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Direct Access to *N*-*tert*-Butanesulfinyl Imines from Aryl Iodides, Alkenyl Alcohols and *N*-*tert*-Butanesulfinamide

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Keywords: Chiral sulfinyl imines · Heck-reaction · One-pot process · Isomerization · *N*-*tert*-Butanesulfinamide

The reaction of aryl iodides, *N*-*tert*-butanesulfinamide, and allyl or homoallyl alcohol in the presence of a catalytic amount of $Pd(OAC)_2$, $NaHCO_3$ as a base and TBAB, leads to the formation of *N*-*tert*-butanesulfinyl imines in moderate yields. In this one-pot process, a sequential Heck-type arylation of the alkenol, isomerization of the double bond and imine formation takes place.

Introduction

The development of new strategies of synthesis that allow an efficient transformation of simple molecules into more complex ones, through the generation of carbon-carbon and carbon-heteroatom bonds, is still of great interest in organic chemistry.[1] When throughout the process a new stereogenic center is formed, it should be done in a stereoselective way. In order to achieve this goal, the chemical yield should not be taken into account exclusively, but waste minimization must be also considered, avoiding the use of toxic and hazardous reagents and solvents, as well.[2] Catalytic processes in unconventional media[3] fulfill these requirements. In terms of efficiency, multicomponent reactions[4] are also very important, because at least two consecutive transformations occurred in the reaction flask, so that the functional group generated after the first step participates in the next reaction, all reactants involved being from the beginning in the reaction medium. There are also one-pot processes in which two or more reactions take place consecutively, without the need to isolate the intermediates, although the reagents participating in the transformations can be added sequentially after each reaction step. Both, the multicomponent reactions and the one-pot processes, in general, are interesting because the amounts of waste, solvents, labour and time are considerably minimized. On the other hand, the chemistry of chiral *N*-*tert*-butanesulfinyl imines[5] has experienced great advances in the last years because the reaction with different

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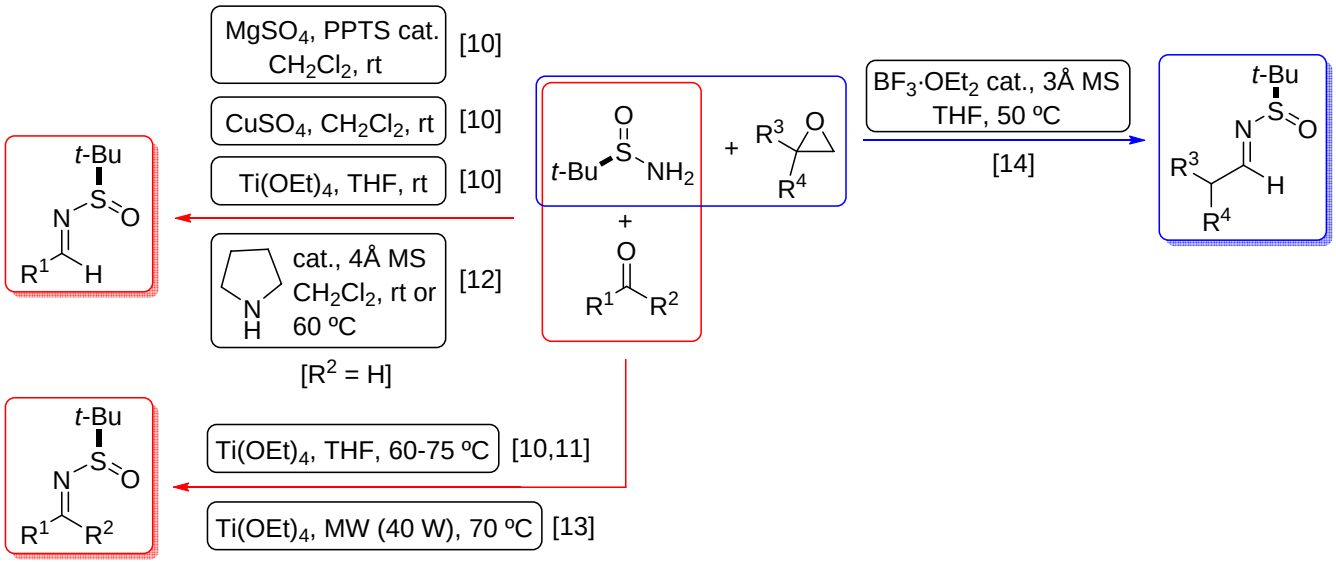
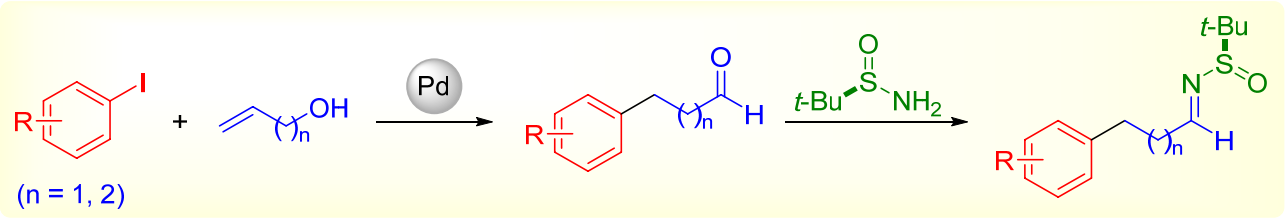
nucleophilic reagents occurred in a highly diastereoselective fashion. In addition, both enantiomeric imines are accessible in large-scale processes[6] and the *tert*-butanesulfinyl group is easily removed under acidic conditions. Importantly, practical processes for recycling the chiral auxiliary upon deprotection of *N-tert*-butanesulfinyl amines have also been reported.[7] In this context, we described the stereoselective allylation of *N-tert*-butanesulfinyl aldimines and ketimines with allylindium species[8] and the first one-pot α-aminoallylation of aldehydes with chiral *tert*-butanesulfinamide, allyl bromides, and indium,[9] which provides homoallylic amines with high chemo- and stereoselectivities. The synthesis of these aldimines was achieved in a straightforward manner by direct condensation of *tert*-butanesulfinamide with carbonyl compounds in the presence of a Lewis acid and a water scavenger at room temperature.[10] However, more demanding reaction conditions are required for the synthesis of the corresponding ketimines, which were accessed for the first time when the condensation was performed in the presence of titanium tetraethoxide in refluxing THF.[10,11] New methodologies for the direct condensation of *N-tert*-butanesulfinyl imines and aldehydes under the influence of pyrrolidines as organocatalyst,[12] or different acids or bases have also been reported recently.[13] The condensation worked well also under microwave irradiation in the presence of titanium tetraethoxide without additional solvents in short reaction times.[14] In this context, we recently carried out the one-pot synthesis of chiral *N-tert*-butanesulfinyl imines starting from commercially available or easily prepared epoxides.[15] The transformation was performed in the presence of a Lewis acid which promoted first the isomerization of the epoxide to give a carbonyl compound, followed by condensation with *N-tert*-butanesulfinamide (Scheme 1).



Scheme 1. Synthesis of *N-tert*-Butanesulfinyl Imines Reported Previously

Continuing our interest in this topic, and with the aim of increasing the number of methodologies which allow the access to chiral functionalized *N-tert*-butanesulfinyl imines, we report here the synthesis of the corresponding 3-arylpropanal and 4-arylbutanal derivatives starting from aryl iodides and allyl alcohol and 3-buten-1-ol, respectively. In order to achieve this goal, a palladium-catalyzed arylation of an alkenyl alcohol with concomitant isomerization of the double bond should occur first, followed by condensation of the resulting aldehyde with *N*-

tert-butanesulfinamide. This two-step transformation in a one-pot process leading to the formation of chiral 3- and 4-aryl substituted *N-tert*-butanesulfinyl aldimines by assembling three components is of great interest given environmental sustainability by minimizing solvents, labour and time (Scheme 2).



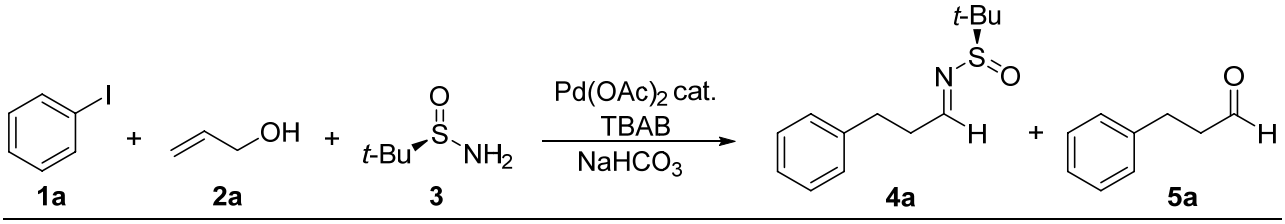
Scheme 2. Proposed Synthesis of *N-tert*-Butanesulfinyl Imines through a One-pot Coupling of Aryl Iodides, Alkenyl Alcohols and *N-tert*-Butanesulfinamide

Results and Discussion

In order to find the best reaction conditions to carry out the synthesis of *N-tert*-butanesulfinyl imines from an aryl iodide **1**, an alkenol **2** and (*R*)-*N-tert*-butanesulfinamide (**3**), we took iodobenzene (**1a**) and allyl alcohol (**2a**) as the model compounds. The palladium-catalyzed coupling of aryl halides and allylic alcohols can be controlled to produce selectively β-aryl carbonyl compounds or the corresponding conjugate aryl alkenols.[16] It was found that the combination of a catalytic amount of $Pd(OAc)_2$ with 2.5 equivalents of $NaHCO_3$, and 1 equivalent of tetrabutylammonium chloride (TBAC) in DMF, led almost exclusively to the carbonyl compound. However, the use of $Pd(OAc)_2$ with a double catalytic amount of PPh_3, and 1 equivalent of AgOAc as base in the same solvent, gave the primary expected Heck product aryl alkenol.[16] Based on these antecedents, we studied first the reaction of iodobenzene (**1a**) with allyl alcohol (**2a**) and (*R*)-*N-tert*-butanesulfinamide (**3**) in a 2:3:1 ratio, in the presence of 4 mol% of $Pd(OAc)_2$, tetrabutylammonium bromide (TBAB) and $NaHCO_3$ in DMF. The reaction was performed at 60 ºC for 24 h. These conditions were almost the same that showed to be optimal for the formation of the carbonyl compound, and led to a mixture of 8% of unreactive starting sulfinamide **3**, 52% of the expected imine **4a** and 40% of the initially formed 3-phenylpropanal (**5a**) (Table 1, entry 1). Similar results were obtained when $MgSO_4$ was added to the reaction mixture to act as water scavenger, in order to facilitate the condensation of the aldehyde **5a** and the sulfinamide **3** (Table 1, entry 2). Starting sulfinamide **3** predominated in the reaction mixture working in THF instead of DMF (Table 1, entry 3). However, the expected imine **4a** was the major component of the reaction mixture working in THF as solvent and using 4Å molecular sieves as water scavenger, and was isolated in 46% yield after column chromatography (Table 1, entry 4). With the aim of promoting the imine condensation, $BF_3{\cdot}OEt_2$ was also added to the reaction mixture, but, unfortunately, a complex mixture of reaction products without traces of the imine **4a** and the precursor aldehyde **5a** was formed (Table 1, entry 5). Similar results to those shown on entries 1 and 2 were obtained working in DMF with 4Å molecular sieves (Table 1, entry 6). We performed also the reaction under conventional solvent-free conditions, because arylation of allylic alcohols proceeded effectively in ionic liquids such as TBAB.[17] The reaction of the starting three components **1a**, **2a** and **3**, in the presence of $Pd(OAc)_2$, $NaHCO_3$ and 1 equivalent of TBAB, without any

additional solvent at 80 ºC for 12 h, led to a mixture of sulfinamide **3** and imine **4a** in a 33/67 ratio, the aldehyde precursor **5a** of the imine being not detected in the reaction mixture (Table 1, entry 7). Total decomposition of the expected products was observed working at 110 ºC (Table 1, entry 8). Finally, the best result was obtained when TBAB, $Pd(OAc)_2$, $NaHCO_3$ and allyl alcohol **2a** were heated at 110 ºC for 4 h and after that, sulfinamide **3** was added to the reaction mixture, which was allowed to react at 80 ºC for 8 additional h. Imine **4a** was by far the major component of the reaction mixture and was isolated in 68% yield after column chromatography purification (Table 1, entry 9).

Table 1. Optimization of the three-component coupling of iodobenzene (**1a**), allyl alcohol (**2a**) and *N-tert*-butanesulfinamide **3**[a]



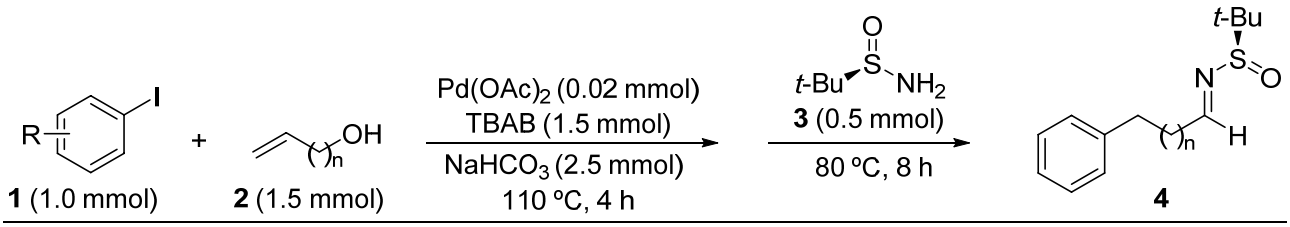
		Reaction Conditions				
Entry	Solvent	Water Scavenger	Additive	Temperature	Time	**3**/**4a**/**5a** Ratio[b]
1	DMF	--	--	60 ºC	24 h	8/52/40
2	DMF	$MgSO_4$	--	60 ºC	24 h	8/63/29
3	THF	$MgSO_4$	--	60 ºC	24 h	65/15/20
4	THF	MS 4Å	--	60 ºC	24 h	27/73(46%)[c]/0
5	THF	MS 4Å	$BF_3{\cdot}OEt_2$	60 ºC	24 h	--[d]
6	DMF	MS 4Å	--	60 ºC	24 h	0/66/34
7	--	--	--	80 ºC	12 h	33/67/0
8	--	--	--	110 ºC	12 h	--[d]
9	--	--	--	110/80 ºC[e]	4/8 h[e]	1/82(68%)[c]/17

[a] All the reactions were carried out with 1.0 mmol of **1a**, 1.5 mmol of **2a**, 0.5 mmol of **3**, 0.02 mmol of $Pd(OAc)_2$, 1.5 mmol of TBAB, 2.5 mmol of $NaHCO_3$, in 1.5 mL of solvent. [b] Ratio was determined from the ^{1}H NMR spectrum of the crude reaction mixture. [c] Isolated yield after column chromatography purification. [d] A complex mixture of reaction products was obtained. [e] The reaction was initially performed at 110 ºC for 4 h and at 80 ºC for 8 additional h.

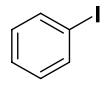
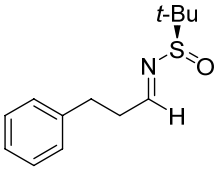
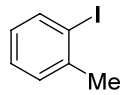
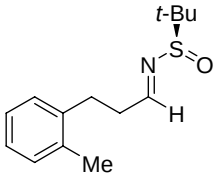
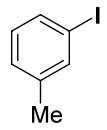
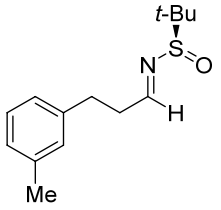
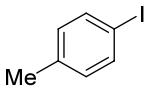
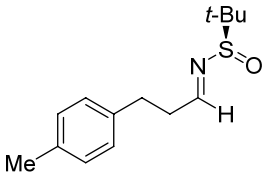
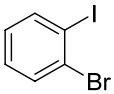
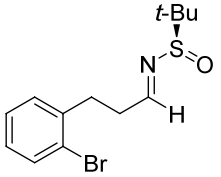
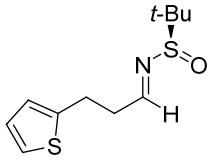
The scope of the reaction under the optimized conditions shown in entry 9 of Table 1 was studied next. The expected imines **4** were obtained in moderate yields in general with values ranging from 68 to 41% (Table 2, entries 1 and 10, respectively). In spite of the moderate yields, it merits to be mentioned that three different processes occurred in this one-pot transformations: palladium-catalyzed coupling reaction of the aryl iodide **1** and the alkenol **2**, further isomerization of the carbon-carbon double leading first to the enol which tautomerizes to form the corresponding aldehyde, and final condensation with sulfonamide **3**. Yields were slightly higher for 3-arylpropanal derivatives (Table 2, entries 1-8) than for those obtained using 3-buten-1-ol (**2b**) (Table 2, entries 9-12). Methyl, bromine and methoxy groups are well tolerated in these transformations, independently of the relative position respect to the iodine atom. The reaction worked also for heteroaromatic iodides, such as

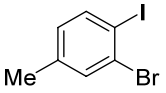
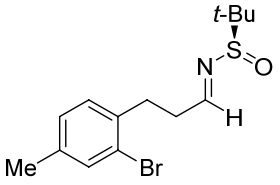
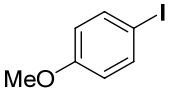
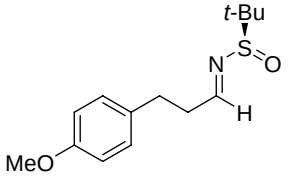
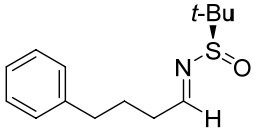
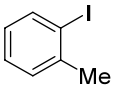
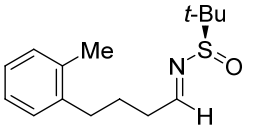
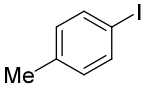
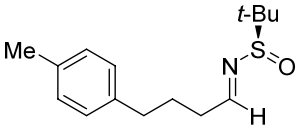
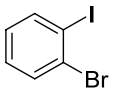
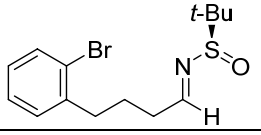
iodothiophene (**1f**) (Table 2, entry 6). Unfortunately, yields were considerably lower under the optimized reaction conditions starting from aryl bromides (see for instance entries 1 and 2 in Table 2), and imine formation was not observed when substituted allylic alcohols **2**, such as methallyl and crotyl alcohols were used as alkylating reagents.

Table 2. Scope of the three-component coupling reaction of iodobenzene (**1a**), allyl alcohol (**2a**) and *N*-*tert*-butanesulfinamide **3**[a]



1 (1.0 mmol) **2** (1.5 mmol) **4**

	Aryl Iodide **1**			*N*-*tert*-Butanesulfiniyl Imine **4**		
Entry	No.	Structure	Alkenol **2**	No.	Structure	Yield (%)[b]
1	**1a**		**2a** (n = 1)	**4a**		68 (17)[c]
2	**1b**		**2a** (n = 1)	**4b**		48 (4)[c]
3	**1c**		**2a** (n = 1)	**4c**		51
4	**1d**		**2a** (n = 1)	**4d**		65
5	**1e**		**2a** (n = 1)	**4e**		55
6	**1f**		**2a** (n = 1)	**4f**		42

7	**1g**		**2a** (n = 1)	**4g**		48
8	**1h**		**2a** (n = 1)	**4h**		45
9	**1a**		**2b** (n = 2)	**4i**		52
10	**1b**		**2b** (n = 2)	**4j**		41
11	**1d**		**2b** (n = 2)	**4k**		45
12	**1e**		**2b** (n = 2)	**4l**		49

[a] All the reactions were carried out with 1.0 mmol of **1a**, 1.5 mmol of **2a**, 0.5 mmol of **3**, 0.02 mmol of $Pd(OAc)_2$, 1.5 mmol of TBAB, 2.5 mmol of $NaHCO_3$. [b] Isolated yield after column chromatography purification. [c] Isolated yield after column chromatography purification starting from the corresponding bromoarene is given in parenthesis.

We found especially interesting *ortho*-bromoaryl substituted imines **4e** and **4l** regarding synthetic applications. They have been used as precursors of chiral tricyclic lactams **6** and **7**, diastereoselective allylation of the prochiral imine functionality and an intramolecular *N*-arylation involving the carbon-bromine bond being key steps of these transformations.[18] In addition, imine **4e** was also used as a reaction intermediate in the synthesis of natural products (-)-angustureine and (-)-cuspareine (Figure 1).[19]

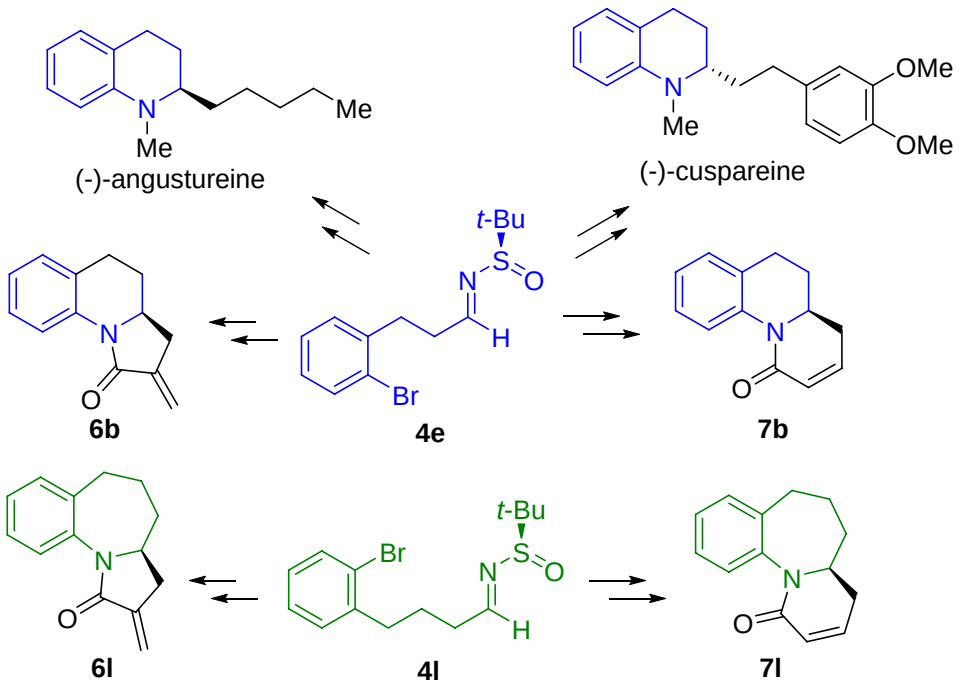


Figure 1. Synthetic Applications of Imines **4b** and **4l**

Conclusions

In summary, *N-tert*-butanesulfinyl aldimines derived from 3-arylpropanal and 4-arylbutanal were prepared in a one-pot process starting from *N-tert*-butanesulfinamide, aryl iodides and allyl and homoallyl alcohols, respectively. A Heck-type palladium-catalyzed coupling involving the aryl iodide and the alkenol occurred first, followed by isomerization of the resulting compound leading to an aldehyde, taking place finally the condensation with the sulfinamide. The functionalized chiral imines, especially those with bromine atoms bonded to the aromatic ring, are of potential synthetic interest as precursor of more complex molecules involving the transformation of the present functionalities. The here presented one-pot solvent-free methodology is also of interest taking into account environmental issues because the amounts of waste, solvents and labour are considerably minimized if compared to classical methods.

Experimental Section

General: (R_S)-*tert*-Butanesulfinamide was a gift of MEDALCHEMY SL (> 99% ee by chiral HPLC on a Chiracel AS column, 90:10 n-hexane/*i*-PrOH, 1.2 mL/min, λ=222 nm). TLC was performed on silica gel 60 F_{254}, using aluminium plates and visualized with phosphomolybdic acid (PMA) stain. Flash chromatography was carried out on hand packed columns of silica gel 60 (230- 400 mesh). Gas chromatographic analyses (GC) were carried out in a Agilent Technologies 6890N instrument equipped with a flame ionization detector and a 30.0 m capillary column (0.25 mm diam, 0.25 μm film thickness), using nitrogen (1.4 ml/min) as carrier gas, $T_{injector}$ = 275°C, T_{column} = 60 °C (3 min) and 60-270 °C (15 °C/min). Melting points are uncorrected. Optical rotations were measured using a polarimeter with a thermally jacketed 5 cm cell at approximately 23 ºC and concentrations (*c*)

are given in g/100 mL. Infrared analyses were performed with a spectrophotometer equipped with an ATR component; wave numbers are given in cm^{-1}. Low-resolution mass spectra (EI) were obtained at 70 eV; and fragment ions in *m/z* with relative intensities (%) in parentheses. High-resolution mass spectra (HRMS) were also carried out in the electron impact mode (EI) at 70 eV and on an apparatus equipped with a time of flight (TOF) analyzer and the samples were ionized by ESI techniques and introduced through an ultra-high pressure liquid chromatography (UPLC) model. ^{1}H NMR spectra were recorded at 300 or 400 MHz for ^{1}H NMR and 75 or 100 MHz for ^{13}C NMR, using $CDCl_3$ as the solvent and TMS as internal standard (0.00 ppm). The data is being reported as: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet or unresolved, br s = broad signal, coupling constant(s) in Hz, integration. ^{13}C NMR spectra were recorded with ^{1}H-decoupling at 100 MHz and referenced to $CDCl_3$ at 77.16 ppm. DEPT-135 experiments were performed to assign CH, CH_2 and CH_3. All reactions requiring anhydrous conditions were performed in oven dried glassware under argon. Otherwise indicated, all commercially available chemicals were purchased from Acros or Sigma-Aldrich and used without purification.

General procedure for the synthesis of *N*-*tert*-butanesulfinyl aldimines 4: A mixture of the TBAB (0.485 g, 1.5 mmol) and $Pd(OAc)_2$ (0.0045 g, 0.02 mmol) was stirred at 110 ºC for 15 min in a high pressure tube under argon. When the mixture was melted, $NaHCO_3$ (0.210 g, 2.5 mmol), the corresponding aryl iodide **1** (1.0 mmol) and alkenol **2** (1.5 mmol) were added, and stirring was continued for 4 h at the same temperature. Then, the reaction mixture was cooled down to 80 ºC, and *tert*-butanesulfinamide (**1**, 0.061 g, 0.5 mmol) was added. The resulting mixture was stirred at 80 ºC for 8 additional h, and after that, cooled down to room temperature, and diluted with EtOAc (25 mL). The resulting suspension was filtered through a short path of Celite and concentrated (15 Torr). The residue was hydrolyzed with water (10 mL), extracted with EtOAc (3×15 mL), dried with anhydrous $MgSO_4$ and evaporated (15 Torr). The residue was purified by column chromatography (silica gel, hexane/EtOAc, 5:1) to yield pure compounds **4**. Yields for compounds **4** are given on Table 2. Physical and spectroscopic data follow.

(R_S)-*N*-(*tert*-Butanesulfinyl)-3-phenylpropan-1-imine (4a):[20] Colourless oil; $[\alpha]_D^{23}$ -208 (*c* 1.1, CH_2Cl_2); R_f 0.78 (hexane/EtOAc: 1/1); IR *v* (film) 3012, 2957, 2869, 1622, 1582, 1496, 1454, 1362, 1180, 1078 cm^{-1}; δ_H 8.11 (t, *J* = 4.2 Hz, 1H), 7.27-7.19 (m, 5H), 3.00-2.90 (m, 2H), 2.90-2.83 (m, 2H), 1.13 (s, 9H); δ_C 168.7 (CH), 140.3 (C), 128.6, 128.3, 126.3 (CH), 56.6 (C), 37.5 (CH_2), 31.4 (CH_2), 22.3 (CH_3); LRMS (EI) *m/z* 131 (M^+-$C_4H_{10}SO$, 34%), 92 (11), 91 (100), 65 (19), 51 (10).

(R_S)-*N*-(*tert*-Butanesulfinyl)-3-(2-methylphenyl)propanimine (4b): Colourless oil; $[\alpha]_D^{23}$ -115 (*c* 1.2, CH_2Cl_2); R_f 0.78 (hexane/EtOAc: 1/1); IR *v* (film) 3025, 2957, 2925, 2848 1621, 1456, 1362, 1182, 1159, 1084, 940 cm^{-1}; δ_H 8.14 (t, *J* = 4.3 Hz, 1H), 7.26-7.11 (m, 4H), 2.97-2.91 (m, 2H), 2.85-2.77 (m, 2H), 2.32 (s, 3H) 1.16 (s, 9H); δ_C 168.65 (CH), 138.55, 135.9 (C), 130.4 , 128.5, 126.3, 126.2 (CH), 56.6 (C), 36.4, 28.8 (CH_2), 22.3, 19.3 (CH_3); LRMS (EI) *m/z* 145 (M^+-$C_4H_{10}SO$, 28%), 105 (100), 104 (11), 103 (13), 79 (11), 77 (16), 51 (10); HRMS (ESI): Calculated for $C_{10}H_{13}NOS$ (M^+-C_4H_8) 195.0718, found 195.0723.

(R_S)-*N*-(*tert*-Butanesulfinyl)-3-(3-methylphenyl)propan-1-imine (4c): Colourless oil; $[\alpha]_D^{23}$ -81 (*c* 1, CH_2Cl_2); R_f 0.75 (hexane/EtOAc: 1/1); IR *v* (film) 3022, 2918, 2857, 1620, 1456, 1362, 1158, 1084, 914, cm^{-1}; δ_H 8.11 (t, *J* = 4.1 Hz, 1H), 7.20-7.15 (m, 1H), 7.02-6.99 (m, 3H), 2.96-2.91 (m, 2H), 2.88-2.81 (m, 2H), 2.32 (s, 3H), 1.13 (s, 9H); δ_C 168.7 (CH), 140.4, 138.2 (C), 129.3 , 128.6, 127.1, 125.4 (CH), 56.7 (C), 37.6, 31.4 (CH_2), 22.4, 21.5 (CH_3); LRMS (EI) *m/z* 145 (M^+-$C_4H_{10}SO$, 31%), 106 (10), 105 (100), 77 (14); HRMS (ESI): Calculated for $C_{14}H_{21}NOS$ (M^+) 251.1344, found 251.1334.

(R_S)-*N*-(*tert*-Butanesulfinyl)-3-(4-methylphenyl)propan-1-imine (4d): Colourless oil; $[\alpha]_D^{23}$ -127 (*c* 1, CH_2Cl_2); R_f 0.78 (hexane/EtOAc: 1/1); IR *v* (film) 3028, 2957, 2923, 2850 1621, 1514, 1455, 1362, 1182, 1085, 807 cm^{-1}; δ_H 8.10 (t, *J* = 4.3 Hz, 1H), 7.13-7.04 (m, 4H), 2.94-2.90 (m, 2H), 2.85-2.80 (m, 2H), 2.31 (s, 3H), 1.13 (s, 9H); δ_C 168.8 (CH), 137.2 , 135.75 (C), 129.2, 128.2 (CH), 56.6 (C), 37.7 , 33.0 (CH_2), 22.3, 21.0 (CH_3); LRMS (EI) *m/z* 145 (M^+-$C_4H_{10}SO$, 23%), 106 (10), 105 (100), 103 (12), 77 (15); HRMS (ESI): Calculated for $C_{14}H_{21}NOS$ (M^+) 251.1344, found 251.1332.

(R_S)-*N*-(*tert*-Butanesulfinyl)-3-(2-bromophenyl)propan-1-imine (4e):[21] Colourless oil; $[\alpha]_D^{23}$ -43 (*c* 1.2, CH_2Cl_2); R_f 0.75 (hexane/EtOAc: 1/1); IR *v* (film) 2974, 2875, 2869, 1622, 1567, 1471, 1439, 1362, 1084, 1024, 749 cm^{-1}; δ_H 8.14 (t, *J* = 4.1 Hz, 1H), 7.53 (dd, *J* = 4.7 Hz, 1H), 7.27-7.23 (m, 2H), 7.11-7.05 (m, 1H), 3.12-3.06 (m, 2H), 2.90-2.83 (m, 2H), 1.17 (s, 9H); δ_C 168.2 (CH), 139.8 (C), 133.0, 130.4, 128.15, 127.7 (CH), 124.4, 56.7 (C), 36.0 , 31.9 (CH_2), 22.4 (CH_3); LRMS (EI) *m/z* 211 (M^+-C_4H_8-^{81}Br, 25%), 209 (26), 171 (97), 169 (100), 90 (23), 89 (19), 77 (10), 63 (11), 51 (10).

(R_S)-*N*-(*tert*-Butanesulfinyl)-3-(thiophen-2-yl)propan-1-imine (4f): Colourless oil; $[\alpha]_D^{23}$ -41 (*c* 1.2, CH_2Cl_2); R_f 0.72 (hexane/EtOAc: 1/1); IR *v* (film) 2959, 2924, 2359, 2341, 1622, 1455, 1363, 1179, 1076 cm^{-1}; δ_H 8.12 (t, *J* = 4.0 Hz, 1H), 7.13 (dd, *J* = 10.0, 5.2 Hz, 1H), 6.91 (dd, *J* = 5.0, 3.6 Hz, 1H), 6.84 (dd, *J* = 3.4, 0.9 Hz, 1H), 3.22-3.18 (m, 2H), 2.94-2.89 (m, 2H), 1.15 (s, 9H), 1.15 (s, 9H); δ_C 167.9 (CH), 143.0 (C), 126.85, 124.7, 123.5 (CH), 56.7 (C), 37.7 (CH_2), 25.5 (CH_2), 22.3 (CH_3); LRMS (EI) *m/z* 137 (M^+-$C_4H_{10}SO$, 22%), 97 (100), 69 (10), 53 (12); HRMS (ESI): Calculated for $C_{11}H_{17}NOS_2$ (M^+) 243.0752, found 243.0753.

(R_S)-*N*-(*tert*-Butanesulfinyl)-3-(2-bromo-4-methylphenyl)propan-1-imine (4g): Colourless oil; $[\alpha]_D^{23}$ -39 (*c* 1.1, CH_2Cl_2); R_f 0.75 (hexane/EtOAc: 1/1); IR *v* (film) 3050, 2923, 2895, 1605, 1559, 1490, 1451, 1389, 1039, 910,732 cm^{-1}; δ_H 8.13 (t, *J* = 4.2 Hz, 1H), 7.36 (s , 1H), 7.12 (d, *J* = 7.7 Hz, 1H), 7.05-7.03 (m, 1H), 3.06-3.02 (m, 2H), 2.86-2.82 (m, 2H), 2.29 (s, 3H), 1.17 (s, 9H); δ_C 168.5 (CH), 138.2, 136.6 (C), 133.5, 130.2, 128.5 (CH), 124.2, 56.8 (C), 36.3 , 31.5 (CH_2), 22.4, 20.7 (CH_3); LRMS (EI) *m/z* 275 (M^+-C_4H_8, 30%), 273 (27), 211 (13), 209 (15), 185 (76), 183 (77), 146 (12), 131 (15), 115 (19), 104 (16), 57 (100), 41 (22); HRMS (ESI): Calculated for $C_{10}H_{12}Br^{81}NOS$ (M^+-C_4H_8) 274.9803, found 274.9802.

(R_S)-*N*-(*tert*-Butanesulfinyl)-3-(4-methoxyphenyl)propan-1-imine (4h): Colourless oil; $[\alpha]_D^{23}$ -140 (*c* 1, CH_2Cl_2); R_f 0.70 (hexane/EtOAc: 1/1); IR *v* (film) 2956, 2931, 2825, 1612, 1510, 1462, 1363, 1244, 1177, 1082, 821 cm^{-1}; δ_H 8.10 (t, *J* = 4.2 Hz, 1H), 7.12 (dd, *J* = 8.7, 0.6 Hz, 2H), 6.83 (dd, *J* = 8.8, 0.6 Hz, 2H), 3.78 (s, 3H), 2.94-2.89 (m, 2H), 2.85-2.79 (m, 2H), 1.14 (s, 9H); δ_C 168.8 (CH), 158.1, 132.45 (C), 129.4, 114.1 (CH), 56.8 (C), 55.4 (CH_3), 37.9, 30.7 (CH_2), 22.4 (CH_3); LRMS (EI) *m/z* 211 (M^+-C_4H_8, 17%), 162 (14), 121 (100), 57 (45), 41 (10); HRMS (ESI): Calculated for $C_{14}H_{21}NO_2S$ (M^+) 267.1293, found 267.1303.

(R_S)-*N*-(*tert*-Butanesulfinyl)-4-phenylbutan-1-imine (4i): Colourless oil; $[\alpha]_D^{23}$ -54 (*c* 0.5, CH_2Cl_2); R_f 0.78 (hexane/EtOAc: 1/1); IR *v* (film) 3028, 2925, 2849, 1622, 1582, 1421, 1371, 1264, 1155, 1076 cm^{-1}; δ_H 8.09 (t, *J* = 4.4 Hz, 1H), 7.31-7.26 (m, 5H), 2.71-2.67 (m, 2H), 2.57-2.52 (m, 2H), 1.98-1.95 (m, 2H), 1.20 (s, 9H); δ_C 169.25 (CH), 141.4 (C), 128.6, 128.3, 126.05 (CH), 56.6 (C), 35.5, 29.7, 27.1 (CH_2), 22.4 (CH_3); LRMS (EI) *m/z* 145 (M^+-$C_4H_{10}SO$, 19%), 105 (100), 103 (12), 79 (10), 77 (15); HRMS (ESI): Calculated for $C_{14}H_{21}NOS$ (M^+) 251.1344, found 251.1341.

(R_S)-*N*-(*tert*-Butanesulfinyl)-4-(2-methylphenyl)butan-1-imine (4j): Colourless oil; $[\alpha]_D^{23}$ -111 (*c* 1, CH_2Cl_2); R_f 0.78 (hexane/EtOAc: 1/1); IR *v* (film) 3026, 2953, 2866, 1620, 1456, 1378, 1362, 1183, 1160, 1080, 740 cm^{-1}; δ_H 8.13 (t, *J* = 4.5 Hz, 1H), 7.28-7.12 (m, 4H), 2.73-2.68 (m, 2H), 2.65-2.58 (m, 2H), 2.33 (s, 3H), 1.99-1.91 (m, 2H), 1.22 (s, 9H); δ_C 169.3 (CH), 139.6, 135.85 (C), 130.3, 128.9, 126.2, 126.0 (CH), 56.6 (C), 35.9, 32.7, 25.8 (CH_2), 22.4, 19.3 (CH_3); LRMS (EI) *m/z* 159 (M^+-$C_4H_{10}SO$, 40%), 118 (21), 117 (18), 106 (30), 105 (100), 91 (20), 79 (10), 77 (13); HRMS (ESI): Calculated for $C_{15}H_{23}NOS$ (M^+) 265.1500, found 265.1489.

(R_S)-*N*-(*tert*-Butanesulfinyl)-4-(4-methylphenyl)butan-1-imine (4k): Colourless oil; $[\alpha]_D^{23}$ -267 (*c* 0.5, CH_2Cl_2); R_f 0.80 (hexane/EtOAc: 1/1); IR *v* (film) 3050, 2960, 2926, 2830, 1622, 1514, 1456, 1421, 1364, 1265, 1073, 964 cm^{-1}; δ_H 8.11 (t, *J* = 4.5 Hz, 1H), 7.12-7.08 (m, 4H), 2.69-2.65 (m, 2H), 2.57-2.54 (m, 2H), 2.34 (s, 3H), 1.98-1.92 (m, 2H), 1.22 (s, 9H); δ_C 169.3 (CH), 138.3, 135.5 (C), 129.1, 128.3 (CH), 56.55 (C), 35.5, 34.8, 27.2 (CH_2), 22.4, 21.0 (CH_3); LRMS (EI) *m/z* 159 (M^+-$C_4H_{10}SO$, 71%), 118 (30), 117 (14), 106 (21), 105 (100), 91 (15), 77 (15); HRMS (ESI): Calculated for $C_{15}H_{23}NOS$ (M^+) 265.1500, found 265.1508.

(R_S)-*N*-(*tert*-Butanesulfinyl)-4-(2-bromophenyl)butan-1-imine (4l):[8d] Colourless oil; $[\alpha]_D^{23}$ -94 (*c* 1, CH_2Cl_2); R_f 0.78 (hexane/EtOAc: 1/1); IR *v* (film) 3052, 2957, 2923, 2875, 1621, 1514, 1455, 1362, 1182, 1085, 807 cm^{-1}; δ_H 8.11 (t, *J* = 4.5 Hz, 1H), 7.53 (dd, *J* = 9.5, 1.5 Hz, 1H), 7.24-7.22 (m , 2H), 7.07 (ddd, *J* = 10.1, 6.7, 2.7 Hz, 1H), 2.83-2.79 (m, 2H), 2.62-2.57 (m, 2H), 1.99-1.95 (m, 2H), 1.20 (s, 9H); δ_C 169.1 (CH), 140.8 (C), 133.0, 130.4, 127.9, 127.6 (CH), 124.5, 56.7 (C), 35.65 , 35.6, 25.6 (CH_2), 22.5 (CH_3); LRMS (EI) *m/z* 225 (M^+-C_4H_8-^{81}Br, 30%), 223 (31), 185 (18), 184 (18), 183 (19), 182 (17), 171 (96), 170 (10), 169 (100), 144 (39), 116 (11), 115 (11), 104 (11), 103 (13), 91 (14), 90 (27), 89 (27), 77 (16), 63 (14), 51 (12).

Supporting Information (see footnote on the first page of this article): Copies of ^{1}H, ^{13}C NMR and DEPT spectra for all the reported compounds.

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Table of Contents

Chiral *N*-*tert*-butanesulfinyl aldimines are prepared in a one-pot process from aryl iodides, allyl or homoallyl alcohols and *N*-*tert*-butanesulfinamide, through a sequential palladium-catalyzed Heck reaction, carbon-carbon double bond rearrangement and imine condensation.

Key Topic: Synthesis of *N-tert*-Butanesulfinyl Aldimines in a One-pot Process from Aryl Iodides, Allyl or Homoallyl Alcohols and *N-tert*-Butanesulfinamide