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Fragmentation of Trifluoromethylated Alkenes and Acetylenes by *N*,*N*-Binucleophiles. Synthesis of Imidazolines or Imidazolidines (Oxazolidines) Controlled by Substituent

Valentine G. Nenajdenko,*[,†] Vasiliy M. Muzalevskiy,[†] Aleksey V. Shastin,*[,‡] Elizabeth S. Balenkova,[†] Evgeniy V. Kondrashov,[§] Igor A. Ushakov,[§] and Alexander Yu. Rulev*[,§]

[†]*Department of Chemistry, Moscow State University, Leninskie Gory, Moscow 119992, Russia,* [‡]*Institute of Problems of Chemical Physics, Chernogolovka, Moscow Region 142432, Russia, and* [§]*A. E. Favorsky Institute of Chemistry, Siberian Branch of the Russian Academy of Sciences, Favorsky Str., Irkutsk 664033, Russia*

nen@acylium.chem.msu.ru; shastin@icp.ac.ru; rulev@irioch.irk.ru

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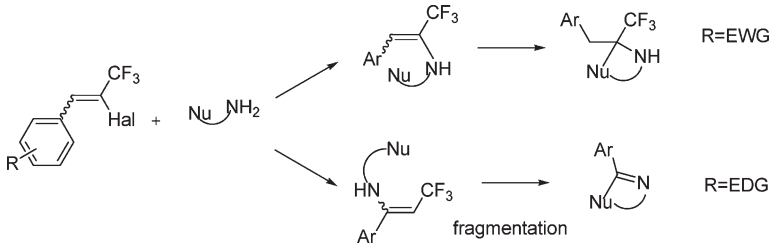

The reaction of β-halogeno-β-polyfluoromethylstyrenes with N,N- or N,O-binucleophiles leads to unexpected fragmentation products (imidazolines) or to heterocyclization giving CF_3-substituted imidazolidines (*N*,*N*-) and oxazolidines (*N*,*O*-) depending on aryl substituent. The scope and the reaction mechanism are discussed.

Introduction

Although trifluoromethyl substituted heterocycles are target compounds for chemical, medicinal, and agricultural research, their synthesis is not always trivial.[1,2] Therefore, development of new efficient methodologies for the preparation of fluorinated heterocycles is strongly required and continues to provide challenges for modern organic chemistry. One of the most attractive methods for the construction of these heterocyclic compounds is based on the use of easily available fluorine-containing building blocks. This approach minimizes quantities of the reagents, reaction times, and the ultimate cost of the products. Because of their polyfunctionality, trifluoromethylated halogenoalkenes could be very valuable starting materials for the preparation of complex fluorinated targets. We have recently studied the unusual reaction of CF_3-styrenes **1** with secondary[3] and primary amines[4] leading to either the expected aminoalkenes or vinylogous guanidinium salts depending on the nature of aromatic substituent. Encouraged by these results and accumulated knowledge of the chemistry of captodative trifluoromethylated halo- and aminoalkenes,[5] we recognized the signitificant synthetic potential of the styrenes **1** as useful precursors for trifluoromethylated heterocycles via reaction with binucleophiles. Trifluoromethylated and CF_2Cl-substituted alkenes[6] are easily available using the new catalytic olefination reaction, a novel general method

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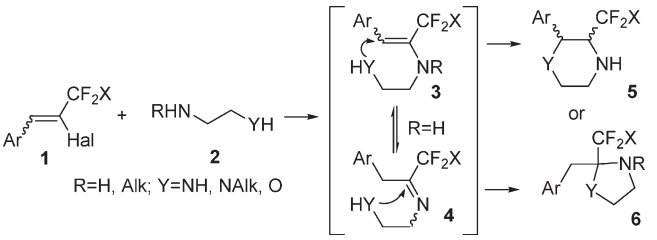
SCHEME 1. Proposed Pathway to Fluorinated Piperazines 5 and/or Imidazolidines 6 via Reactions of CF_2X-Substituted Styrenes (1) with Binucleophiles

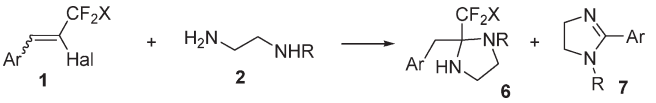


for olefination of carbonyl compounds developed by our group.[7] We expected the possibility of formation of such relatively rare CF_2X-substituted heterocycles as piperazines[8] **5** or imidazolidines[9] **6**, known to exhibit highly specific activity against *Trypanosome rhodesiense*. We expected this reaction to lead to target five- or six-membered heterocycles through nucleophilic halogen substitution followed by an intramolecular cyclization via attack by the secondary nucleophilic center at the double bond (Scheme 1). Earlier, captodative carbonyl-bearing halo- or aminoalkenes have been successfully transformed into oxazoline, morpholine, or piperazine derivatives by a one-pot procedure.[10]

Results and Discussion

To our surprise, the model reaction of bromide **1a** with ethylenediamine gave compound **7a** as a major product, which was a result of cleavage of the C−C double bond (Scheme 2). It should be noted that the oxidation state of the arylmethyne carbon atom is increased in the course of the reaction because the product **7a** is a derivative of benzoic acid. Formally an oxidative cleavage of double bond in nucleophilic conditions takes place. It is remarkable that the transformation occurs under solvent-free conditions at

SCHEME 2. Reactions of β-Halogeno-β-trifluoromethyl- and β-(Chlorodifluoromethyl)styrenes 1 with Ethylenediamines 2



room temperature. Imidazolidine **6a** is formed only as a minor product, and formation of piperazine derivative **5** is not observed at all. As a rule the known oxidations of the double bonds are carried out in the more harsh conditions, in acidic media with strong oxidants such as $KMnO_4$ or $K_2Cr_2O_7$.[11]

To study the scope and the mechanism of this unusual reaction, we investigated the influence of substrate structure (variations of substituents in aromatic ring, the nature of the halogen at the double bond (F, Cl, Br) and in the $CHal_3$ moiety, correspondingly CF_3 and CF_2Cl derivatives) and binucleophile structure to the reaction path. The possibility to control the reaction by solvent and temperature were studied as well.

We found that cleavage of the double bond is the major reaction path for the styrenes **1** bearing electron-donating substituents on the aromatic ring. The treatment of compounds **1a**−**j** with ethylenediamine gave a mixture of non-fluorinated imidazolines **7a**−**f** and fluorinated imidazolidines **6a**−**g**. The high total yield of these heterocycles let us to conclude that no other types of transformations of initial styrenes occur. Compounds **7a**−**f** (Table 1) are formed preferentially in most cases. Moreover styrenes **1k,l** gave imidazolines **7g,h** as the only products.

Solvent and temperature effects were studied to optimize the reaction conditions. The reaction of a model styrene **1a** proceeded smoothly at room temperature in solvent-free conditions, but rather prolonged reaction time (about 1 day) was required (entry 1). In refluxing THF, ethanol or toluene the complete conversion of the substrate **1a** occurred in 6−7 h to increase the total yield of the products up to 96%. Although the content of **6a** in product mixture declined 2-fold, one cannot say that the solvent has a principal influence on the reaction.

The reaction is quite general. For example, treatment of styrenes **1h,k** with *N*-methyl ethylenediamine led analogously to *N*-methyl imidazolines **7i,j**. Similar behavior was also observed for alkenes activated with a CF_2Cl group. No significant difference was observed in the case of CF_2Cl-substituted alkene **1b**, which gave **6b** and **7a** in almost the same ratio compared to its trifluoromethylated analogue **1a**.

Next, we studied the influence of the olefinic halogen atom (F, Cl, Br) on the reaction path. It is known that the S_NV reaction (nucleophilic vinylic substitution) may proceed by a variety of mechanisms depending on the substrate structure, nucleophile, leaving group, and solvent. The most common one is the two-step addition−elimination or elimination−addition sequence. However, other variants including radicals and cation species are also known.[12]

It was shown that alkenes **1** bearing F, Cl, Br substituents in α-position to a CF_3 group gave the same products in all cases independently of halogen nature.[3,4,13] The **6a**/**7a** ratio

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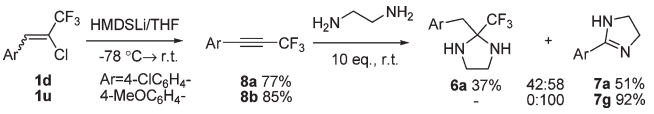
TABLE 1. Synthesis of Imidazolidines 6 and Imidazolines 7

							yield, % [b]		
entry	**1**	Ar	Hal	CF_2X	R	conditions/time	**6**	**7**	ratio **6**:**7**
1	**a**	4-ClC_6H_4	Br	CF_3	H	A[a]/1 d	**6a** (26)	**7a** (41)	39:61
2	**a**	4-ClC_6H_4	Br	CF_3	H	THF, reflux, 7 h	**6a** (20)	**7a** (75)	21:79
3	**a**	4-ClC_6H_4	Br	CF_3	H	EtOH, 78 °C, 7 h	**6a** (16)	**7a** (80)	17:83
4	**a**	4-ClC_6H_4	Br	CF_3	H	toluene, 110 °C, 7 h	**6a** (14)	**7a** (78)	15:85
5	**b**	4-ClC_6H_4	F	CF_2Cl	H	A/1 d	**6b** (26)	**7a** (61)	30:70
6	**c**	4-ClC_6H_4	F	CF_3	H	dioxane, 100 °C, 7 h	**6a** (51)	**7a** (40)	56:44
7	**d**	4-ClC_6H_4	Cl	CF_3	H	neat, 80 °C, 6 h	**6a** (30)	**7a** (39)	43:57
8	**e**	Ph	Cl	CF_3	H	A/3 d	**6c** (19)	**7b** (58)	25:75
9	**f**	Ph	Br	CF_3	H	A/1 d	**6c** (15)	**7b** (55)	21:79
10	**g**	4-FC_6H_4	Br	CF_3	H	A/1d	**6d** (10)	**7c** (55)	15:85
11	**h**	4-MeC_6H_4	Br	CF_3	H	A/4d	**6e** (12)	**7d** (56)	18:82
12	**i**	3-$MeOC_6H_4$	Br	CF_3	H	A/4d	**6f** (20)	**7e** (64)	24:76
13	**j**	2-$MeOC_6H_4$	Br	CF_3	H	A/4d	**6g** (20)	**7f** (45)	31:69
14	**k**	4-$MeOC_6H_4$	Br	CF_3	H	A/2d		**7g** (61)	0:100
15	**l**	3,4-$(MeO)_2C_6H_3$	Br	CF_3	H	A/5d		**7h** (54)	0:100
16	**h**	4-MeC_6H_4	Br	CF_3	Me	A/3d		**7i** (65)	0:100
17	**k**	4-$MeOC_6H_4$	Br	CF_3	Me	A/1d		**7j** (58)	0:100

[a]A = neat, rt. [b]Isolated yield.

SCHEME 3. Reactions of CF_3-Substituted Acetylenes 8a and 8b with Ethylenediamine



for chloro-(**1d**) and bromoalkenes (**1a**) was found to be quite similar (43:57 and 39:61, correspondingly). In contrast, in the case of vinylfluoride **1c** the product **6a** was formed predominantly and the **6a**/**7a** ratio switched to 56:44. Therefore, halogen substitution is not a crucial step for chlorides and bromides, and reactions occur through the same intermediate. We assumed that an elimination−addition sequence takes place in both cases to form acetylene as the first intermediate. Fluoride is a relatively poor leaving group, and therefore addition−elimination may also make noticeable contribution to the transformation.

To confirm this hypothesis CF_3-substituted acetylenes **8a** and **8b** were prepared from the corresponding chloroalkenes by treatment with lithium hexamethyldisylazide and then used as substrates in the reaction with ethylenediamine (Scheme 3).

To our delight the reactions of CF_3-substituted acetylenes **8a** and **8b** with ethylenediamine provided compounds **6a**, **7a**, and **7g** with the same **6**/**7** ratio but in higher yields compared to the corresponding parent alkenes. Additionally, the formation of acetylenes was confirmed by mass-spectral monitoring of reaction of **1a** with ethylenediamine in methanol. The reaction mixture (after 2 h at rt) contained 54% of starting material **1a**, 16% of the corresponding acetylene **8a**, 7% of **6a**, and 23% of **7a**. (Relative values were obtained by integration of corresponding chromatographic peaks. The values were calculated to give a sum equial 100%.) These observations confirmed beyond doubt that reaction may proceed through the formation of acetylenes. Taking into account this data, we proposed a plausible mechanism for the reaction (Scheme 4). Two alternative transformations can be postulated as an initial step of the cascade process. The first one is dehydrohalogenation to form acetylene **8** (proceeds preferentially for chlorides and bromides), and another one is an addition of ethylenediamine to the double bond (for fluorides).

Probably these directions are two competitive pathways of the reaction depending on conditions and reagents. Regioselectivity of acetylene hydroamination has a decisive role on further transformations in both cases. When ethylenediamine attacks β-position of styrene, enamine **3** is formed followed by tautomerization into imine **4** and cyclization into final imidazolidine **6**. Much deeper and more complex transformations are observed when ethylenediamine attacks α-position of styrene and/or acetylene **8**. In this case enamine nitrogen activates fluorine (anchimeric like assistance) and promotes an elimination of hydrogen fluoride from **10** giving difluoroalkene **11**. Probably the formation of a quite stable HF molecule (enthalpy of formation −65 kcal/mol) is strong compensation for the total energy consumption of double or triple bond breaking. Addition of ethylenediamine to the strongly activated double bond of difluoroalkene **11** gives difluoride **12**, which eliminates easily hydrogen fluoride forming the highly conjugated system of intermediate 1-aza-1,3-diene **13**. Intramolecular addition of an amino group followed by the extrusion of the last hydrogen fluoride molecule results in formation of nonfluorinated imine **14**. Compound **14** is cyclized to **15**, which is the key intermediate of the whole transformation. The finalizing step proceeds through the six-membered ring transition state accompanyied by the breaking of C−C bond. As a result imidazolines **7** and **17** are formed. Since two molecules are formed from a single molecule of **15**, the total entropy of the system rises. The increasing of

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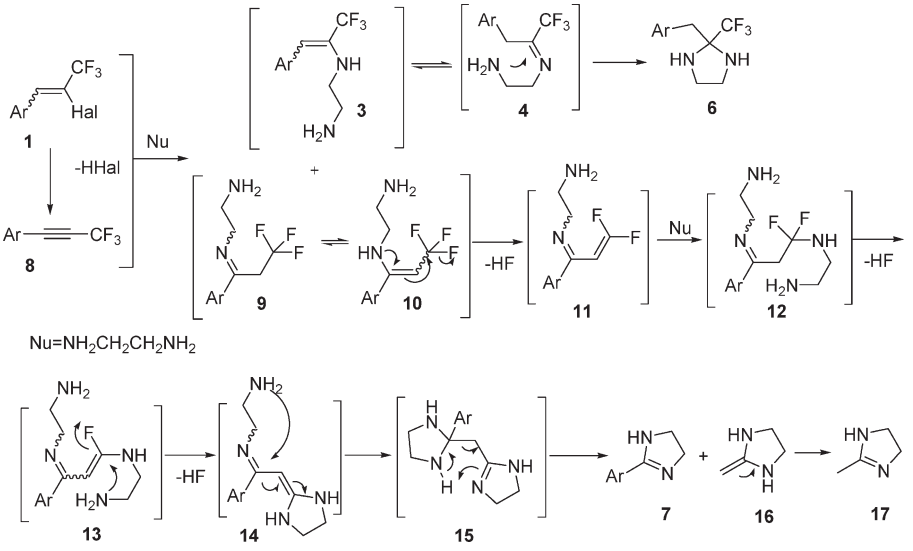
SCHEME 4. Plausible Mechanism for the Reaction of Styrenes 1 with Ethylenediamine



the reaction entropy might be an additional compensation for such rare (unusual) bond cleavage. We undertake some efforts to trap the second reaction component **17**. The NMR spectra of several crude reaction mixtures were measured. Analyzing carefully reaction mixtures formed by alkenes **1a**, **1k**, and ethylenediamine, we observed the identical sets of the signals, which are the same as those known from the literature for methyl imidazoline **17**. The quantity of **17** found in both reaction mixtures is equal to the corresponding amount of imidazolines **7a** and **7g**, which is in agreement with proposed mechanism.

Real time monitoring of the reaction of **1k** with *N*-methylethylenediamine was carried out by measuring both ^{1}H and ^{19}F spectra every 30 min during 24 h. This data set allowed observation of the signals of postulated acetylene **8b**, mixtures of *Z*/*E*-enamines **10a**, and imines **9a**. The content of these compounds rose for some time accompanied by simultaneous shrinking of initial styrene share in the reaction mixture. In the next 24 h all fluorine signals disappeared with the exception of the fluoride anion signal. The major product did not contain fluorine and was assigned as intermediate **14a** by the set of $^{1}H-^{13}C$ HMBC and $^{1}H-^{13}C$ HSQC experiments. After 3 days of standing at room temperature, compound **14a** also disappeared. Therefore almost all steps of the proposed reaction mechanism are perfectly confirmed by spectral data.

Deeper analysis of the fragmentation reflects some similarities with retro-Claisen reaction. Indeed, both fragmentation products **7** and **17** are the carboxylic acids derivatives as well as intermediates **14**, **15** can be considered as ketoester derivatives **18**. In addition the trifluoromethylated alkenes **1**, acetylenes **8** and ketoesters have the same oxidation level. In literature there are rare examples of similar destruction of ketoesters. For example, the reaction of ketoesters with phenylenediamines gives substituted benzimidazoles.[14] However,

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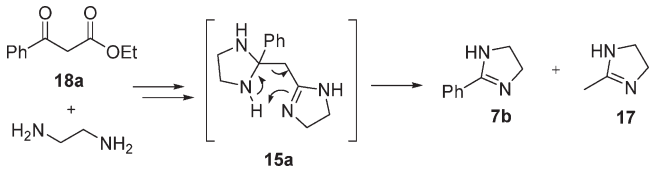
SCHEME 5. Reaction of Ketoester 18a with Ethylenediamine



the mechanism of these transformations has never been studied. We decided to confirm our proposal experimentally to have additional mechanistic data. In our hands, reaction of ethyl benzoylacetate with ethylenediamine led to formation of the same fragmentation products **7b** and **17**, observed by mass and NMR spectra (scheme 5). So, reactions of ketoesters and styrenes with ethylenediamines lead to the same type of products and apparently have similar key intermediates. This is an additional reason to regard intermediate **15** as key intermediate of styrene cleavage, because it has the same oxidation level as ketoesters.

In contrast to styrenes **1a**−**l**, their analogues **1m**−**t** bearing an electron-withdrawing group at the benzene ring afforded exclusively the target trifluoromethylated heterocycles **6** and the fragmentation was not observed (Scheme 6, Table 2). In the same way styrenes **1m,n** having *o*-bromine gave only imidazolidines **6** without an admixture of fragmentation products **7**. Such results can be easily rationalized by the influence of electron and (or) sterical properties of substituent in aryl ring. The strong negative mesomeric effect of the nitro group as well as the bulkiness of the *o*-bromine direct the ethylenediamine to attack the β-position of styrene. As a result the reaction proceeds regioselectively resulting in formation of imidazolidines **6** as the only reaction products. According to our previous results such styrenes are more active in reactions with both secondary and primary amines.[3,4] As a rule the reaction of 2- or 4-nitrostyrenes **1** with ethylenediamine proceeds smoothly at room temperature to give the target derivatives in good to excellent yield. 3-Nitrostyrene **1q** was found also to be rather reactive (Table 2, entry 5). Other binucleophiles (both N,N- and N,O-types) gave similar imidazolidines (oxazolidines in the case of aminoalcohols); however,

SCHEME 6. Reactions of Binucleophiles 2 with Styrenes 1 Bearing an Electron-Withdrawing Group in the Aromatic Ring

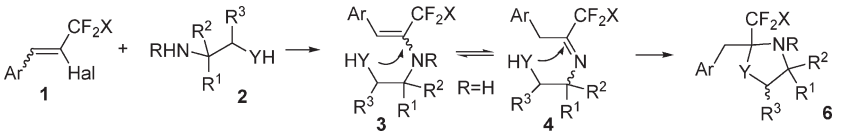


TABLE 2. Synthesis of Fluorinated Imidazolidines and Oxazolidines 6

entry		Ar	halogen	CF_2X	conditions	yield, %[a]
		Binucleophile = ethylenediamine $R^1 = R^2 = R^3 = R = H$; Y = NH				
1	**m**	2-BrC_6H_4	F	CF_2Cl	A/2 d	**6h** (63)
2	**n**	2-BrC_6H_4	Br	CF_3	A/1 h	**6i** (82)
3	**o**	4-$NO_2C_6H_4$	F	CF_3	A/1 d	**6j** (89)
4	**p**	4-$NO_2C_6H_4$	Cl	CF_3	A/1 d	**6j** (55)
5	**q**	3-$NO_2C_6H_4$	Cl	CF_3	A/1 d	**6k** (55)
6	**r**	2-$NO_2C_6H_4$	F	CF_2Cl	A/1 d	**6l** (69)
7	**s**	2-$NO_2C_6H_4$	Cl	CF_3	A/1 d	**6m** (97)
		Binucleophile = *N*-methylethylenediamine $R^1 = R^2 = R^3 = H$; R = H; Y = NMe				
8	**p**	4-$NO_2C_6H_4$	Cl	CF_3	A/1 d	**6n** (91)
9	**q**	3-$NO_2C_6H_4$	Cl	CF_3	A/4 h	**3a** (52)[b] **6o** (35)
10	**t**	2-$NO_2C_6H_4$	Br	CF_3	A/4 h	**6p** (92)
		Binucleophile = *N*,*N*′-dimethylethylenediamine $R^1 = R^2 = R^3 = H$; R = Me; Y = NMe				
11	**p**	4-$NO_2C_6H_4$	Cl	CF_3	A/1 d	**6q** (89)
12	**q**	3-$NO_2C_6H_4$	Cl	CF_3	THF, reflux, 7 h	**3b** (32)[c]
13	**t**	2-$NO_2C_6H_4$	Br	CF_3	A/6 d	**6r** (76)
		Binucleophile = 1,2-diaminocyclohexane $R^1 = R = H$; $R^2 = R^3 =$ -$(CH_2)_4$-; Y = NH				
14	**s**	2-$NO_2C_6H_4$	Cl	CF_3	A/1 d	**6s** (82)
		Binucleophile = ethanolamine $R^1 = R^2 = R^3 = R = H$; Y = O				
15	p	4-$NO_2C_6H_4$	Cl	CF_3	dioxane, reflux, 7 h	**6t** (53)
16	**s**	2-$NO_2C_6H_4$	Cl	CF_3	THF, reflux, 7 h	**3c** + **4a** (66)[d] **6u** (60)
		Binucleophile = 2-aminobutanol $R^2 = R^3 = R = H$; R^1 = Et; Y = O				
17	**p**	4-$NO_2C_6H_4$-	Cl	CF_3	neat, 80 °C, 6 h	**6v** (88)
		Binucleophile = 2-amino-2-methylpropanol $R^3 = R = H$; $R^1 = R^2$ = Me; Y = O				
18	**s**	2-$NO_2C_6H_4$-	Cl	CF_3	neat, reflux, 2 h	**6w** (64)[e]

[a]Isolated yield. [b]The enamine **3a** was cyclized into imidazolidine **6o** during purification by column chromatography on silica gel. [c]Initial styrene **1q** (25%) was recovered after column chromatography. [d]Initial styrene **1s** (10%) was recovered after column chromatography. The mixture (~1:1) of **3c** and **4a** has been transformed almost completely into the heterocycle **6u** after reflux in dioxane for 19 h (yield 60% (starting from initial styrene) after column chromatography). [e]In the presence of Et_3N (1 equiv).

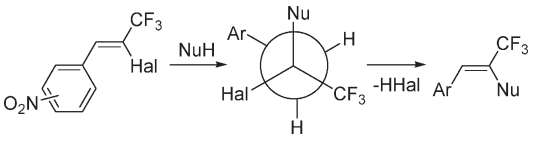
more prolonged reaction time and/or more severe experimental conditions were required.

We succeeded in confirming also the intermediate formation of enamines in the reaction. Sometimes the cyclization step for substituted diamines or aminoalcohols was rather slow and only acyclic derivatives **3** were obtained (entries 9, 12, 16). In fact, when styrene **1q** was treated with *N*-methylethylenediamine, only enamine **3a** was obtained in good yield (Table 2, entry 9). The reaction of the same styrene **1q** with symmetric *N*,*N*′-dimethylethylenediamine proceeds slowly, leading to the acyclic derivative **3b** as a major product in moderate yield even after a long refluxing in THF (Table 2, entry 12). The enamines **3a,b** were quite stable: no changes occurred when they were kept at ambient temperature even for 2 weeks in $CDCl_3$ solution or in the pure state. Surprisingly, in the attempt to purify by column chromatography on silica gel, enamine **3a** undergoes a transformation into its cyclic isomer **6o**. Consequently, both cyclic and acyclic derivatives can be isolated in pure state depending on the experimental conditions.

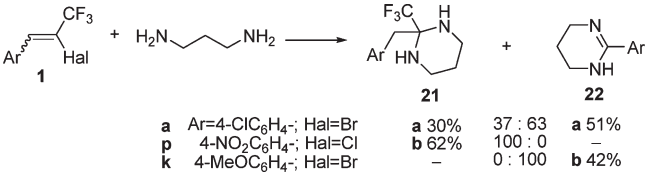
It should be noted that enamine **3c** is formed in the mixture with their imino-tautomer **4a**. Thus, in the ^1H and ^{13}C spectra the signals of the enamine moiety of compound **3c** (singlet of the olefinic proton and the signals of double bond carbon atoms, correspondingly) are accompanied by the characteristic signals of its isomer **4a** (singlet of methylene group and the quadruplet of the azomethine carbon atom). The simple heating of the mixture of enamine **3c** and its tautomer **4a** in dioxane for 19 h has afforded oxazolidine **6u** in high yield. The stereochemistry of enamine derivatives was determined unambiguously by 2D NMR spectroscopy and deserves some comments related to the mechanism of the reaction of alkenes bearing an EWG. Taking into account the same *Z*/*E* ratio of the initial substrate **1q** and enamine **3a** (*Z*/*E* = 4:1), we concluded that the substitution of the halostyrenes proceeds stereoselectively with the retention of configuration. These results are in a good agreement with the postulated addition−elimination sequence of transformations that involves intermediate formation of the adduct where most steric interactions are minimized (Scheme 7).

Next, we checked the influence of the distance between two nucleophilic centers of the binucleophile on the reaction direction. We studied a reaction of the model substrate **1a** with 1,3-propylenediamine, which is a 1,3-binucleophile (Scheme 8). We observed again the generality of the reaction; the cleavage of the double bond was observed leading to the

SCHEME 7. Stereochemistry of Reaction of Binucleophiles with Styrenes 1 Bearing an Electron-Withdrawing Group



SCHEME 8. Reactions of β-Halogeno-β-trifluoromethylstyrenes 1 with 1,3-Diaminopropane

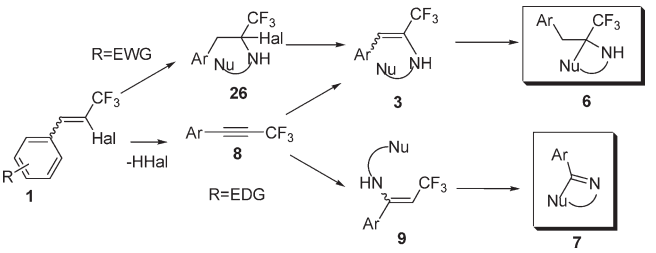


formation of amidine derivative **22a** and competitive formation of **21a**.

Electron-poor nitrostyrene **1p** gave exclusively trifluoromethylated compound **21b**, whereas electron-rich methoxystyrene **1k** provided only the fragmentation product **22b**. It should be noted that the fragmentation/nonfragmentation product ratio is very similar to that observed for ethylenediamine. This fact points out additionally the decisive role of styrene electron nature on the reaction direction. Electron-donating substituents in the aryl ring direct the initial attack of the nucleophile to the α-position of styrene, leading to unstable enamine **23**. The latter one undergoes a cascade of transformations giving intermediate **24**, which forms fragmentation products **22** and **25**. Heterocycle **25** was observed in both mass and NMR spectra, although we could not isolate it in pure form. Formation of compound **25** is an additional proof of the proposed fragmentation mechanism (Scheme 9).

Summarizing the obtained results, we can conclude that the direction of reaction of binucleophiles with β-halogeno-β-trifluoromethylstyrenes is controlled strongly by substituents on the aromatic ring. We can speculate that the reaction occurs in two different pathways (Scheme 10) depending on the nature of substituents. In the case of an EWG such as a nitro group or a bulky substituent as *o*-bromine, the mechanism includes the formation of captodative enamine **3** via initial attack of the binucleophile on the β-olefin carbon atom of styrene **1** followed by base-mediated elimination of HHal. The isolation of the intermediate **3** in some cases (Table 2, entries 9, 12, 16) as a precursor of heterocycles **6** supports strongly this hypothesis. To the best of our knowledge, the successful synthesis of heterocycles **6** is the first example of double nucleophilic addition to the same carbon atom of the double bond adjacent to a strong electron-withdrawing group of captodative system. In the case of electron-donating groups the intermediate formation of acetylene **8** is possible. The fragmentation and formation of imidazolines **7** are observed if the binucleophile attacks the α-position (neighboring to the aryl ring) of styrene or acetylene. Otherwise the reaction products are imidazolidines **6**.

SCHEME 10. Reaction Pathways Depending on Substituent in β-Halogeno-β-trifluoromethylstyrenes



Conclusion

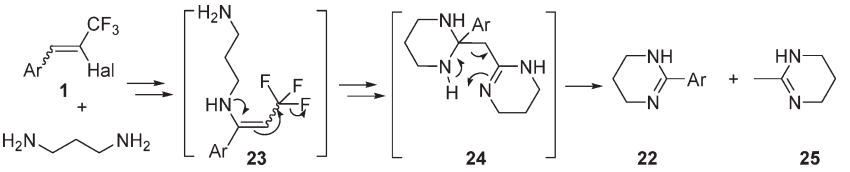
In summary, the reaction direction of β-halogeno-β-trifluoromethyl styrenes with *N*,*N*- and *N*,*O*-binucleophiles is controlled by electron and sterical factors. Alkenes bearing an EWG at the aromatic ring give trifluoromethylated imidazolidines in good to high yields. The unprecedented fragmentation of styrenes having an EDG is observed. The possible reaction mechanism is discussed.

Experimental Section

General Remarks. ^{1}H, ^{13}C, ^{15}N, and ^{19}F NMR spectra were recorded on 400 MHz spectrometers in $CDCl_3$ or DMSO-d_6. Chemical shifts (δ) in ppm are reported using TMS or residual signals of chloroform (7.25 for ^{1}H and 77.20 for ^{13}C) or DMSO (2.50 for ^{1}H and 39.50 for ^{13}C) as internal references. The coupling constants (*J*) are given in hertz (Hz). The concerted application of $^{1}H-^{1}H$ 2D COSY and NOESY homonuclear experiments as well as $^{1}H-^{13}C$ 2D HSQC and HMBC heteronuclear experiments was used for the distinction of the carbon and proton resonances in cases of **3a−c**, **4a**, and **6n−r,t,u,w**. The silica gel used for flash chromatography was 230−400 mesh. All reagents were of reagent grade and were either used as such or distilled prior to use. All solvents were dried by standard procedures and freshly distilled prior to use. The β-bromo-,[6e] β-chloro-,[6b] and β-fluoro-β-(tri-[13d] or difluoromethyl[6b])styrenes **1a−u** were prepared as reported previously. NMR spectra of compounds **7a,b,d,g**,[15] **7c**,[16] **7f**,[17] **7h**,[18] **8a,b**,[19] **17**,[20] **22b**,[21] and **25**[22] are in agreement with published data.

General Procedure for Synthesis of Acetylenes 8. A preheated 100-mL three-necked round-bottomed flask was charged with dry THF (30 mL) and hexamethyldisilazane (6.86 mL, 33 mmol) and cooled down to −50 °C in argon flow. *n*-BuLi (13.2 mL of 2.5 M solution in hexane, 33 mmol) was slowly added, maintaining the temperature below −30 °C. The reaction mixture was kept 20 min at this temperature and cooled down to −90 °C. Next, corresponding styrene **1** (30 mmol, solution in 10 mL of dry THF) was added at a temperature below −70 °C. The reaction mixture obtained was allowed to warm slowly to room

SCHEME 9. Possible Mechanism for the Reaction of Styrenes 1 with 1,3-Diaminopropane



temperature and broken down by a saturated solution of NH_4Cl. The organic phase was separated, and the water phase was extracted with ether (3 × 20 mL). The combined extracts were washed with water (2 × 50 mL) and dried over Na_2SO_4. Volatiles were removed in vacuo, and the residue was filtered through a short silica gel pad using hexane.

General Procedure for Reactions of β-Halogeno-β-(tri- or difluoromethyl)styrenes 1 and Acetylenes 8 with Binucleophiles 2. The appropriate compound (styrene **1** or acetylene **8**, 1−1.5 mmol) and the binucleophile **2** (5−15 mmol), either in the solvent (2−3 mL) given or without solvent, were maintained at room temperature or reflux or were heated in a sealed glass tube with a Young tap (for conditions used in each particular case see Tables 1 and 2). Excessive amine and the solvent were evaporated off at reduced pressure, and the residue was purified by column chromatography on silica gel using the appropriate eluent [the following mixtures were used: CH_2Cl_2/pentane (2:1), Et_2O/hexane (1:2), $CHCl_3$, CH_2Cl_2/MeOH (30:1), $CHCl_3$/MeOH (9:1), CH_2Cl_2/MeOH/NEt_3 (80:15:5)]. In the NMR spectra of some mixtures of the (*Z*,*E*)-enamines **3** and the azomethines **4** only the most characteristic signals are given for minor components.

***N*-Methyl-*N*′-[2-(3-nitrophenyl)-1-(trifluoromethyl)ethenyl]-ethane-1,2-diamine (3a) (mixture (3.7:1) of *Z*,*E*-isomers).** Yield 52%; yellow oil; ATR/FT-IR ν = 1349, 1526 (NO_2), 1631 (C=C), 3378 (NH) cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.15 (br.s., 2H, NH), 2.73 (s, 3 H, CH_3), 2.82 (t, J = 2.0 Hz, 6.2 H, CH_2), 2.94 (t, J = 6.2 Hz, 2 H, CH_2), 6.43 (s, 1 H, CH=), 7.50 (m, 1 H, 5-H), 7.70 (m, 1 H, 6-H), 8.08 (m, 1 H, 4-H), 8.42 (s, 1 H, 2-H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 40.1 ($NHCH_3$), 40.7 (CH_2), 57.8 (CH_2), 116.4 (q, J = 4.8 Hz, CH=), 122.5 (C-4), 122.8 (q, J = 280.8 Hz, CF_3), 123.9 (C-2), 129.3 (C-5), 135.2 (C-6), 136.4 (C-1), 139.4 (q, J = 28.4 Hz, =*C*-CF_3), 148.5 (C-3). Anal. Calcd for $C_{12}H_{14}F_3N_3O_2$: C 49.83; H 4.88; N 14.53. Found: C 49.52; H 4.69; N 14.11.

(*Z*)-*N*,*N*′-Dimethyl-*N*-[2-(3-nitrophenyl)-1-(trifluoromethyl)-ethenyl]ethane-1,2-diamine (3b). Yield 32%); brown oil; ATR/FT-IR ν = 1349, 1527 (NO_2), 1630 (C=C), 3335 (NH) cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 1.70 (br.s., 1H, NH), 2.35 (s, 3 H, CH_3), 2.69 (m, 5 H, CH_3, NHCH_2), 3.00 (t, J = 6.2 Hz, 2 H, N(Me)CH_2), 6.40 (s, 1 H, CH=), 7.47 (m, 1 H, 5-H), 7.68 (m, 1 H, 6-H), 8.05 (m, 1 H, 4-H), 8.40 (s, 1 H, 2-H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 36.3 (NH*C*H_3), 40.9 (NCH_3), 49.6 (NH*C*H_2), 53.9 (NCH_2), 115.9 (q, J = 4.8 Hz, CH=), 122.4 (C-4), 122.7 (q, J = 280.8 Hz, CF_3), 123.8 (C-2), 129.2 (C-5), 135.2 (C-6), 136.3 (C-1), 139.1 (q, J = 28.4 Hz, =*C*-CF_3), 148.4 (C-3); ^{19}F NMR (282 MHz, DMSO-d_6) δ −63.7; ^{15}N NMR (40.6 MHz, $CDCl_3$) δ −11.6 (NO_2), −345.3 (NCH_3), −360.7 ($NHCH_3$). Anal. Calcd for $C_{13}H_{16}F_3N_3O_2$: C 51.48; H 5.32; N 13.86. Found: 51.07; H 5.25; N 13.52.

Mixture (1.2:1) of (*E*,*Z*)-Azometine (3c) and (*E*,*Z*)-Enamine (4a). Yellow oil; yield (66%).

2-{[2-(2-Nitrophenyl)-1-(trifluoromethyl)ethenyl]amino}ethanol (3c) (mixture (3.8:1) of *Z*,*E*-isomers). ATR/FT-IR ν = 1343, 1523 (NO_2), 1652 (C=C), 3387 (NH), 3554 (OH) cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) *Z* -izomer δ 2.36 (br.s., 1 H, OH), 2.85 (m, 2 H, NCH_2), 3.54 (m, 2 H, OCH_2), 4.02 (br.s, 1 H, NH), 6.16 (s, 1 H, =CH), 7.35 (m, 1 H, 4-H), 7.55 (m, 1 H, 5-H), 7.63 (m, 1 H, 6-H), 7.96 (m, 1 H, 3-H); *E*-izomer δ 3.16 (m, 2 H, NCH_2), 3.85 (m, 2 H, OCH_2), 4.28 (s, 1 H, NH), 5.82 (s, 1 H, =CH); ^{13}C NMR (100.6 MHz, $CDCl_3$) *Z*-izomer δ 48.3 (NCH_2), 61.1 (OCH_2), 100.7 (q, J = 5.6 Hz, =CH), 121.80 (q, J = 275.4 Hz, CF_3), 124.9 (C-3), 127.9 (C-4), 130.0 (C-1), 131.4 (C-6), 133.0 (C-5), 135.2 (q, J = 30.4 Hz, =C-NH), 148.1 (C-2); *E*-izomer δ 45.7 (NCH_2), 60.1 (OCH_2), 98.1 (q, J = 2 Hz, =CH), 148.4 (C-2); ^{15}N NMR (40.6 MHz, $CDCl_3$) *Z*-izomer δ −326.6 (NH), −7.0 (NO_2); *E*-izomer δ −320.1 (NH).

2-{2,2,2-Trifluoro-[1-(2-nitrobenzyl)ethylidene]amino}ethanol (4a) (*E*:*Z* isomers 1:9). ATR/FT-IR ν = 1343, 1523 (NO_2), 1681 (C=N), 3554 (OH) cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) *Z*-izomer δ 2.80 (br.s., 1 H, OH), 3.55 (t, J = 4.8 Hz, 2 H, N−CH_2), 3.86 (t, J = 4.8 Hz, 2 H, OCH_2), 4.14 (s, 2 H, ArCH_2), 7.21 (m, 1 H, 6-H), 7.44 (m, 1 H, 4-H), 7.58 (m, 1 H, 5-H), 8.02 (m, 1 H, 3-H); *E*-izomer δ 4.20 (s, 2 H, $ArCH_2$), 7.25 (m, 1 H, 6-H); ^{13}C NMR (100.6 MHz, $CDCl_3$) *Z*-izomer δ 31.6 (Ar*C*H_2), 54.0 (NCH_2), 61.6 (OCH_2), 119.5 (q, J = 279.1 Hz, CF_3), 125.7 (C-3), 128.8 (C-4), 130.6 (C-1), 131.0 (C-6), 134.0 (C-5), 148.7 (C-2), 157.4 (q, J = 32.4 Hz, C=N); ^{15}N NMR (40.6 MHz, $CDCl_3$) *Z*-izomer δ −39.9 (C=N), −7.7 (NO_2); *E*-izomer δ −50.2 (C=N). Anal. Calcd for $C_{11}H_{11}F_3N_2O_3$: C 47.83; H 4.01; N 10.14. Found: C 47.80; H 3.72; N 10.19 (for the mixture of **3c** and **4a**).

2-(4-Chlorobenzyl)-2-(trifluoromethyl)imidazolidine (6a). Yield 26%; colorless solid; mp 108−109 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 1.94 (br s, 2H, 2NH), 2.67−2.70 (m, 2H, CH_2), 2.98−3.01 (m, 2H, CH_2), 3.02 (s, 2H, CH_2), 7.26 (d, J = 8.3 Hz, 2H, Ar), 7.35 (d, J = 8.3 Hz, 2H, Ar); ^{13}C NMR (100 MHz, $CDCl_3$) δ 38.0 (CH_2), 46.5 (2(−NH−CH_2)), 80.5 (q, J = 27.0 Hz, C-CF_3), 126.9 (q, J = 286.7 Hz, CF_3); 128.8 (CH), 132.2 (CH), 132.4, 133.6 (Ar). ESI-MS (m/z) calcd for $C_{11}H_{12}ClF_3N_2H$ [M^+] 265.0719, found 265.0726.

2-(4-Chlorobenzyl)-2-(chlorodifluoromethyl)imidazolidine (6b). Yield 26%; colorless solid; mp 113−114 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 2.02 (br s, 2H, 2NH), 2.58−2.63 (m, 2H, CH_2), 2.97−3.02 (m, 2H, CH_2), 3.06 (s, 2H, CH_2), 7.25 (d, J = 8.2 Hz, 2H, Ar), 7.31 (d, J = 8.2 Hz, 2H, Ar); ^{13}C NMR (100 MHz, $CDCl_3$) δ 38.9 (CH_2), 46.5 (2(−NH−CH_2)), 84.4 (t, J = 22.5 Hz, C-CF_2Cl), 132.9 (t, J = 303.0 Hz, CF_2Cl); 128.6 (CH), 132.1 (CH), 132.8, 133.5 (Ar). Anal. Calcd for $C_{11}H_{12}Cl_2F_2N_2$: C 47.00; H 4.30; N 15.27. Found: C 47.17; H 4.43.

2-Benzyl-2-(trifluoromethyl)imidazolidine (6c). Yield 15%; pale yellow solid; mp 43−44 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 2.02 (br s, 2H, 2NH), 2.62−2.66 (m, 2H, CH_2), 2.94−2.98 (m, 2H, CH_2), 3.07 (s, 2H, CH_2), 7.27−7.30 (m, 2H, Ar), 7.34−7.41 (m, 3H, Ar); ^{13}C NMR (100 MHz, $CDCl_3$) δ 38.1 (CH_2), 46.7 (2(−NH−CH_2)), 80.6 (q, J = 27.8 Hz, C-CF_3), 126.7 (q, J = 285.8 Hz, CF_3); 127.6 (CH), 128.8 (CH), 130.7 (CH), 133.6 (Ar). Anal. Calcd for $C_{11}H_{13}F_3N_2$: C 57.39; H 5.56. Found: C 57.56; H 5.44.

2-(4-Fluorobenzyl)-2-(trifluoromethyl)imidazolidine (6d). Yield 10%; colorless solid; mp 65−67 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 1.98 (br s, 2H, 2NH), 2.67−2.70 (m, 2H, CH_2), 2.97−3.02 (m, 2H, CH_2), 3.03 (s, 2H, CH_2), 7.06 (t, J = 8.5 Hz, 2H, Ar), 7.26−7.31 (m, 2H, Ar); ^{13}C NMR (100 MHz, $CDCl_3$) δ 37.6 (CH_2), 46.6 (2(−NH−CH_2)), 80.5 (q, J = 29.5 Hz, C-CF_3), 126.6 (q, J = 287.5 Hz, CF_3); 115.6 (d, J = 21.1 Hz, CH), 129.5, 132.3 (d, J = 8.4 Hz, CH), 162.3 (d, J = 247.0 Hz) (Ar). Anal. Calcd for $C_{11}H_{12}F_4N_2$: C 53.23; H 4.87. Found: C 53.41; H 4.77.

2-(4-Methylbenzyl)-2-(trifluoromethyl)imidazolidine (6e). Yield 12%; colorless solid; mp 59−60 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 2.07 (br s, 2H, 2NH), 2.37 (s, 3H, Me), 2.64−2.69 (m, 2H, CH_2),

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2.94−2.99 (m, 2H, CH_2), 3.04 (s, 2H, CH_2), 7.14−7.21 (m, 4H, Ar); ^{13}C NMR (100 MHz, $CDCl_3$) δ 21.1 (Me), 37.5 (CH_2), 46.7 (2(−NH−CH_2)), 80.6 (q, J = 26.1 Hz, C-CF_3), 125.6 (q, J = 288.3 Hz, CF_3); 128.1, 129.6 (CH), 130.5 (CH), 137.5 (Ar). ESI-MS (m/z) calcd for $C_{12}H_{15}F_3N_2H$ [M^+] 245.1266, found 245.1271.

2-(3-Methoxylbenzyl)-2-(trifluoromethyl)imidazolidine (6f). Yield 20%; colorless solid; mp 48−49 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.06 (br s, 2H, 2NH), 2.66−2.72 (m, 2H, CH_2), 2.95−2.99 (m, 2H, CH_2), 3.04 (s, 2H, CH_2), 3.83 (s, 3H, MeO), 6.82−6.91 (m, 2H, Ar), 7.29 (t, J = 7.8 Hz, 1H, Ar); ^{13}C NMR (100 MHz, $CDCl_3$) δ 38.0 (CH_2), 46.7 (2(−NH−CH_2)), 55.3 (MeO), 80.6 (q, J = 27.0 Hz, C-CF_3), 126.8 (q, J = 285.8 Hz, CF_3); 112.8 (CH), 116.6 (CH), 123.0 (CH), 129.9 (CH), 135.1, 159.9 (Ar). Anal. Calcd for $C_{12}H_{15}F_3N_2O$: C 55.38; H 5.81. Found: C 55.42; H 5.94.

2-(2-Methoxylbenzyl)-2-(trifluoromethyl)imidazolidine (6g). Yield 20%; colorless solid; mp 67−68 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.49−2.62 (m, 4H, CH_2, 2NH), 2.88−2.91 (m, 2H, CH_2), 3.15 (s, 2H, CH_2), 3.87 (s, 3H, MeO), 6.95 (d, J = 7.7 Hz, 1H, Ar), 6.98 (td, J = 7.7 Hz, J = 0.9 Hz, 1H, Ar), 7.16 (dd, J = 7.7 Hz, J = 1.7 Hz, 1H, Ar), 7.30 (td, J = 7.7 Hz, J = 1.7 Hz, 1H, Ar); ^{13}C NMR (100 MHz, $CDCl_3$) δ 32.2 (CH_2), 47.0 (2(−NH−CH_2)), 55.6 (MeO), 81.4 (q, J = 29.5 Hz, C-CF_3), 126.6 (q, J = 285.8 Hz, CF_3); 111.2 (CH), 121.3 (CH), 122.3, 129.2 (CH), 133.0 (CH), 157.7 (Ar). Anal. Calcd for $C_{12}H_{15}F_3N_2O$: C 55.38; H 5.81. Found: C 55.50; H 5.92.

2-(2-Bromobenzyl)-2-(chlorodifluoromethyl)imidazolidine (6h). Yield 63%; brownish solid; mp 50−52 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.32 (br s, 2H, 2NH), 2.52−2.57 (m, 2H, CH_2), 2.93−2.99 (m, 2H, CH_2), 3.34 (s, 2H, CH_2), 7.17 (t, J = 7.6 Hz, 1H, Ar), 7.30 (t, J = 7.6 Hz, 1H, Ar), 7.41 (d, J = 7.6 Hz, 1H, Ar), 7.59 (d, J = 7.6 Hz, 1H, Ar); ^{13}C NMR (100 MHz, $CDCl_3$) δ 38.6 (CH_2), 46.4 (2(−NH−CH_2)), 84.9 (t, J = 23.2 Hz, C-CF_2Cl), 133.0 (t, J = 302.7 Hz, CF_2Cl); 125.7, 127.5 (CH), 129.1 (CH), 133.2 (CH), 133.3 (CH), 134.5 (Ar). Anal. Calcd for $C_{11}H_{12}BrClF_2N_2$: C 40.58; H 3.71. Found: C 40.39; H 3.80.

2-(2-Bromobenzyl)-2-(trifluoromethyl)imidazolidine (6i). Yield 82%; white solid; mp 42−43 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.23 (br s, 2H, 2NH), 2.59−2.65 (m, 2H, CH_2), 2.93−2.99 (m, 2H, CH_2), 3.30 (s, 2H, CH_2), 7.19 (t, J = 7.6 Hz, 1H, Ar), 7.32 (t, J = 7.6 Hz, 1H, Ar), 7.40 (d, J = 7.6 Hz, 1H, Ar), 7.61 (d, J = 7.6 Hz, 1H, Ar); ^{13}C NMR (100 MHz, $CDCl_3$) δ 37.5 (CH_2), 46.4 (2(−NH−CH_2)), 80.9 (q, J = 27.0 Hz, C-CF_3), 126.6 (q, J = 286.6 Hz, CF_3); 125.7, 127.6 (CH), 129.3 (CH), 133.2 (CH), 133.4 (CH), 134.0 (Ar). Anal. Calcd for $C_{11}H_{12}BrF_3N_2$: C 42.74; H 3.91. Found: C 42.88; H 3.99.

2-(4-Nitrobenzyl)-2-(trifluoromethyl)imidazolidine (6j). Yield 27%; pale purple crystals; mp 108−109 °C; ^{1}H NMR (300 MHz, DMSO-d_6) δ 2.57−2.67 (m, 2H, CH_2), 2.73−2.84 (m, 2H, CH_2), 2.98−3.09 (br s, 2H, CH_2), 3.11 (s, 2H, CH_2), 7.74 (d, J = 8.8 Hz, 2H, Ar), 8.16 (d, J = 8.8 Hz, 2H, Ar); ^{19}F NMR (282 MHz, DMSO-d_6) δ −79.3; ^{13}C NMR (75 MHz, DMSO-d_6) δ 38.7, 45.7, 79.8 (q, J = 26.8 Hz, C-CF_3), 126.6 (q, J = 287.7 Hz, CF_3); 122.6 (CH), 132.1 (CH), 143.1, 146.5 (Ar). ESI-MS (m/z) calcd for $C_{11}H_{12}F_3N_3O_2H$ [M^+] 276.0960, found 276.0954. Anal. Calcd for $C_{11}H_{12}F_3N_3O_2$: C 48.00; H 4.39; N 15.27. Found: C 48.06; H 4.46; N 15.09.

2-(3-Nitrobenzyl)-2-(trifluoromethyl)imidazolidine (6k). Yield 55%; pale yellow solid; mp 65−67 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.97 (br s, 2H, 2NH), 2.66−2.73 (m, 2H, CH_2), 2.98−3.02 (m, 2H, CH_2), 3.10 (s, 2H, CH_2), 7.51 (t, J = 7.9 Hz, 1H, Ar), 7.69 (d, J = 7.9 Hz, 1H, Ar), 8.14 (dd, J = 7.9 Hz, J = 1.3 Hz, 1H, Ar), 8.24 (s, 1H, Ar); ^{13}C NMR (100 MHz, $CDCl_3$) δ 38.9 (CH_2), 46.3 (2(−NH−CH_2)), 80.2 (q, J = 27.0 Hz, C-CF_3), 126.5 (q, J = 288.3 Hz, CF_3); 122.4 (CH), 125.8 (CH), 129.1 (CH), 136.4, 137.2 (CH), 148.1 (Ar). Calcd for $C_{11}H_{12}F_3N_3O_2$: C 48.00; H 4.39. Found: C 47.87; H 4.49.

2-(Chlorodifluoromethyl)-2-(2-nitrobenzyl)imidazolidine (6l). Yield 69%; pale yellow solid; mp 98−100 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.07 (br s, 2H, 2NH), 2.45−2.49 (m, 2H, CH_2), 2.92−2.98 (m, 2H, CH_2), 3.51 (s, 2H, CH_2), 7.42−7.46 (m, 2H, Ar), 7.55 (t, J = 7.6 Hz, 1H, Ar), 7.87 (d, J = 7.6 Hz, 1H, Ar); ^{19}F NMR (282 MHz, $CDCl_3$) δ −80.30; ^{13}C NMR (100 MHz, $CDCl_3$) δ 36.3 (CH_2), 45.8 (2(−NH−CH_2)), 84.3 (t, J = 22.8 Hz, C-CF_2Cl), 132.8 (t, J = 303.9 Hz, CF_2Cl); 124.8 (CH), 128.2 (CH), 129.5, 132.2 (CH), 134.1 (CH), 151.6 (Ar). Anal. Calcd for $C_{11}H_{12}ClF_2N_3O_2$: C 45.30; H 4.15. Found: C 45.47; H 4.23.

2-(2-Nitrobenzyl)-2-(trifluoromethyl)imidazolidine (6m). Yield 97%; pale yellow solid; mp 53−55 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ 1.96 (br s, 2H, CH_2), 2.51−2.57 (m, 2H, CH_2), 2.92−2.97 (m, 2H, CH_2), 3.47 (s, 2H, CH_2), 7.43 (dd, J = 7.6 Hz, J = 1.4 Hz, 1H, Ar), 7.47 (dd, J = 7.6 Hz, J = 1.6 Hz, 1H, Ar), 7.56 (td, J = 7.6 Hz, J = 1.4 Hz, 1H, Ar), 7.90 (dd, J = 7.6 Hz, J = 1.6 Hz, 1H, Ar); ^{19}F NMR (282 MHz, $CDCl_3$) δ −81.5; ^{13}C NMR (75 MHz, $CDCl_3$) δ 35.5, 45.8, 80.2 (q, J = 27.4 Hz, C-CF_3), 126.5 (q, J = 288.4 Hz, CF_3); 124.9 (CH), 128.3 (CH), 129.1, 132.2 (CH), 134.0 (CH), 151.5 (Ar). ESI-MS (m/z) calcd for $C_{11}H_{12}F_3N_3O_2H$ [M^+] 276.0960, found 276.0954. Anal. Calcd for $C_{11}H_{12}F_3N_3O_2$: C 48.00; H 4.39; N 15.27. Found: C 47.97; H 4.53; N 15.08.

1-Methyl-2-(4-nitrobenzyl)-2-(trifluoromethyl)imidazolidine (6n). Yield 91%; light yellow solid; mp 112 °C; IR (KBr) ν = 1130, 1154, 1345, 1513, 1604, 3376 cm^{-1}; MS (EI) m/z (relative intensity) 289 (M^+, < 1), 220 (24), 174 (22), 153 (100), 110 (40); ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.78 (s, 1 H, NH), 2.46 (m, 1 H), 2.65 (q, J = 1.6 Hz, 3 H), 2.89 (A-part of the AB-system, J = 14.1 Hz, 1 H), 2.90 (m, 3 H), 3.14 (B-part of the AB-system, J = 14.1 Hz, 1 H), 7.41 (d, J = 8.4 Hz, 2 H), 8.08 (d, J = 8.4 Hz, 2 H). ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 34.0 (NCH_3), 35.8 (ArCH_2), 43.3 ($HNCH_2$), 52.9 (NCH_2), 80.1 (q, J = 25.1 Hz, N−C−N), 123.1 (C-3,5), 126.9 (q, J = 296.3 Hz, CF_3), 132.0 (C-2,6), 142.6 (C-1), 147.3 (C-4). Anal. Calcd for $C_{12}H_{14}F_3N_3O_2$: C 49.83; H 4.88; N 14.53. Found: C 49.85; H 5.03; N 14.87.

1-Methyl-2-(3-nitrobenzyl)-2-(trifluoromethyl)imidazolidine (6o). Yield 67%; orange-red solid; mp 51−52 °C; ATR/FT-IR ν = 1350, 1523 (NO_2), 3374 (NH) cm^{-1}. MS (EI) m/z (relative intensity) 289 (M^+, < 1), 220 (7), 174 (7), 153 (100), 110 (13), 90 (8), 69 (7); ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.79 (s, 1 H, NH), 2.47 (m, 1 H), 2.69 (q, J = 2.0 Hz, 3 H, CH_3), 2.90 (m, 4 H, CH_3, A-part of the AB-system), 3.18 (B-part of the AB-system, J = 13.8 Hz, 1 H), 7.48 (m, 1 H, 5-H), 7.59 (m, 1 H, 6-H), 8.14 (m, 2 H, 4-H, 2-H). ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 34.1 (NCH_3), 35.5 (ArCH_2), 43.4 (NH−CH_2), 52.9 (N−CH_2), 80.1 (q, J = 24.6 Hz, N−C−N), 122.3 (C-4), 126.0 (C-2), 127.0 (q, J = 296.3 Hz, CF_3), 128.9 (C-5), 136.8 (C-1), 137.3 (C-6), 148.1 (C-3). Anal. Calcd for $C_{12}H_{14}F_3N_3O_2$: C 49.83; H 4.88; N 14.53. Found: C 50.06; H 4.86; N 14.26.

1-Methyl-2-(2-nitrobenzyl)-2-(trifluoromethyl)imidazolidine (6p). Yield 92%; solid; mp 87 °C; IR (KBr) ν = 1153, 1361, 1526, 3395 cm^{-1}; MS (EI) m/z (relative intensity) 289 (M^+, < 1), 220 (15), 173 (7), 153 (100), 110 (42); ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.87 (s, 1 H, NH), 2.04 (m, 1 H), 2.49 (q, J = 2.1 Hz, 3 H), 2.77 (m, 3 H), 2.98 (A-part of the AB-system, J = 13.8 Hz, 1 H), 3.63 (B-part of the AB-system, J = 13.8 Hz, 1 H), 7.27−7.35 (m, 1 H, 6-H), 7.35−7.40 (m, 1 H, 4-H), 7.45−7.52 (m, 1 H, 5-H), 7.70−7.75 (m, 1 H, 3-H). ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 32.9 (N−CH_3), 33.3 (q, J = 1.5 Hz, ArCH_2), 43.3 (NH−CH_2), 52.6 (N−CH_2), 79.9 (q, J = 25.1 Hz, N−C−N), 124.4 (C-3), 126.7 (q, J = 295.6 Hz, CF_3), 128.1 (C-3), 129.2 (C-1), 131.8 (C-5), 134.3 (C-6), 152.1 (C-2); ^{19}F NMR (376.5 MHz, $CDCl_3$) δ −75.94. Anal. Calcd for $C_{12}H_{14}F_3N_3O_2$: C 49.83; H 4.88; F 19.70. Found: C 49.80; H 5.10; F 19.72.

1,3-Dimethyl-2-(4-nitrobenzyl)-2-(trifluoromethyl)imidazolidine (6q). Yield: 89%; yellow solid; mp 43−44 °C; MS (EI) m/z (relative intensity) 303 (M^+, < 1), 234 (62), 188 (50), 167 (100), 110 (45); ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.50 (q, J = 1.7 Hz,

6 H), 2.77 (m, 2 H), 2.90 (m, 2 H), 3.06 (s, 2 H), 7.51 (d, J = 8.7 Hz, 2 H), 8.08 (d, J = 8.7 Hz, 2 H). ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 33.9 (N−CH_3), 35.4 (ArCH_2), 51.4 (N−CH_2), 81.4 (q, J = 23.6 Hz, N−C−N), 122.8 (C-3,5), 127.0 (q, J = 301.9 Hz, CF_3), 132.0 (C-2,6), 144.4 (C-1), 146.9 (C-4). IR (KBr) ν = 1132, 1160, 1262, 1347, 1515, 1604 cm^{-1}. Anal. Calcd for $C_{13}H_{16}F_3N_3O_2$: C 51.48; H 5.32; N 13.86. Found: C 51.75; H 5.45; N 13.48.

1,3-Dimethyl-2-(2-nitrobenzyl)-2-(trifluoromethyl)imidazolidine (6r). Yield 76%; yellow solid; mp 46−48 °C; IR (KBr) ν = 1134, 1160, 1265, 1358, 1529 cm^{-1}; MS (EI) m/z (relative intensity) 303 (M^+, <1), 234 (17), 187 (5), 167 (100), 110 (21); ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.21 (q, J = 1.1 Hz, 6 H), 2.61 (m, 2 H), 2.76 (m, 2 H), 3.37 (s, 2 H), 7.35 (m, 1 H, 6-H), 7.43−7.50 (m, 2 H, 4-H, 5-H), 7.72 (m, 1 H, 3-H). ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 31.4 (N−CH_3), 35.6 (ArCH_2), 51.7 (N−CH_2), 80.8 (q, J = 24.3 Hz, N−C−N), 124.3 (C-3), 126.8 (q, J = 297.8 Hz, CF_3), 127.6 (C-1), 130.4 (C-4), 131.2 (C-5), 134.4 (C-6), 152.5 (C-2). Anal. Calcd for $C_{13}H_{16}F_3N_3O_2$: C 51.48; H 5.32; N 13.86. Found: C 51.62; H 5.39; N 14.04.

2-(2-Nitrobenzyl)-2-(trifluoromethyl)-octahydro-1*H*-benzo[*d*]-imidazole (6s). Yield 82%; white solid; mp 127−129 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.84−1.00 (m, 2H, CH_2), 1.04−1.21 (m, 2H, CH_2), 1.32−1.40 (m, 1H, CH_2), 1.56−1.65 (m, 2H, CH_2), 1.66−1.73 (m, 1H, CH_2), 1.80−1.88 (m, 1H, CH_2), 1.96 (br s, 2H, 2NH), 2.52−2.60 (m, 1H, CH_2), 3.24 (d, J = 13.7 Hz, 1H, CH_2−Ar), 3.67 (d, J = 13.7 Hz, 1H, CH_2−Ar), 7.47 (t, J = 7.6 Hz, 2H, Ar), 7.57 (td, J = 7.6 Hz, J = 0.8 Hz, 1H, Ar), 7.90 (d, J = 7.6 Hz, Ar); ^{13}C NMR (100 MHz, $CDCl_3$) δ 24.0 (CH_2), 24.2 (CH_2), 29.9 (CH_2), 30.1 (CH_2), 36.7 (CH_2−Ar), 62.2 (CH-NH), 62.5 (CH-NH), 78.6 (q, J = 27.8 Hz, C-CF_3), 126.4 (q, J = 289.4 Hz, CF_3); 124.8 (CH), 128.2 (CH), 129.4, 132.0 (CH), 134.1 (CH), 151.8 (Ar). Anal. Calcd for $C_{15}H_{18}F_3N_3O_2$: C 54.71; H 5.51. Found: C 54.92; H 5.62.

2-(4-Nitrobenzyl)-2-(trifluoromethyl)-1,3-oxazolidine (6t). Yield 53%; yellow-orange solid; mp 113−114 °C; IR (KBr) ν = 1350, 1520 (NO_2), 1606, 3323 (NH) cm^{-1}; MS (EI) m/z (relative intensity) 276 (M^+, <1), 257 (2), 245 (2), 229 (2), 207 (8), 177 (2), 161 (5), 140 (100), 136 (5), 89 (25), 69 (25); ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.05 (br.s, J = 7.5 Hz 1 H, NH), 2.89 (m, 1 H), 3.05 (A-part of the AB-system, J = 14.1 Hz, 1 H), 3.34 (B-part of the AB-system, J = 14.1 Hz, 1 H), 3.90 (m, 1 H), 7.48 (d, J = 8.2 Hz, 2 H), 8.15 (d, J = 8.2 Hz, 2 H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 37.4 (ArCH_2), 46.3 (NCH_2), 68.2 (OCH_2), 95.3 (q, J = 29.5 Hz, N−C−N), 123.8 (C-3,5), 124.9 (q, J = 288.2 Hz, CF_3), 132.1 (C-2,6), 141.2 (C-1), 147.8 (C-4). Anal. Calcd for $C_{11}H_{11}F_3N_2O_3$: C 47.83; H 4.01; N 10.14. Found: C 47.85; H 3.98; N 10.04.

2-(2-Nitrobenzyl)-2-(trifluoromethyl)-1,3-oxazolidine (6u). Yield 60%; white solid; mp 99 °C; IR (KBr) ν = 1368, 1529 (NO_2), 3324 (NH) cm^{-1}; MS (EI) m/z (relative intensity) 276 (M^+, <1), 259 (3), 214 (5), 198 (6), 169 (5), 140 (100), 120 (8), 92 (17), 77 (18), 69 (33); ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.44 (s, 1 H, NH), 2.77 (m, 1 H), 3.04 (m, 1 H), 3.30 (m, 1 H), 3.40 (A-part of the AB-system, J = 14.2 Hz, 1 H), 3.64 (B-part of the AB-system, J = 14.2 Hz, 1 H), 3.86 (m, 1 H), 7.42−7.48 (m, 2 H, 4-H, 5-H), 7.55 (m, 1 H, 6-H), 7.85 (m, 1 H, 3-H). ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 34.1 (ArCH_2), 45.9 (NCH_2), 68.2 (OCH_2), 95.2 (q, J = 29.9 Hz, O−C−N), 124.8 (q, J = 288.2 Hz, CF_3), 125.0 (C-3), 128.0 (C-1), 128.8 (C-4), 132.6 (C-5), 134.5 (C-6), 151.5 (C-2). Anal. Calcd for $C_{11}H_{11}F_3N_2O_3$: C 47.83; H 4.01; N 10.14. Found: C 47.80; H 3.82; N 10.15.

2-(4-Nitrobenzyl)-4-ethyl-2-(trifluoromethyl)oxazolidine (6v). mixture of isomers (93:7); yield 88%; white crystals; mp 72−75 °C; major isomer: ^{1}H NMR (300 MHz, $CDCl_3$) δ 0.75 (t, J = 7.4 Hz, 3H, Me), 0.94−1.11 (m, 1H, CH_2-CH_3), 1.19−1.35 (m, 1H, CH_2-CH_3), 1.74 (br s, 1H, NH), 2.80 (t, J = 8.0 Hz, 1H, CH_2O), 3.08 (d, J = 13.9 Hz, 1H, CH_2−Ar), 3.29−3.44 (m, 1H, CHNH), 3.41 (d, J = 13.9 Hz, 1H, CH_2−Ar), 4.01 (t, J = 7.1 Hz, 1H, CH_2O), 7.53 (d, J = 8.7 Hz, 2H, Ar), 8.24 (d, J = 8.7 Hz, 2H, Ar); ^{19}F NMR (282 MHz, $CDCl_3$) δ −82.1; ^{13}C NMR (75 MHz, $CDCl_3$) δ 10.5, 25.7, 37.1, 59.5, 73.0, 95.3 (q, J = 29.7 Hz, C-CF_3), 124.6 (q, J = 288.2 Hz, CF_3); 123.5 (CH), 132.0 (CH), 141.1, 147.5 (Ar); minor isomer: ^{1}H NMR (300 MHz, $CDCl_3$) δ 2.52 (t, J = 8.0 Hz, 1H, CH_2O), 3.93 (t, J = 7.1 Hz, 1H, CH_2O); ^{19}F NMR (282 MHz, $CDCl_3$) δ −82.2; ^{13}C NMR (75 MHz, $CDCl_3$) δ 10.8, 26.2, 38.8, 73.1; 123.2 (CH), 131.9 (CH), 141.7, 147.3 (Ar). ESI-MS (m/z) calcd for $C_{13}H_{15}F_3N_2O_3Na$ [M^+] 327.0932, found 327.0931. Anal. Calcd for $C_{13}H_{15}F_3N_2O_3$: C 51.32; H 4.97; N 9.21. Found: C 51.63; H 5.06; N 9.11.

4,4-Dimethyl-2-(2-nitrobenzyl)-2-(trifluoromethyl)-1,3-oxazolidine (6w). Yield 64%; white solid; mp 59 °C; IR ν = 1357, 1530 (NO_2), 3383 (NH) cm^{-1}; MS (EI) m/z (relative intensity) 305 (M^+ + 1, <1), 168 (58), 55 (100); ^{1}H NMR (400 MHz, $CDCl_3$) δ 0.41 (s, 3 H, CH_3), 1.14 (s, 3 H, CH_3), 2.25 (s, 1 H, NH), 3.34 (d, J = 7.8 Hz, 1 H, CH_2N), 3.37 (A-part of AB-system, J = 14.2 Hz, 1 H, ArCH_2), 3.53 (B-part of AB-system, J = 14.2 Hz, 1 H, ArCH_2), 3.67 (d, J = 7.8 Hz, 1 H, CH_2N), 7.40−7.50 (m, 2 H, 4,5-H), 7.50−7.60 (m, 1 H, 6-H), 7.80−7.90 (m, 1 H, 3-H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 27.8, 28.5 (CH_3), 34.5 (ArCH_2), 59.1 (NCMe_2), 79.7 (OCH_2), 96.0 (q, J = 29.5 Hz, CCF_3), 124.8 (C-3), 124.9 (q, J = 289.9 Hz, CF_3), 128.5 (C-1), 128.7 (C-4), 132.4 (C-5), 135.1 (C-6), 151.8 (C-2); ^{19}F NMR (376.5 MHz, $CDCl_3$) δ −81.87; ^{15}N NMR (40.6 MHz, $CDCl_3$) δ −307.9 (NH), −4.5 (NO_2). Anal. Calcd for $C_{13}H_{15}F_3N_2O_3$: C 51.32; H 4.97; N 9.21. Found: C 51.35; H 5.13; N 9.30.

2-(4-Chlorophenyl)-4,5-dihydro-1*H*-imidazole (7a). Yield 41%; white powder; mp 186−187 °C(lit.[23] 186−187 °C). ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.80 (s, 4H, CH_2), 4.41 (br s, 1H, NH), 7.38 (d, J = 8.6 Hz, 2H, Ar), 7.74 (d, J = 8.6 Hz, 2H, Ar). ESI-MS (m/z) calcd for $C_9H_9ClN_2H$ [M^+] 181.0533, found 181.0527.

2-Phenyl-4,5-dihydro-1*H*-imidazole (7b). Yield 55%; white powder; mp 102−103 °C (lit.[23] 101−102 °C); ^{1}H NMR (400 MHz, DMSO-d_6) δ 3.60 (s, 4H, CH_2), 7.40−7.47 (m, 3H, Ar), 7.82 (d, J = 7.8 Hz, 2H, Ar). ESI-MS (m/z) calcd for $C_9H_{10}N_2H$ [M^+] 147.0922, found 147.0917.

2-(4-Fluorophenyl)-4,5-dihydro-1*H*-imidazole (7c). Yield 55%; white powder; mp 149−150 °C (lit.[16] 147−148 °C); ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.78 (s, 4H, CH_2), 5.59 (br s, 1H, NH), 7.06 (t, J = 8.6 Hz, 2H, Ar), 7.78−7.83 (m, 2H, Ar).

2-(4-Methylphenyl)-4,5-dihydro-1*H*-imidazole (7d). Yield 56%; white powder; mp 180−181 °C (lit.[23] 178−179 °C); ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.39 (s, 3H, Me), 3.78 (s, 4H, CH_2), 5.03 (br s, 1H, NH), 7.21 (d, J = 8.1 Hz, 2H, Ar), 7.70 (d, J = 8.1 Hz, 2H, Ar). ESI-MS (m/z) calcd for $C_{10}H_{12}N_2H$ [M^+] 161.1079, found 161.1075.

2-(3-Methoxyphenyl)-4,5-dihydro-1*H*-imidazole (7e). Yield 64%; white powder; mp 96−97 °C (lit.[23] 98−99 °C); ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.72 and 3.73 (both s, 7H, MeO and 2CH_2), 6.94 (dd, J = 8.0 Hz, J = 2.1 Hz, 1H, Ar), 7.20 (t, J = 8.0 Hz, 1H, Ar), 7.39 (d, J = 8.0 Hz, 1H, Ar), 7.44 (d, J = 2.1 Hz, 1H, Ar), 7.91 (br s, 1H, NH).

2-(2-Methoxyphenyl)-4,5-dihydro-1*H*-imidazole (7f). Yield 45%; white solid; mp 60−62 °C (lit.[17] 60−64 °C); ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.64 (s, 4H, 2CH_2), 3.89 (s, 3H, MeO), 5.70 (br s, 1H, NH), 7.00 (t, J = 7.8 Hz, 1H, Ar), 7.06 (d, J = 7.8 Hz, 1H, Ar), 7.43 (td, J = 7.8 Hz, J = 1.8 Hz, 1H, Ar), 8.01 (dd, J = 7.8 Hz, J = 1.8 Hz, 1H, Ar).

2-(4-Methoxyphenyl)-4,5-dihydro-1*H*-imidazole Hydrobromide (7g). Yield 61%; white powder; mp 218−220 °C (lit.[23] 218−219 °C); ^{1}H NMR (400 MHz, CD_3CN) δ 3.90 (s, 3H, MeO), 3.96

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(s, 4H, CH_2), 7.11 (d, J = 8.8 Hz, 2H, Ar), 8.26 (d, J = 8.8 Hz, 2H, Ar).

2-(3,4-Dimethoxyphenyl)-4,5-dihydro-1*H*-imidazole (7h). Yield 54%; white powder; mp 152−154 °C (lit.[24] 153−154 °C); ^{1}H NMR (400 MHz, DMSO-d_6) δ 3.61 (s, 4H, $2CH_2$), 3.78 and 3.80 (both s, 3H, MeO), 6.99 (d, J = 8.5 Hz, 1H, Ar), 7.38 (dd, J = 8.5 Hz, J = 1.8 Hz, 1H, Ar), 7.44 (d, J = 1.8 Hz, 1H, Ar). ESI-MS (m/z) calcd for $C_{11}H_{14}N_2O_2H$ [M^+] 207.1134, found 207.1127.

1-Methyl-2-(4-methylphenyl)-4,5-dihydroimidazole Hydrobromide (7i). Yield 65%; yellow solid; mp 148−150 °C; MS (EI) m/z (relative intensity) 174 (29, M^+), 131 (100), 116 (17), 91 (23), 65 (28); ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.36 (s, 3 H, Me), 3.17 (s, 3 H, NCH_3), 3.95 (m, 2 H, NCH_2), 4.13 (m, 2 H, =NCH_2), 7.28 (d, J = 8.0 Hz, 2 H, 3,5-H), 7.61 (d, J = 8.0 Hz, 2 H, 2,6-H), 9.50−10.50 (br s, 1 H, HBr). ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 21.8 (Me), 35.1(NMe), 42.8 (CH_2N), 52.7 (CH_2N=), 118.9 (C-1), 129.3 (C-3,5), 130.0 (C-2,6), 144.8 (C-4), 166.3 (N−C=N). Anal. Calcd for $C_{11}H_{15}BrN_2$ H_2O: C 48.36; H 6.27; N 10.25. Found: C 48.28; H 5.91; N 10.00.

2-(4-Methoxyphenyl)-1-methyl-4,5-dihydroimidazole Hydrobromide (7j). Yield 58%, yellow solid; mp 143−144 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.08 (s, 3 H, CH_3), 3.68 (s, 3 H, CH_3), 3.80 (m, 2 H, CH_2), 4.00 (m, 2 H, CH_2), 6.84 (d, J = 8.7 Hz, 2 H, 3,5-H), 7.58 (d, J = 8.7 Hz, 2 H, 2,6-H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ 35.1 (NMe), 42.3 (CH_2−N), 52.6 (CH_2−N=), 55.5 (OMe), 113.3 (C-1), 114.6 (C-3,5), 131.3 (C-2,6), 163.5 (C-4), 165.6 (N−C=N). Anal. Calcd for $C_{11}H_{15}BrN_2O$ 0.5 H_2O: C 47.16; H 5.76; N 10.00. Found: C 47.21; H 5.67; N 9.86.

1-Chloro-4-(3,3,3-trifluoroprop-1-ynyl)benzene (8a). Yield 77%; colorless liquid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 (d, J = 8.6 Hz, 2H, Ar), 7.49 (d, J = 8.6 Hz, 2H, Ar).

1-Methoxy-4-(3,3,3-trifluoroprop-1-ynyl)benzene (8b). Yield 85%; colorless liquid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.83 (s, 3H, OCH_3), 6.89 (d, J = 8.9 Hz, 2H, Ar), 7.49 (d, J = 8.9 Hz, 2H, Ar).

2-Methyl-4,5-dihydro-1*H*-imidazole (17). ^{1}H NMR (400 MHz, DMSO-d_6) δ 1.79 (s, 3H, CH_3), 3.40 (s, 4H, $2CH_2$).

2-(4-Chlorobenzyl)-2-(trifluoromethyl)-hexahydropyrimidine (21a). Yield 30%; viscous oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.25−1.36 (m, 1H, CH_2), 1.39−1.47 (m, 1H, CH_2), 1.55 (br s, 2H, 2NH), 2.86 (s, 2H, $C\underline{H}_2$Ar), 2.89−2.97 (m, 2H, NHC$\underline{H}_2$), 3.06−3.16 (m, 2H, NHC$\underline{H}_2$), 7.26 (d, J = 8.5 Hz, 2H, Ar), 7.31 (d, J = 8.5 Hz, 2H, Ar); ^{13}C NMR (100 MHz, $CDCl_3$) δ 25.2 (CH_2), 40.5 (2(−NH−CH_2)), 40.8 (CH_2Ar), 70.0 (t, J = 25.1 Hz, $\underline{C}$-CF_3), 127.3 (t, J = 293.5 Hz, CF_3); 128.4 (CH), 132.6 (CH), 133.4 (2 −C=, (Ar). Anal. Calcd for $C_{12}H_{14}ClF_3N_2$: C 51.71; H 5.06. Found: C 51.92; H 5.17.

2-(4-Nitrobenzyl)-2-(trifluoromethyl)-hexahydropyrimidine (21b). Yield 62%; colorless crystals; mp 143−145 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.28−1.40 (m, 1H, CH_2), 1.42−1.50 (m, 1H, CH_2), 1.57 (br s, 2H, 2NH), 2.90−2.98 (m, 2H, NHC$\underline{H}_2$), 2.99 (s, 2H, C$\underline{H}_2$Ar), 3.07−3.13 (m, 2H, NHC$\underline{H}_2$), 7.51 (d, $\underline{J}$ = 8.6 Hz, 2H, Ar), 8.16 (d, J = 8.6 Hz, 2H, Ar); ^{13}C NMR (100 MHz, $CDCl_3$) δ 25.0 (CH_2), 40.4 (2(−NH−CH_2)), 41.2 (CH_2Ar), 70.4 (t, J = 25.4 Hz, $\underline{C}$-CF_3), 127.1 (t, J = 294.2 Hz, CF_3); 123.2 (CH), 132.2 (C$\underline{H}$), 142.2, 147.3 (Ar). Anal. Calcd for $C_{12}H_{14}F_3N_3O_2$: C 49.83; H 4.88. Found: C 49.73; H 4.97.

2-(4-Chlorophenyl)-1,4,5,6-tetrahydropyrimidine (22a). Yield 51%; white powder; mp 127−130 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.64 (quintet, J = 5.7 Hz, 2H, CH_2), 3.24 (t, J = 5.7 Hz, 4H, 2N−CH_2), 6.23 (br s, 1H, NH), 7.13 (d, J = 8.5 Hz, 2H, Ar), 7.42 (d, J = 8.5 Hz, 2H, Ar); ^{13}C NMR (100 MHz, $CDCl_3$) δ 20.2 (CH_2), 41.5 (2(−NH−CH_2)) 154.8 (C=N); 127.8 (CH), 128.2 (CH), 134.5, 135.7 (Ar). Anal. Calcd for $C_{10}H_{11}ClN_2$: C 61.70; H 5.70. Found: C 61.50; H 5.84.

2-(4-Methoxyphenyl)-1,4,5,6-tetrahydropyrimidine (22b). Yield 42%; white solid; mp 132−135 °C (lit.[21] 132−134 °C); ^{1}H NMR (400 MHz, $CDCl_3$) δ 1.71 (quintet, J = 5.8 Hz, 2H, CH_2), 3.34 (t, J = 5.8 Hz, 4H, 2N−CH_2), 3.70 (s, 3H, MeO), 4.48 (br s, 1H, NH), 6.75 (d, J = 8.8 Hz, 2H, Ar), 7.51 (d, J = 8.8 Hz, 2H, Ar).

2-Methyl-1,4,5,6-tetrahydropyrimidine (25). ^{1}H NMR (400 MHz, DMSO-d_6) δ 1.72 (quintet, J = 5.8 Hz, 2H, CH_2), 2.04 (s, 3H, CH_3), 3.25 (t, J = 5.8 Hz, 4H, 2N−CH_2).

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Supporting Information Available: ^{1}H and ^{13}C NMR spectra of all compounds. This material is available free of charge via the Internet at http://pubs.acs.org.

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