and dried over $Na_2SO_4$. After filtration and evaporation of the solvent, the crude was purified by chromatography (PE/EtOAc 55:45) to give the desired product as colorless oil (1208 mg, 85%). $R_f$ 0.40 (PE/EtOAc 1:1) and 0.20 (PE/$Et_2O$ 1:2+1% EtOH). **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 7.67 (d, *J* = 15.7, 1H, ArCH=CH), 7.13 (dd, *J* = 8.3, 2.0, 1H, H–6), 7.09 (d, *J* = 2.0, 1H, H–2), 6.89 (d, *J* = 15.7, 1H, ArCH=*CH*), 6.87 (d, *J* = 8.3, 1H, H–5), 6.08 (ddt, *J* = 17.3, 10.6, 5.4, 1H, $CH_2$=CH), 5.42 (dq, *J* = 17.3, 1.6, 1H, $CH_{trans}$H=CH), 5.31 (dq, *J* = 10.5, 1.4, 1H, $CH_{cis}$H=CH), 4.65 (dt, *J* = 5.4, 1.5, 2H, $OCH_2$), 3.92 (s, 3H, $OCH_3$), 3.77 (s, 3H, $NOCH_3$), 3.31 (s, 3H, $NCH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 167.2 (C=O), 149.7 (C–O), 149.4 (C–O), 143.4 (ArCH=CH), 132.8 ($CH_2$=CH), 128.4 (C–1), 121.9 (C-6), 118.3 (*CH*$_2$=*CH*), 113.6 (ArCH=CH), 112.9 (C–5), 110.6 (C–2), 69.7 ($OCH_2$), 61.8 ($NOCH_3$), 56.0 ($OCH_3$), 32.5 ($NCH_3$). **IR** ($\nu_{max}$): 607, 815, 851, 919, 993, 1013, 1104, 1147, 1162, 1191, 1226, 1255, 1267, 1419, 1454, 1509, 1595, 1605, 1646, 2605, 2831, 2855, 2926, 2969, 3012, 3038, 3080, 3445. **UV/Vis** (25 μM in MeOH): 222 (0.2554), 236 (0.2867), 296 (0.3778), 326 (0.4862). **HRMS** (ESI+): calcd. for $C_{15}H_{20}NO_4$ [M+H]+278.1392, found 278.1396.

**(*Z*)-3-(4-(allyloxy)-3-methoxyphenyl)-*N*-methoxy-*N*-methylacrylamide ((*Z*) 8j)**. A solution of **(*E*) 8j** (500 mg, 1.80 mmol) in MeOH (18 mL) was irradiated at 350 nm until the photostationary state was reached as judged by $^1$H NMR (4 h). After evaporation of the solvent, the *E*/*Z* mixture (27:73) was purified by chromatography (PE/$Et_2O$ 1:2+1% EtOH) to give pure *Z* isomer as colorless oil (273 mg). $R_f$ 0.27 (PE/$Et_2O$ 1:2+1% EtOH). **$^1$H NMR** (300 MHz, DMSO-$d_6$) δ = 7.33 (d, *J* = 2.1, 1H, CH–2), 7.07 (dd, *J* = 8.4, 2.1, 1H, CH–6), 6.92 (d, *J* = 8.4, 1H, CH–5), 6.65 (d, *J* = 12.8, 1H, ArCH=CH), 6.14 (d, *J* = 12.9, 1H, ArCH=*CH*), 6.03 (ddt, *J* = 17.3, 10.6, 5.3, 1H, $CH_2$=CH), 5.38 (dq, *J* = 17.3, 1.7, 1H, $CH_{trans}$H=CH), 5.24 (dq, *J* = 10.5, 1.5, 1H, $CH_{cis}$H=CH), 4.56 (dt, *J* = 5.3, 1.5, 2H, $OCH_2$), 3.74 (s, 3H, $OCH_3$), 3.63 (s, 3H, $NOCH_3$), 3.16 (s, 3H, $NCH_3$). **$^{13}$C NMR** (75 MHz, DMSO-$d_6$) δ = 167.5 (C=O), 149.3 (C–O), 148.9 (C–O), 136.6 (ArCH=CH), 134.2 ($CH_2$=CH), 129.0 (C–1), 123.3 (CH–6), 119.8 (ArCH=CH), 117.8 (*CH*$_2$=*CH*), 114.2 (CH–2), 114.1 (CH–5), 69.6 ($OCH_2$), 61.5 ($NOCH_3$), 56.2 ($OCH_3$), 33.0 ($NCH_3$). **IR** ($\nu_{max}$): 636, 806, 993, 1139, 1230, 1256, 1270, 1509, 2935, 3090. **UV/Vis** (25 μM in MeOH): 275 (0.2411), 301 (0.2279).

**(*E*)-3-(4-(allyloxy)-3-methoxyphenyl)-*N*-methyl-*N*-phenylacrylamide (8k)**. Following the general procedure B, **8d** (232 mg, 0.750 mmol), NaH (60% dispersion in mineral oil, 45 mg, 1.125 mmol) and MeI (80 μL, 1.275 mmol) in dry DMF (4 mL) was reacted and, after workup and chromatography (PE/EtOAc 1:1), the desired compound was afforded as white solid (238 mg, 98%). $R_f$ 0.52 (PE/EtOAc 1:1). **m.p**. 92.5–93.7 °C. **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 7.61 (d, *J* = 15.5, 1H, ArCH=CH), 7.47–7.40 (m, 2H, 2×CH Ph), 7.39–7.32 (m, 1H, CH Ph), 7.27–7.21 (m, 2H, 2×CH Ph), 6.90 (dd, *J* = 8.3, 2.0, 1H, CH–6), 6.81 (d, *J* = 2.0, 1H, CH–2), 6.78 (d, *J* = 8.3, 1H, CH–5), 6.23 (d, *J* = 15.5, 1H, ArCH=*CH*), 6.04 (ddt, *J* = 17.3, 10.6, 5.4, 1H, $CH_2$=CH), 5.37 (dq, *J* = 17.3, 1.6, 1H, $CH_{trans}$H=CH), 5.27 (dq, *J* = 10.5, 1.4, 1H, $CH_{cis}$H=CH), 4.59 (dt, *J* = 5.4, 1.5, 2H, $OCH_2$), 3.80 (s, 3H, $OCH_3$), 3.41 (s, 3H, $NCH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 166.3 (C=O), 149.3 (C–O), 149.3 (C–O), 143.7 (N–C), 141.5 (ArCH=CH), 132.8 ($CH_2$=CH), 129.5 (2×CH Ph), 128.4 (C–1), 127.4 (CH Ph), 127.3 (2×

CH Ph), 121.2 (C-6), 118.2 (*CH*$_2$=*CH*), 116.8 (ArCH=CH), 112.9 (C–5), 110.9 (C–2), 69.7 ($OCH_2$), 55.9 ($OCH_3$), 37.5 ($NCH_3$). **IR** ($\nu_{max}$): 603, 699, 775, 800, 839, 944, 986, 1007, 1034, 1121, 1143, 1220, 1244, 1261, 1383, 1495, 1510, 1581, 1592, 1652, 2606, 2882, 2939, 2967, 3005, 3047. **UV/Vis** (25 μM in MeOH): 214 (0.5023), 238 (0.4837), 297 (0.4969), 328 (0.6691). **HRMS** (ESI+): calcd. for $C_{20}H_{22}NO_3$ [M+H]+ 324.1600, found 324.1608.

**(*E*)-3-(4-(allyloxy)-3-methoxyphenyl)-*N*-(4-methoxyphenyl)-*N*-methylacrylamide (8l)**. Following the general procedure B, **8e** (60 mg, 0.177 mmol), NaH (60% dispersion in mineral oil, 11 mg, 0.266 mmol) and MeI (20 μL, 0.301 mmol) in dry DMF (1 mL) was reacted and, after workup and chromatography (PE/EtOAc 1:1), the desired compound was afforded as pale yellow solid (58 mg, 92%). $R_f$ 0.34 (PE/EtOAc 1:1). **m.p**. 115.2–116.5 °C. **$^1$H NMR** (300 MHz,$CDCl_3$) δ = 7.59 (d, *J* = 15.5, 1H, ArCH=CH), 7.21–7.10 (m, 2H, para syst.), 6.99–6.88 (m, 3H, para syst. + CH–6), 6.82 (d, *J* = 2.0, 1H, CH–2), 6.78 (d, *J* = 8.3, 1H, CH–5), 6.23 (d, *J* = 15.4, 1H, ArCH=*CH*), 6.04 (ddt, *J* = 17.3, 10.6, 5.4, 1H, $CH_2$=CH), 5.38 (dq, *J* = 17.2, 1.6, 1H, *CH*$_{trans}$H=CH), 5.28 (dq, *J* = 10.5, 1.3, 1H, *CH*$_{cis}$H=CH), 4.60 (dt, *J* = 5.4, 1.5, 2H, $OCH_2$), 3.85 (s, 3H, $OCH_3$), 3.81 (s, 3H, $OCH_3$), 3.37 (s, 3H, $NCH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 166.5 (C=O), 158.7 (C–O), 149.3 (C–O), 149.3 (C–O), 141.4 (Ar*C*H=CH), 136.6 (C–N), 132.9 ($CH_2$=CH), 128.6 (C–1), 128.5 (2×CH para syst.), 121.0 (C-6), 118.2 (*CH*$_2$=*CH*), 116.8 (ArCH=CH), 114.6 (2×CH para syst.), 113.0 (C–5), 111.2 (C–2), 69.7 ($OCH_2$), 56.0 ($OCH_3$), 55.5 ($OCH_3$), 37.7 ($NCH_3$). **IR** ($\nu_{max}$): 602, 800, 809, 838, 945, 988, 1007, 1019, 1039, 1107, 1123, 1142, 1222, 1249, 1423, 1509, 1599, 1651, 2598, 2847, 2882, 2940, 2963, 3011, 3049. **UV/Vis** (25 μM in MeOH): 237 (0.4847), 298 (0.4099), 323 (0.5540). **HRMS** (ESI+): calcd. for $C_{21}H_{24}NO_4$ [M+H]+ 354.1705, found 354.1700.

**(*E*)-3-(4-(allyloxy)-3-methoxyphenyl)-*N*-methyl-*N*-(4-nitrophenyl) acrylamide (8m)**. Following the general procedure A, **7** (1.69 mmol), pyridine (273 μL, 3.38 mmol) and 4-nitroaniline (304 mg, 2.20 mmol) in dry DCM was reacted for 18 h. After workup and chromatography (PE/EtOAc 2:8) the desired secondary amide co-eluted with 4-nitroaniline (80:20 respectively by $^1$H NMR, corrected yield 92%) that was impossible to remove. Following the general procedure B, the above mentioned mixture (58 mg, corresponding to 0.150 mmol of secondary amime), NaH (60% dispersion in mineral oil, 9 mg, 0.225 mmol) and MeI (16 μL, 0.255 mmol) in dry DMF (0.75 mL) was reacted and, after workup and chromatography (PE/EtOAc 6:4), the desired tertiary amide was afforded as pale yellow solid (25 mg, 45% from **7**). $R_f$ 0.20 (PE/EtOAc 6:4). **m.p**. 151.7–13.2 °C. **$^1$H NMR** (300 MHz,$CDCl_3$) δ = 8.33–8.27 (m, 2H, para syst.), 7.69 (d, *J* = 15.4, 1H, ArCH=CH), 7.45–7.39 (m, 2H, para syst.), 6.96 (dd, *J* = 8.4, 2.0, 1H, CH–6), 6.86 (d, *J* = 2.0, 1H, CH–2), 6.81 (d, *J* = 8.4, 1H, CH–5), 6.26 (d, *J* = 15.4, 1H, ArCH=*CH*), 6.05 (ddt, *J* = 17.2, 10.6, 5.4, 1H, $CH_2$=CH), 5.39 (dq, *J* = 17.3, 1.6, 1H, *CH*$_{trans}$H=CH), 5.29 (dq, *J* = 10.2, 1.4, 1H, *CH*$_{cis}$H=CH), 4.62 (dt, *J* = 5.4, 1.5, 2H, $OCH_2$), 3.83 (s, 3H, $OCH_3$), 3.48 (s, 3H, $NCH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 166.2 (C=O), 149.9 (C–O), 149.7 (C–O), 149.4 (C–O), 145.9 (C–N), 143.5 (Ar*C*H=CH), 132.7 ($CH_2$=CH), 127.8 (C–1), 127.2 (2×CH para syst.), 124.9 (2×CH para syst.), 121.4 (CH–6), 118.4 (*CH*$_2$=*CH*), 115.7 (ArCH=CH), 113.0 (CH–5), 111.1 (CH–2), 69.7 ($OCH_2$), 56.0 ($OCH_3$), 37.3 ($NCH_3$). **IR** ($\nu_{max}$): 604, 699, 796, 847, 852, 858, 868, 929, 986, 997, 1013, 1035, 1104, 1117, 1138, 1225, 1258, 1334, 1492, 1510, 1585, 1653, 2850, 2922, 2963, 3072, 3105. **UV/Vis** (25 μM in MeOH): 239 (0.3704), 294 (0.4506), 328 (0.4886). **HRMS** (ESI+): calcd. for $C_{20}H_{21}N_2O_5$ [M+H]+ 369.1450, found 369.1457.

**(*E*)-3-(4-(allyloxy)-3-methoxyphenyl)-*N*-benzyl-*N*-methylacrylamide (8n)**. Following the general procedure B, **8g** (131 mg, 0.406 mmol), NaH (60% dispersion in mineral oil, 24 mg, 0.609 mmol) and MeI (43 μL, 0.690 mmol) in dry DMF (2 mL) was reacted and, after workup and chromatography (PE/EtOAc 50:45), the desired compound was afforded as white foam (125 mg, 91%). $R_f$ 0.60 (PE/EtOAc 6:4). **$^1$H NMR** (300 MHz, DMSO-$d_6$) δ = 7.47 (d, *J* = 15.3, 1H, ArCH=CH), 7.39–7.19 (m, 6H, 5×CH Ph + CH–2), 7.14 (dd, *J* = 8.3, 2.0, 1H, CH–6), 7.02 (d, *J* = 15.4, 1H, ArCH=*CH*), 6.95 (d, *J* = 8.4, 1H, CH–5), 6.03 (ddt, *J* = 17.1, 10.5, 5.3, 1H, $CH_2$=CH), 5.37 (dq, *J* = 17.3, 1.6, 1H, *CH*$_{trans}$H=CH), 5.23 (dq, *J* = 10.5, 1.5, 1H, *CH*$_{cis}$H=CH), 4.68 (s, 2H, $NCH_2$), 4.57 (dt, *J* = 5.1, 1.4, 2H, $OCH_2$), 3.81 (d, *J* = 1.2, 3H, $OCH_3$), 3.02 (s, 3H, $NCH_3$ buried by $H_2O$). **$^{13}$C NMR** (75 MHz, DMSO-$d_6$) δ = 166.7 (C=O), 150.2 (C–O), 150.0 (C–O), 141.8 (Ar*C*H=CH), 138.5 (C quat. Ph), 134.2 ($CH_2$=CH), 129.3 (C–1), 128.9 (2×CH Ph), 127.7 (CH Ph), 127.5 (2×CH Ph), 122.2 (CH–6), 117.8 (*CH*$_2$=*CH*), 117.2 (ArCH=CH), 114.9 (CH–5), 112.7 (CH–2), 69.9 ($OCH_2$), 56.7 ($OCH_3$), 34.9 ($NCH_3$). **IR** ($\nu_{max}$): 697, 726, 1138, 1250, 1509, 1594, 2246, 2934, 3063. **UV/Vis** (25 μM in MeOH): 218 (0.3188), 238 (0.3001), 295 (0.3787), 325 (0.4755). **HRMS** (ESI+): calcd. for $C_{21}H_{24}NO_3$ [M+H]+ 338.1756, found 338.1750.

**(*E*)-3-(4-hydroxy-3-methoxyphenyl)acrylamide (9a)**.[17] To a solution of ferulic acid (400 mg, 2.06 mmol) in 1 M NaOH (aq. solution, 5 mL) was added $Ac_2O$ (0.78 mL, 8.25 mmol) at 0 °C. After stirring at rt for 2 h, the white precipitate formed was filtered, washed with $H_2O$ (10 mL) and purified by chromatography (PE/EtOAc 3:7 + 5% MeOH) to give **3** as white solid (263 mg, 66%). To a solution of **3** (154 mg, 0.737 mmol) in dry THF (7 mL) were added $Et_3N$ (235 μL, 1.70 mmol) and ethyl chloroformate (162 μL, 1.70 mmol) at 0 °C. After stirring for 30 min at rt, $NH_4OH$ (28% aq., 665 μL) was added dropwise and the mixture was reacted for 18 h. Then the volume was reduced and the mixture was extracted with $H_2O$ (20 mL) and EtOAc (3×20 mL). The organic layer was washed with brine and dried over $Na_2SO_4$. After filtration and evaporation of the solvent, the crude was purified by chromatography (PE/EtOAc 1:9 + 1% EtOH) to give **8a** as yellow sticky solid (76 mg, 53%). $R_f$ 0.31 (PE/EtOAc 9:1 + 1% EtOH). **m.p**. 105.4–153.2 °C. **UV/Vis** (25 μM in MeOH): 220 (0.2924), 237 (0.3071), 295 (0.3985), 321 (0.4784). Others data were in accordance with the literature.

**(iE)-*N*-butyl-3-(4-hydroxy-3-methoxyphenyl)acrylamide (9b)**. Following the general procedure C, **8a** (211 mg, 0.730 mmol), $HCO_2NH_4$ (101 mg, 1.61 mmol) and $Pd(PPh_3)_2Cl_2$ (13 mg, 0.018 mmol) in dry $CH_3CN$ (5 mL) was reacted for 24 h at 80 °C. After workup and chromatography (DCM + 4% MeOH) the desired compound was afforded as pale yellow foam (182 mg, 99%). $R_f$ 0.35 (DCM + 4% MeOH). **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 7.54 (d, *J* = 15.5 Hz, 1H, ArCH=CH), 7.05 (dd, *J* = 8.2, 1.9 Hz, 1H, H–6), 6.97 (d, *J* = 1.9 Hz, 1H, H–2), 6.90 (d, *J* = 8.2 Hz, 1H, H–5), 6.26 (d, *J* = 15.5 Hz, 1H, ArCH=*CH*), 6.04 (s, 1H, OH), 5.72 (t, *J* = 5.8 Hz, 1H, NH), 3.89 (s, 3H, $OCH_3$), 3.38 (td, *J* = 7.1, 5.8 Hz, 2H, $CH_2CH_2CH_2CH_3$), 1.63–1.47 (m, 2H, $CH_2CH_2CH_2CH_3$), 1.46–1.29 (m, 2H, $CH_2CH_2CH_2CH_3$), 0.94 (t, *J* = 7.3 Hz, 3H, $CH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 166.7 (C=O), 147.6 (C–O), 147.0 (C–O), 140.9 (Ar*C*H=CH), 127.3 (C–1), 121.9 (CH–6), 118.4 (ArCH=CH), 115.0 (CH–5), 110.0 (CH–2), 55.8 ($OCH_3$), 39.6 ($CH_2CH_2CH_2CH_3$), 31.7 ($CH_2CH_2CH_2CH_3$), 20.2 ($CH_2CH_2CH_2CH_3$), 13.8 ($CH_3$). **UV/Vis** (25 μM in MeOH): 219 (0.3675), 234 (0.3689), 293 (0.3895), 319 (0.4895). Others data were in accordance with the literature.[20b]

**(*E*)-*N*,*N*-dibutyl-3-(4-hydroxy-3-methoxyphenyl)acrylamide (9c)**. Following the general procedure C, **8c** (232 mg, 0.671 mmol), $HCO_2NH_4$ (93 mg, 1.48 mmol) and $Pd(PPh_3)_2Cl_2$ (12 mg, 0.017 mmol) in dry $CH_3CN$ (5 mL) was reacted for 24 h at 80 °C. After workup and chromatography (PE/EtOAc 6:4) the desired compound was afforded as pale yellow oil (197 mg, 96%). $R_f$ 0.34 (PE/EtOAc 6:4). **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 7.62 (d, *J* = 15.3 Hz, 1H, ArCH=CH), 7.09 (dd, *J* = 8.2, 2.0 Hz, 1H, CH–6), 6.97 (d, *J* = 1.9 Hz, 1H, CH–2), 6.92 (d, *J* = 8.2 Hz, 1H, CH–5), 6.68 (d, *J* = 15.3 Hz, 1H, ArCH=*CH*), 5.89 (s, 1H, OH), 3.92 (s, 3H, $OCH_3$), 3.50–3.30 (m, 4H 2 x $CH_2CH_2CH_2CH_3$), 1.73–1.50 (m, 4H, 2×$CH_2CH_2CH_2CH_3$), 1.47–1.27 (m, 4H, 2×$CH_2CH_2CH_2CH_3$ ), 0.98 (t, *J* = 7.3 Hz, 3H, $CH_3$), 0.94 (t, *J* =

7.3 Hz, 3H, $CH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 166.5 (C=O), 147.5 (C–O), 146.9 (C–O), 142.5 (ArCH=CH), 128.1(C–1), 121.6 (CH–6), 115.3 (ArCH=CH), 115.0 (CH–5), 110.4 (CH–2), 56.0 ($OCH_3$), 48.0 ($CH_2CH_2CH_2CH_3$), 46.8 ($CH_2CH_2CH_2CH_3$), 32.0 ($CH_2CH_2CH_2CH_3$), 30.2 ($CH_2CH_2CH_2CH_3$), 20.4 ($CH_2CH_2CH_2CH_3$), 20.2 ($CH_2CH_2CH_2CH_3$), 14.0 ($CH_3$), 13.9 ($CH_3$). **IR** ($\nu_{max}$): 605, 798, 818, 975, 1036, 1129, 1165, 1196, 1204, 1250, 1281, 1288, 1409, 1445, 1460, 1480, 1513, 1572, 2658, 2792, 2858, 2872, 2931, 2959, 3014, 3094. **UV/Vis** (25 μM in MeOH): 219 (0.4042), 236 (0.3919), 299 (0.4440), 223 (0.5882). **HRMS** (ESI+): calcd. for $C_{18}H_{28}NO_3$ [M+H]+306.2069, found 306.2072.

**(*E*)-3-(4-hydroxy-3-methoxyphenyl)-*N*-phenylacrylamide (9 d)**. Following the general procedure C, **8 d** (96 mg, 0.310 mmol), $HCO_2NH_4$ (44 mg, 0.682 mmol) and $Pd(PPh_3)_2Cl_2$ (5 mg, 7.75 μmol) in dry $CH_3CN$ (2.5 mL) was reacted for 24 h at 80 °C. After workup and chromatography (PE/EtOAc 55:45) the desired compound was afforded as pale yellow oil (81 mg, 97%). **$R_f$** 0.44 (PE/EtOAc 1:1). **UV/Vis** (25 μM in MeOH): 237 (0.2763), 332 (0.6671). Others data were in accordance with the literature.[31]

**(*Z*)-*N*,*N*-dibenzyl-3-(4-hydroxy-3-methoxyphenyl)acrylamide ((*Z*) 9 h)**. Following the general procedure C, **(*Z*)-8 h** (45 mg, 0.109 mmol), $HCO_2NH_4$ (15 mg, 0.240 mmol) and $Pd(PPh_3)_2Cl_2$ (2 mg, 2.72 μmol) in dry $CH_3CN$ (1 mL) was reacted for 24 h at 80 °C. After workup and chromatography (PE/EtOAc 7:3) the desired compound was afforded as pale yellow foam (31 mg, 75%). **$R_f$** 0.59 (PE/EtOAc 1:1). $^1$H NMR of the crude showed that almost no isomerization occurs.

**(*E*)-3-(4-hydroxy-3-methoxyphenyl)-*N*-methyl-N-phenylacrylamide (9 k)**. Following the general procedure C, **8 k** (101 mg, 0.312 mmol), $HCO_2NH_4$ (44 mg, 0.684 mmol) and $Pd(PPh_3)_2Cl_2$ (6 mg, 7.75 μmol) in dry $CH_3CN$ (2.5 mL) was reacted for 24 h at 80 °C. After workup and chromatography (PE/EtOAc 1:1) the desired compound was afforded as pale yellow oil (80 mg, 90%). **$R_f$** 0.33 (PE/EtOAc 1:1). **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 7.60 (d, *J* = 15.5, 1H, ArCH=CH), 7.50–7.39 (m, 2H, 2×CH Ph), 7.39–7.32 (m, 1H, CH Ph), 7.29–7.20 (m, 2H, 2× CH Ph), 6.89 (dd, *J* = 8.2, 1.7, 1H. H–6), 6.82 (d, *J* = 8.2, 1H, H–5), 6.79 (d, *J* = 1.7, 1H, H–2), 6.21 (d, *J* = 15.5, 1H, ArCH=*CH*), 5.90 (s, 1H, OH), 3.83 (s, 3H, $OCH_3$), 3.41 (s, 3H, $NCH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 166.6 (C=O), 147.3 (C–O), 146.6 (C–O), 143.9 (C–N), 141.9 (ArCH=CH), 129.7 (2×CH Ph), 127.9 (C–1), 127.6 (CH Ph), 127.5 (2× CH Ph), 121.7 (C-6), 116.5 (ArCH=CH), 114.8 (C–5), 110.4 (C–2), 56.0 ($OCH_3$), 37.7 ($NCH_3$). **IR** ($\nu_{max}$): 603, 667, 698, 772, 799, 812, 1033, 1121, 1168, 1226, 1263, 1286, 1377, 1429, 1518, 1563, 1635, 2587, 2836, 2937, 2965, 2995, 3061. **UV/Vis** (25 μM in MeOH): 216 (0.2854), 241 (0.3600), 299 (0.3420), 331 (0.5366). **HRMS** (ESI+): calcd. for $C_{17}H_{18}NO_3$ [M+H]+284.1287, found 284.1289.

**(*E*)-4-(4-(allyloxy)-3-methoxyphenyl)but-3-en-2-one ((*E*) 11 a)**. Following the general procedure D, **(*E*) 8 j** (200 mg, 0.721 mmol), MeMgBr (3.0 M in $Et_2O$, 1.5 mL, 4.33 mmol) in dry THF (7 mL) was reacted for 4 h at −30 °C. After workup and chromatography (PE/EtOAc 75:25) the desired compound was afforded as pale yellow solid (119 mg, 72%). **$R_f$** 0.27 (PE/EtOAc 75:25). **m.p**. 67.8–68.8 °C. **UV/Vis** (25 μM in MeOH): 237 (0.2097), 298 (0.3106), 332 (0.4821). Others data were in accordance with the literature.[32]

**(*Z*)-4-(4-(allyloxy)-3-methoxyphenyl)but-3-en-2-one ((*Z*) 11 a)**. Following the general procedure D, **(*Z*) 8 j** (136 mg, 0.490 mmol), MeMgBr (3.0 M in $Et_2O$, 0.5 mL, 1.47 mmol) in dry THF (5 mL) was reacted for 4 h at −30 °C. After workup and chromatography (PE/EtOAc 9:1) the desired compound was afforded as yellow oil (92 mg, 83%). **$R_f$** 0.74 (PE/EtOAc 6:4). **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 7.64 (d, *J* = 2.1, 1H, H–2), 7.09 (dd, *J* = 8.3, 2.1, 1H, H–6), 6.84 (d, *J* = 8.4, 1H, H–5), 6.72 (d, *J* = 12.8, 1H, ArCH=CH), 6.13 (d, *J* = 12.7, 1H, ArCH=*CH*), 6.08 (ddt, *J* = 17.3, 10.5, 5.4, 1H, $CH_2$=CH), 5.41 (dq, *J* = 17.3, 1.6, 1H, $CH_{trans}$H=CH), 5.30 (dq, *J* = 10.5, 1.4, 1H, $CH_{cis}$H=CH), 4.64 (dt, *J* = 5.4, 1.5, 2H, $OCH_2$), 3.92 (s, 3H, $OCH_3$), 2.23 (s, 3H, $CH_3$–C=O). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 200.0 (C=O), 149.4 (C–O), 148.7 (C–O), 141.2 (ArCH=CH), 132.9 ($CH_2$=CH), 128.4 (C–1), 126.2 (ArCH=CH), 124.5 (CH–6), 118.3 ($CH_2$=*CH*), 113.2 (CH–2), 112.3 (CH–5), 69.7 ($OCH_2$), 55.9 ($OCH_3$), 31.4 ($CH_3$–C=O). **IR** ($\nu_{max}$): 636, 976, 994, 1135, 1174, 1231, 1255, 1509, 2936, 3004, 3097. **UV/Vis** (25 μM in MeOH): 230 (0.2019), 300 (0.2002), 333 (0.2590). **HRMS** (ESI+): calcd. for $C_{14}H_{17}O_3$ [M+H]+233.1178, found 233.1183.

**(*E*)-1-(4-(allyloxy)-3-methoxyphenyl)pent-1-en-3-one (11 b)**. Following the general procedure D, **(*E*) 8 j** (150 mg, 0.541 mmol), EtMgBr (3.0 M in $Et_2O$, 1.1 mL, 3.25 mmol) in dry THF (5 mL) was reacted for 4 h at −30 °C. After workup and chromatography (PE/EtOAc 9:1) the desired compound was afforded as pale yellow solid (42 mg, 31%). **$R_f$** 0.24 (PE/EtOAc 9:1). **m.p**. 65.1–65.8 °C. **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 7.50 (d, *J* = 16.2, 1H, ArCH=CH), 7.14–7.06 (m, 2H, H–2+H–6), 6.87 (d, *J* = 9.3, 1H, H–5), 6.63 (d, *J* = 16.1, 1H, ArCH=*CH*), 6.08 (ddt, *J* = 17.2, 10.6, 5.4, 1H, $CH_2$=CH), 5.42 (dq, *J* = 17.3, 1.6, 1H, $CH_{trans}$H=CH), 5.31 (dq, *J* = 10.5, 1.4, 1H, $CH_{cis}$H=CH), 4.65 (dt, *J* = 5.4, 1.5, 2H, $OCH_2$), 3.91 (s, 3H, $OCH_3$), 2.69 (q, *J* = 7.3, 2H, $CH_2CH_3$), 1.17 (t, *J* = 7.3, 3H, $CH_2CH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 200.9 (C=O), 150.2 (C–O), 149.5 (C–O), 142.2 (ArCH=CH), 132.7 ($CH_2$=CH), 127.6 (C–1), 124.1 (ArCH=CH), 122.7 (CH–6), 118.4 ($CH_2$=*CH*), 112.8 (CH–5), 110.0 (CH–2), 69.7 ($OCH_2$), 55.9 ($OCH_3$), 33.8 ($CH_2CH_3$), 8.3 ($CH_2CH_3$). **IR** ($\nu_{max}$): 617, 781, 813, 844, 925, 930, 960, 994, 1008, 1141, 1167, 1190, 1200, 1226, 1258, 1424, 1512, 1653, 2833, 2875, 2938, 2955, 2976, 3019, 3041, 3082, 3294. **UV/Vis** (25 μM in MeOH): 240 (0.2032), 298 (0.2980), 333 (0.4596). **HRMS** (ESI+): calcd. for $C_{15}H_{19}O_3$ [M+H]+247.1334, found 247.1330.

**(*E*)-1-(4-(allyloxy)-3-methoxyphenyl)hept-1-en-3-one (11 c)**. Following the general procedure D, **(*E*) 8 j** (205 mg, 0.739 mmol), *n*BuLi (1.6 M in hexane, 0.9 mL, 1.48 mmol) in dry THF (7 mL) was reacted for 2 h at −40 °C. After workup and chromatography (PE/EtOAc 10:1) the desired compound was afforded as white foam (89 mg, 44%). **$R_f$** 0.20 (PE/EtOAc 10:1). **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 7.49 (d, *J* = 16.1, 1H, ArCH=CH), 7.15–7.05 (m, 2H, H–2+H–6), 6.87 (d, *J* = 8.5, 1H, H–5), 6.62 (d, *J* = 16.1, 1H, ArCH=*CH*), 6.08 (ddt, *J* = 17.3, 10.7, 5.4, 1H, $CH_2$=CH), 5.42 (dq, *J* = 17.3, 1.6, 1H, $CH_{trans}$H=CH), 5.31 (dq, *J* = 10.5, 1.4, 1H, $CH_{cis}$H=CH), 4.65 (dt, *J* = 5.4, 1.5, 2H, $OCH_2$), 3.91 (s, 3H, $OCH_3$), 2.65 (t, *J* = 7.4, 2H, $CH_2$C=O), 1.67 (p, *J* = 7.4, 2H, $CH_2CH_2CH_3$), 1.38 (hex, *J* = 7.4, 2H, $CH_2CH_2CH_3$), 0.94 (t, *J* = 7.3, 3H, $CH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 200.6 (C=O), 150.2 (C–O), 149.5 (C–O), 142.3 (ArCH=CH), 132.7 ($CH_2$=CH), 127.7 (C–1), 124.4 (ArCH=CH), 122.7 (CH–6), 118.4 ($CH_2$=*CH*), 112.8 (CH–5), 110.1 (CH–2), 69.7 ($OCH_2$), 55.9 ($OCH_3$), 40.4 ($CH_2$C=O), 26.6 ($CH_2CH_2CH_3$), 22.5 ($CH_2CH_2CH_3$), 13.9 ($CH_3$). **IR** ($\nu_{max}$): 611, 789, 810, 880, 921, 926, 979, 996, 1033, 1144, 1168, 1182, 1228, 1265, 1423, 1453, 1513, 1593, 1653, 2885, 2901, 2953, 2990, 3012, 3081, 3095, 3119, 3281. **UV/Vis** (25 μM in MeOH): 239 (0.1839), 298 (0.2758), 335 (0.4362). **HRMS** (ESI+): calcd. for $C_{17}H_{23}O_3$ [M+H]+275.1647, found 275.1641.

**(*E*)-1-(4-(allyloxy)-3-methoxyphenyl)penta-1,4-dien-3-one (11 d)**. Following the general procedure D, **(*E*) 8 j** (93 mg, 0.335 mmol), vinylMgBr (1.0 M in THF, 1.7 mL, 1.68 mmol) in dry THF (7 mL) was reacted for 2 h at 0 °C. After workup and chromatography (PE/EtOAc 85:15) the desired compound was afforded as yellow oil (30 mg, 36%). **$R_f$** 0.71 (PE/EtOAc 6:4). **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 7.63 (d, *J* = 15.9, 1H, ArCH=CH), 7.19–7.09 (m, 2H, H–2+H–6), 6.88 (d, *J* = 8.0, 1H, H–5), 6.87 (d, *J* = 15.9, 1H, ArCH=*CH*), 6.73 (dd, *J* = 17.4, 10.6, 1H, $CH_2$=CHC=O), 6.37 (dd, *J* = 17.4, 1.4, 1H, $CH_{trans}$H=CHC=O), 6.08 (ddt, *J* = 17.1, 10.7, 5.4, 1H, $CH_2$=CH), 5.85 (dd, *J* = 10.6, 1.3, 1H, $CH_{cis}$H=CHC=O), 5.42 (dq, *J* = 17.3, 1.5, 1H, $CH_{trans}$H=CH), 5.32 (dq, *J* = 11.0, 1.3, 1H, $CH_{cis}$H=CH), 4.66 (dt, *J* = 5.4, 1.5, 2H, $OCH_2$), 3.93 (s, 3H, $OCH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 189.4 (C=O), 150.4 (C–O), 149.6 (C–O), 144.0 (ArCH=CH), 135.3 ($CH_2$=CHC=O), 132.6 ($CH_2$=CH), 128.2 ($CH_2$=*CH*C=O), 127.7 (C–1),

122.9 (CH–6), 122.4 (ArCH=CH), 118.4 (*CH*$_2$=*CH*), 112.8 (CH–5), 110.3 (CH–2), 69.7 ($OCH_2$), 56.0 ($OCH_3$). **IR** ($\nu_{max}$): 607, 806, 985, 1101, 1137, 1208, 1226, 1253, 1507, 1576, 2935, 3079, 3389. **UV/Vis** (25 μM in MeOH): 242 (0.1831), 351 (0.2907). **HRMS** (ESI+): calcd. for $C_{15}H_{17}O_3$ [M+H]+245.1178, found 245.1187.

**(*E*)-3-(4-(allyloxy)-3-methoxyphenyl)-1-phenylprop-2-en-1-one ((*E*) 11 e)**. Following the general procedure D, **(*E*) 8 j** (150 mg, 0.541 mmol), PhMgCl (2.0 M in THF, 1.6 mL, 3.25 mmol) in dry THF (7 mL) was reacted for 2 h at −30 °C. After workup and chromatography (PE/EtOAc 9:1) the desired compound was afforded as bright yellow solid (130 mg, 62%). **R$_f$** 0.29 (PE/EtOAc 9:1). **m.p**. 78.1–79.4 °C. **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 8.07–7.96 (m, 2H, 2×CH Ph), 7.76 (d, *J* = 15.6, 1H, ArCH=CH), 7.64–7.51 (m, 1H, CH Ph), 7.56–7.43 (m, 2H, 2×CH Ph), 7.39 (d, *J* = 15.6, 1H, ArCH=C*H*), 7.20 (dd, *J* = 8.3, 1.9, 1H, H–6), 7.17 (d, *J* = 2.0, 1H, H–2), 6.89 (d, *J* = 8.2, 1H, H–5), 6.09 (ddt, *J* = 17.3, 10.6, 5.4, 1H, $CH_2$=CH), 5.43 (dq, *J* = 17.2, 1.6, 1H, C*H*$_{trans}$H=CH), 5.32 (dq, *J* = 10.5, 1.3, 1H, C*H*$_{cis}$H=CH), 4.66 (dt, *J* = 5.4, 1.5, 2H, $OCH_2$), 3.94 (s, 3H, $OCH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 190.6 (C=O), 150.4 (C–O), 149.6 (C–O), 145.0 (ArCH=CH), 138.5 (C–C=O), 132.7 ($CH_2$=CH), 132.6 (CH Ph), 128.6 (2×CH Ph), 128.4 (2×CH Ph), 128.0 (C–1), 122.9 (CH–6), 120.1 (ArCH=CH), 118.4 (*CH*$_2$=*CH*), 112.9 (CH–5), 110.5 (CH–2), 69.7 ($OCH_2$), 56.0 ($OCH_3$). **IR** ($\nu_{max}$): 611, 659, 693, 705, 711, 728, 740, 779, 788, 801, 850, 868, 915, 978, 999, 1019, 1037, 1139, 1169, 1176, 1197, 1212, 1225, 1237, 1256, 1446, 1511, 1576, 1589, 2832, 2858, 2912, 2935, 2958, 2992, 3065. **UV/Vis** (25 μM in MeOH): 262 (0.3055), 356 (0.4733). **HRMS** (ESI+): calcd. for $C_{19}H_{19}O_3$ [M+H]+295.1334, found 295.1329.

**(*Z*)-3-(4-(allyloxy)-3-methoxyphenyl)-1-phenylprop-2-en-1-one ((*Z*) 11 e)**. Following the general procedure D, **(*Z*) 8 j** (136 mg, 0.490 mmol), PhMgCl (2.0 M in THF, 0.75 mL, 1.47 mmol) in dry THF (5 mL) was reacted for 2 h at −30 °C. After workup and chromatography (PE/EtOAc 10:1) the desired compound was afforded as bright yellow oil (115 mg, 79%). **R$_f$** 0.82 (PE/EtOAc 6:4). **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 8.03–7.92 (m, 2H, 2×CH Ph), 7.57–7.47 (m, 1H, CH Ph), 7.47–7.35 (m, 2H, 2×CH Ph), 7.25 (d, *J* = 1.9, 1H, CH–2), 7.02 (dd, *J* = 8.4, 2.0, 1H, CH–6), 6.92 (d, *J* = 13.0, 1H, ArCH=CH), 6.76 (d, *J* = 8.3, 1H, CH–5), 6.55 (d, *J* = 12.9, 1H, ArCH=C*H*), 6.04 (ddt, *J* = 17.4, 10.6, 5.4, 1H, $CH_2$=CH), 5.37 (dq, *J* = 17.3, 1.6, 1H, C*H*$_{trans}$H=CH), 5.27 (dq, *J* = 10.5, 1.5, 1H, C*H*$_{cis}$H=CH), 4.59 (dt, *J* = 5.4, 1.5, 2H, $OCH_2$), 3.75 (s, 3H, $OCH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 194.4 (C=O), 148.9 (C–O), 148.7 (C–O), 140.1 (ArCH=CH), 137.7 (C–C=O), 133.0 (CH Ph), 132.9 ($CH_2$=CH), 128.8 (2×CH Ph), 128.5 (2×CH Ph), 128.3 (C–1), 124.1 (ArCH=CH), 123.9 (CH–6), 118.2 (*CH*$_2$=*CH*), 113.0 (CH–2), 112.4 (CH–5), 69.6 ($OCH_2$), 55.8 ($OCH_3$). **IR** ($\nu_{max}$): 617, 689, 699, 753, 806, 996, 1004, 1016, 1137, 1221, 1256, 1507, 2934, 3004, 3059. **UV/Vis** (25 μM in MeOH): 260 (0.3552), 356 (0.3369).

**(*E*)-3-(4-(allyloxy)-3-methoxyphenyl)-1-(5-bromothiophen-2-yl) prop-2-en-1-one (11 f)**. To a solution of 2-bromothiophene (400 μL, 4.13 mmol) in dry THF (18.5 mL) was added drop-wise *n*BuLi (1.6 M in hexane, 2.1 mL, 3.30 mmol) at −78 °C under Ar. After 1 h, part of the resulting solution (~0.16 M, 9.0 mL, 1.44 mmol) was transferred into an empty 2-neck flask placed at −78 °C under Ar. Then a solution of **(*E*) 8 j** (200 mg, 0.721 mmol) in dry THF (5 mL) was added drop-wise and the mixture was reacted for 3 h allowing the temperature to warm up. The mixture was poured into $NH_4Cl$ saturated aq. solution (15 mL) and extracted with EtOAc (3×15 mL). The organic layer was washed with brine and dried over $Na_2SO_4$. After filtration and evaporation of the solvent, the crude was purified by chromatography (PE/EtOAc 85:15) to give the desired product as yellow solid (163 mg, 60%). **R$_f$** 0.25 (PE/EtOAc 85:15). **m.p**. 103.5–104.3 °C. **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 7.78 (d, *J* = 15.4, 1H, ArCH=CH), 7.59 (d, *J* = 4.1, 1H, CH–3 thienyl), 7.19 (dd, *J* = 8.3, 1.7, 1H, CH–6), 7.17 (d, *J* = 15.5, 1H, ArCH=C*H*), 7.15–7.11 (m, 2H, CH-4 thienyl + CH–2), 6.89 (d, *J* = 8.3, 1H, CH–5), 6.08 (ddt, *J* = 17.2, 10.6, 5.4, 1H, $CH_2$=CH), 5.43 (dq, *J* = 17.3, 1.6, 1H, C*H*$_{trans}$H=CH), 5.32 (dq, *J* = 10.5, 1.3, 1H, C*H*$_{cis}$H=CH), 4.66 (dt, *J* = 5.4, 1.5, 2H, $OCH_2$), 3.94 (s, 3H, $OCH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 180.8 (C=O), 150.6 (C–O), 149.6 (C–O), 147.2 (C–C=O), 144.7 (ArCH=CH), 132.6 ($CH_2$=CH), 131.5 (CH–3 thienyl), 131.3 (CH-4 thienyl), 127.7 (C–1), 123.1 (CH–6), 122.4 (C–Br), 118.5 (*CH*$_2$=*CH*), 118.4 (ArCH=CH), 112.9 (CH–5), 110.7 (CH–2), 69.7 ($OCH_2$), 56.0 ($OCH_3$). **IR** ($\nu_{max}$): 620, 708, 718, 734, 737, 801, 812, 837, 849, 913, 925, 962, 980, 995, 1008, 1023, 1076, 1138, 1177, 1213, 1225, 1239, 1255, 1321, 1341, 1413, 1513, 1577, 1587, 1641, 2832, 2864, 2916, 2959, 2984, 3015, 3031, 3077, 3101, 3159. **UV/Vis** (25 μM in MeOH): 270 (0.2413), 318 (0.3797), 371 (0.6465). **HRMS** (ESI+): calcd. for $C_{17}H_{16}BrO_3S$ [M+H]+ 379.0004, found 379.0006.

**(*E*)-3-(4-(allyloxy)-3-methoxyphenyl)-1-(pyridin-2-yl)prop-2-en-1-one (11 g)**. To a solution of 2-bromopyridine (394 μL, 4.13 mmol) in dry THF (18.5 mL) was added drop-wise *n*BuLi (1.6 M in hexane, 2.1 mL, 3.30 mmol) at −78 °C under Ar. After 1 h, part of the resulting solution (~0.16 M, 7.0 mL, 1.12 mmol) was transferred into an empty 2-neck flask placed at −78 °C under Ar. Then a solution of **(*E*) 8 j** (103 mg, 0.371 mmol) in dry THF (3 mL) was added drop-wise and the mixture was reacted for 3 h allowing the temperature to warm up. The mixture was poured into $NH_4Cl$ saturated aq. solution (15 mL) and extracted with EtOAc (3×15 mL). The organic layer was washed with brine and dried over $Na_2SO_4$. After filtration and evaporation of the solvent, the crude was purified by chromatography (PE/EtOAc 8:2) to give the desired product as green solid (27 mg, 25%). **R$_f$** 0.52 (PE/EtOAc 75:25). **m.p**. 71.0–74.8 °C. **$^1$H NMR** (300 MHz, $CDCl_3$) δ = 8.75 (ddd, *J* = 4.8, 1.7, 0.9, 1H, CH–6 Py), 8.19 (dt, *J* = 7.9, 1.3, 0.9, 1H, CH–3 Py), 8.15 (d, *J* = 15.9, 1H, ArCH=C*H*), 7.90 (d, *J* = 16.0, 1H, ArCH=CH), 7.88 (td, *J* = 7.7, 1.7, 1H, CH-4 Py), 7.49 (ddd, *J* = 7.6, 4.7, 1.3, 1H, CH–5 Py), 7.30–7.24 (m, 2H, CH–2 + CH–6), 6.90 (d, *J* = 8.8, 1H, CH–5), 6.09 (ddt, *J* = 17.2, 10.7, 5.4, 1H, $CH_2$=CH), 5.43 (dq, *J* = 17.3, 1.5, 1H, C*H*$_{trans}$H=CH), 5.32 (dq, *J* = 10.5, 1.3, 1H, C*H*$_{cis}$H=CH), 4.67 (dt, *J* = 5.4, 1.5, 2H, $OCH_2$), 3.97 (s, 3H, $OCH_3$). **$^{13}$C NMR** (75 MHz, $CDCl_3$) δ = 189.3 (C=O), 154.4(*C*–C=O), 150.5 (C–O), 149.5 (C–O), 148.7 (CH–6 Py), 145.1 (ArCH=CH), 137.0 (CH-4 Py), 132.7 ($CH_2$=CH), 128.3 (C–1), 126.8 (CH–5 Py), 123.7 (CH–6), 122.9 (CH–3 Py), 118.6 (ArCH=CH), 118.4 (*CH*$_2$=*CH*), 112.7 (CH–5), 110.5 (CH–2), 69.7 ($OCH_2$), 56.0 ($OCH_3$). **IR** ($\nu_{max}$): 601, 616, 679, 687, 743, 789, 811, 838, 924, 941, 993, 1013, 1024, 1035, 1050, 1095, 1141, 1155, 1209, 1237, 1250, 1257, 1265, 1323, 1418, 1510, 1571, 1591, 1661, 2831, 2883, 2962, 2984, 2998, 3010, 3052, 3078, 3310. **UV/Vis** (25 μM in MeOH): 254 (0.1937), 267 (0.2221), 364 (0.4201). **HRMS** (ESI+): calcd. for $C_{18}H_{18}NO_3$ [M+H]+296.1287, found 296.1282.

**Photoisomerization studies**. 70 mM solutions of the synthesized compounds in $CD_3OD$ were exposed to different light sources (300 nm, 350 nm) and $^1$H NMR spectra were registered over time until the photostationary state was reached (15 min, 30 min, 60 min, 90 min, and 120 min). The (*E*)/(*Z*) ratio was determined by integration.

**Determination of the quantum yield**. Solutions of **(*E*) 8 c**, **(*E*) 8 h**, **(*E*) 11 a**, and **(*Z*) 11 a** in $CDCl_3$ were precisely prepared (ca. 70 mM, [$P_0$]) and exposed for 60 s and 120 s at 350 nm. The (*E*)/(*Z*) ratio was determined by integration and these values were used to determine the concentration of the stating isomer after the given amount of time [$P_t$]. Using the following equation the quantum yield (Φ) was calculated as average of the values determined after 60 s and 120 s of irradiation.

$$\phi = ([P_0] - [P_t])\frac{V}{q_{(n,p)} \cdot t}$$

Where [$P_0$] and [$P_t$] are the molar concentrations of the starting isomer at 0 s and at time t, V is the volume of the irradiated

solution (L), $q_{(n,p)}$ is the photon flux (mol/s) and t is the irradiation time (s). The photon flux was determined using a chemical actinometer (see S.I.).[33] The high concentration employed ensures a complete absorption of the incident photon by the sample at 350 nm ($A > 2$) and therefore $q_{(n,p)} \approx q_{(n,p)absorbed}$.

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## Conflict of Interest

The authors declare no conflict of interest.

**Keywords:** Amides · Biomass · Isomerization · Natural products · Photochemistry

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