Acylimines of methyl trifluoropyruvate in cyclocondensation with C,N-bisnucleophiles

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Reactions of acylimines of methyl trifluoropyruvate with C,N-bisnucleophiles gave fluoro-containing heterocycles including the 5-oxo-4,5-dihydro-1*H*-pyrrole fragment.

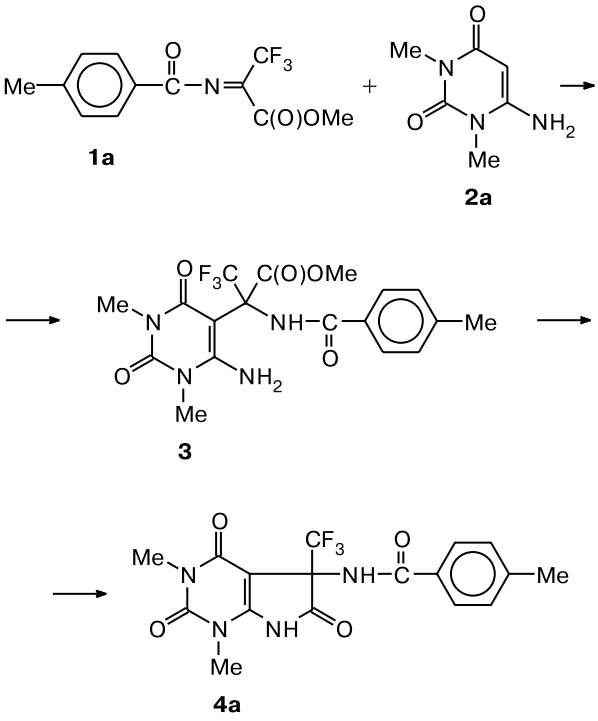
Key words: acylimines, methyl trifluoropyruvate, 3-aminocrotononitrile, methyl 3-aminocrotonates, *N*-substituted 3-aminocyclohexenones, 6-aminouracils, 6-aminothiouracils, 3-phenethylamino-1-phenylbut-2-en-1-one, hexahydro-1*H*-pyrrolo[2,3-*d*]pyrimidines, hexahydro-1*H*-indoles, dihydro-1*H*-pyrroles, 2,5-dioxopyrrolidine, hexahydro-6-thia-1,5,8a-triazaindacenes, cyclocondensation.

Acylimines of methyl trifluoropyruvate (MTFP) (**1**) are known to act as 1,2-biselectrophiles in reactions with C,O- and N,N-bisnucleophiles (*e.g.*, acetylacetone[1] and benzamidine[2]) and undergo cyclocondensation into furanones and dihydroimidazoles, respectively. Here we present our data on reactions of acylimines **1** with various C,N-bisnucleophiles that yield fluoro-containing (including fused) dihydropyrroles. Dihydropyrroles exhibit a broad spectrum of biological activities: some of them were found to be hypotensive agents,[3] inhibitors of the biosynthesis of cholesterol,[4] and antihelminthics.[5]

In the present work, we studied reactions of acylimines of MTFP **1** with a number of C,N-bisnucleophiles.

The reaction of 4-methylbenzoylimine of MTFP **1a** with 6-amino-1,3-dimethyluracil **2a** gave *C*-alkylation product **3**, which was converted into pyrrolo[2,3-*d*]pyrimidine **4a** by heating in DMF in the presence of a catalytic amount of Et_3N (Scheme 1).

Scheme 1



6-Aminouracils **2**, 6-aminothiouracils **5**, *N*-substituted 3-aminocyclohexenones **6**, 3-aminocrotononitrile **7**, methyl 3-aminocrotonates **8**, and 3-phenethylamino-1-phenylbut-2-en-1-one **9** were studied as C,N-bisnucleophiles in cyclocondensation reactions with acylimines of MTFP **1a—l** (Scheme 2). The reactions of acylimines **1** with the above reagents follow a two-step scheme consisting of exothermic *C*-alkylation and subsequent cyclization with elimination of MeOH.

Cyclocondensation reactions of acylimines **1a—l** with nucleophiles **2b—d**, **5a—g**, **6a—d**, **7**, **8a—c**, and **9** were carried out by mixing equimolar amounts of the reagents in DMF at 20 °C. After the exothermic reaction was completed, the mixture was heated at 90—100 °C for 5 h in the presence of a catalytic amount of Et_3N, without isolating intermediate adducts. The resulting hexahydro-1*H*-pyrrolo[2,3-*d*]pyrimidines **4b—h** and **10a—g**, hexahydro-1*H*-indoles **11a—e**, and dihydro-1*H*-pyrroles **12a—c**, **13a—e**, and **14a,b** were obtained in 65—86% yields.

The compounds obtained are crystalline solids; their compositions and structures were confirmed by elemental

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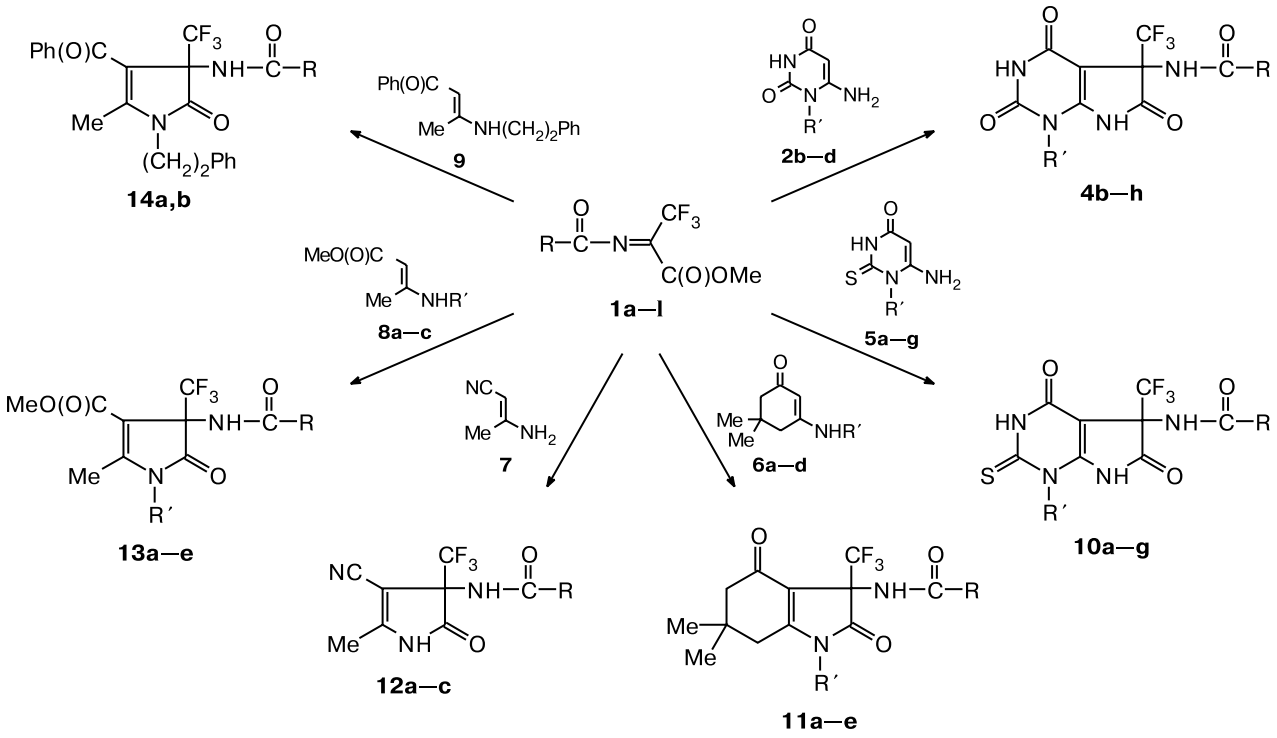
Scheme 2



Compound	R	Compound	R′	Compound	R	R′	Compound	R	R′
1a	4-MeC_5H_4	**2b**	Ph	**4b**	Me	Ph	**11a**	Ph	Bu
1b	Me	**2c**	4-FC_6H_4	**4c**	Me	4-FC_6H_4	**11b**	Ph	$PhCH_2$
1c	Et	**2d**	$PhCH_2CH_2$	**4d**	Bu^i	Ph	**11c**	Ph	$PhCH_2CH_2$
1d	Bu^i	**5a**	All	**4e**	2-FC_6H_4	Ph	**11d**	4-MeC_6H_4	4-MeC_6H_4
1e	Ph	**5b**	CH_2=C(Me)CH_2	**4f**	4-FC_6H_4	Ph	**11e**	2-Thienyl	4-MeC_6H_4
1f	2-MeC_6H_4	**5c**	Ph	**4g**	4-FC_6H_4	$PhCH_2CH_2$	**13a**	4-FC_6H_4	H
1g	2-$MeOC_6H_4$	**5d**	4-MeC_6H_4	**4h**	2-Furyl	Ph	**13b**	2-FC_6H_4	H
1h	4-ClC_6H_4	**5e**	4-MeC_6H_4	**10a**	Ph	All	**13c**	4-FC_6H_4	$PhCH_2$
1i	2-FC_6H_4	**5f**	$PhCH_2$	**10b**	Ph	CH_2=C(Me)CH_2	**13d**	2-FC_6H_4	$PhCH_2CH_2$
1j	4-FC_6H_4	**5g**	4-$FC_6H_4CH_2$	**10c**	2-FC_6H_4	CH_2=C(Me)CH_2	**13e**	4-FC_6H_4	$PhCH_2$
1k	2-Furyl	**6a**	Bu	**10d**	4-MeC_6H_4	Ph			
1l	2-Thienyl	**6b**	$PhCH_2$	**10e**	4-FC_6H_4	$PhCH_2$			
12a	Et	**6c**	$PhCH_2CH_2$	**10f**	4-FC_6H_4	4-$FC_6H_4CH_2$			
12b	4-ClC_6H_4	**6d**	4-MeC_6H_4	**10g**	2-$MeOC_6H_4$	4-MeC_6H_4			
12c	2-MeC_6H_4	**8a**	H						
14a	Ph	**8b**	$PhCH_2$						
14b	2-Thienyl	**8c**	$PhCH_2CH_2$						

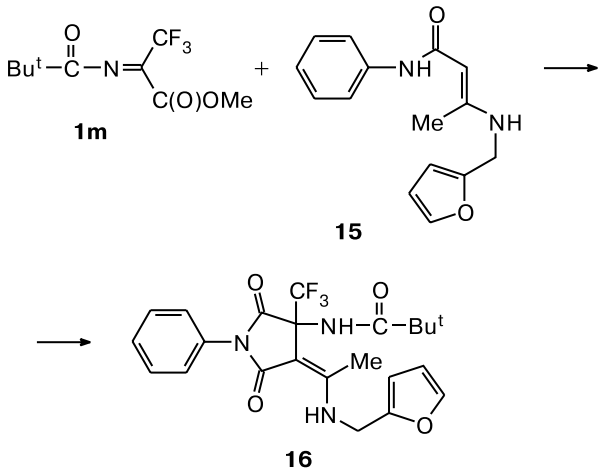
analysis and NMR spectroscopy. In ^{19}F NMR spectra, signals for the trifluoromethyl group at δ 2—6 are informative.

Introduction of a third nucleophilic site into C,N-bisnucleophiles radically changes the cyclocondensation pathway in the aforementioned transformations. For instance, the reaction of pivaloylimine of MTFP **1n** with *N*-furfuryl-3-aminocrotonanilide **15** yielded 2,5-dioxopyrrolidine **16**, which is a cyclocondensation product at the amide rather than amino N atom (Scheme 3). This structure was evident from signals for the $FurCH_2NH$ group in the ^1H NMR spectrum: a doublet for the CH_2 protons at δ 4.55 (J = 6.3 Hz) and a triplet for the NH proton at δ 9.63 (J = 6.3 Hz).

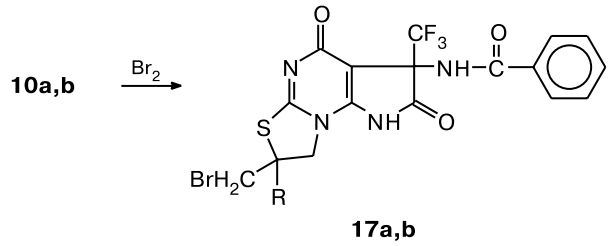
Pyrrolo[2,3-*d*]pyrimidines **10a,b** containing the allyl and methallyl thioamide fragments underwent cyclization in the presence of bromine into hexahydro-6-thia-1,5,8a-triazaindacenes **17a,b** by analogy with allylureas[6] (Scheme 4).

Thus, we studied the transformations of acylimines of methyl trifluoropyruvate in cyclocondensation reactions with C,N-bisnucleophiles and developed a preparative method for the synthesis of various novel fluoro-containing 1*H*-pyrrolones, including fused ones.

Scheme 3



Scheme 4



R = H (**a**), Me (**b**)

Experimental

^{1}H and ^{19}F NMR spectra were recorded on a Bruker DXP 200 spectrometer (200 and 188 MHz, respectively) in DMSO-d_6 with residual signals for the protons of the deuterated solvent as the internal standard (^{1}H) and with CF_3COOH as the external standard (^{19}F). Melting points were determined in glass capillaries. Acylimines of methyl trifluoropyruvate (**1a**—**m**) were prepared according to a known procedure.[1] The starting 6-amino- and 6-aminothiouracils[7] and 3-aminocyclohexenones[8] were prepared as described earlier. Methyl 3-aminocrotonate and 3-aminocrotononitrile (Aldrich) were used as purchased.

Methyl 2-(6-amino-1,3-dimethyl-2,4-dioxo-1,2,3,4-tetrahydropyrimidin-5-yl)-3,3,3-trifluoro-2-(4-methylbenzoylamino)propionate (3). Aminouracil **2a** (1.55 g, 0.01 mol) was added to a solution of imine **1a** (2.73 g, 0.01 mol) in DMF (20 mL). After the exothermic reaction was completed, the reaction mixture was stirred for 1 h and poured into water (50 mL). The precipitate that formed was filtered off and recrystallized from 50% EtOH to give compound **3** (3.7 g, 86%), m.p. 284—286 °C. Found (%): C, 50.29; H, 4.31; N, 13.25. $C_{18}H_{19}F_3N_4O$. Calculated (%): C, 50.49; H, 4.47; N, 13.08. ^{1}H NMR, δ: 2.44 (s, 3 H, Me); 3.32, 3.44 (both s, 3 H each, MeN); 3.81 (s, 3 H, MeO); 6.51 (s, 2 H, NH_2); 7.29, 7.74 (both d, 2 H each, CH_{Ar}, J = 8.6 Hz); 12.09 (s, 1 H, NH). ^{19}F NMR, δ: 2.56 (s).

N*-(1,3-Dimethyl-2,4,6-trioxo-5-trifluoromethyl-2,3,4,5,6,7-hexahydro-1*H*-pyrrolo[2,3-*d*]pyrimidin-5-yl)-4-methylbenzamide (4a).** ***A. A solution of amide **3** (2.14 g, 0.005 mol) and Et_3N (0.2 mL) in DMF (10 mL) was heated at 90—100 °C for 5 h. The reaction mixture was cooled and poured into water (50 mL). The precipitate that formed was filtered off and recrystallized from 50% EtOH to give compound **4a** (1.6 g, 72%), m.p. 196—198 °C.

Table 1. Yields, melting points, and elemental analysis data for compounds **4a**—**h**, **10a**—**g**, **11a**—**e, 12a**—**c**, **13a**—**e**, **14a,b**, and **16**

Compound	Yield (%)	M.p./°C	Found / Calculated (%)			Molecular formula
			C	H	N	
4a	83	196—198	50.37 50.52	3.66 3.81	14.32 14.14	$C_{17}H_{15}F_3N_4O_4$
4b	79	310—312	48.79 48.92	3.13 3.01	15.33 15.21	$C_{15}H_{11}F_3N_4O_4$
4c	84	262—264	46.72 46.64	2.77 2.61	14.38 14.50	$C_{15}H_{10}F_4N_4O_4$
4d	78	191—193	52.81 52.69	4.29 4.18	13.51 13.65	$C_{18}H_{17}F_3N_4O_4$
4e	76	309—311	53.69 53.58	2.82 2.70	12.63 12.50	$C_{20}H_{12}F_4N_4O$
4f	80	331—333	53.62 53.58	2.55 2.70	12.41 12.50	$C_{20}H_{12}F_4N_4O_4$
4g	75	273—275	55.31 55.47	3.23 3.39	11.89 11.76	$C_{22}H_{16}F_4N_4O_4$
4h	77	317—319	51.52 51.44	2.76 2.64	13.21 13.33	$C_{18}H_{11}F_3N_4O_5$

(*to be continued*)

Table 1 (*continued*)

Compound	Yield (%)	M.p./°C	Found / Calculated (%)			Molecular formula
			C	H	N	
10a	79	263—265	49.91	3.11	13.77	$C_{17}H_{13}F_3N_4O_3S$
			49.76	3.19	13.65	
10b	82	301—303	50.78	3.43	13.37	$C_{18}H_{15}F_3N_4O_3S$
			50.94	3.56	13.20	
10c	73	211—213	48.96	3.31	12.55	$C_{18}H_{14}F_4N_3O_3S$
			48.87	3.19	12.66	
10d	75	298—300	54.91	3.14	12.29	$C_{21}H_{15}F_3N_4O_3S$
			54.78	3.28	12.17	
10e	72	305—307	52.84	3.11	11.84	$C_{21}H_{14}F_4N_4O_3S$
			52.72	2.95	11.71	
10f	75	287—289	50.93	2.77	11.41	$C_{21}H_{13}F_5N_4O_3S$
			50.81	2.64	11.29	
10g	78	265—267	53.71	3.62	11.31	$C_{22}H_{17}F_3N_4O_4S$
			53.88	3.49	11.42	
11a	81	158—160	62.66	5.82	6.48	$C_{22}H_{25}F_3N_2O_3$
			62.55	5.97	6.63	
11b	69	193—195	62.65	5.21	6.02	$C_{25}H_{23}F_3N_2O_3$
			62.78	5.08	6.14	
11c	74	196—198	66.81	5.48	5.81	$C_{26}H_{25}F_3N_2O_3$
			66.37	5.36	5.95	
11d	76	226—228	66.48	5.45	5.82	$C_{26}H_{25}F_3N_2O_3$
			66.37	5.36	5.95	
11e	77	241—243	59.85	4.42	6.17	$C_{23}H_{21}F_3N_2O_3S$
			59.73	4.58	6.06	
12a	83	238—240	45.81	3.69	16.25	$C_{10}H_{10}F_3N_3O_2$
			45.98	3.86	16.09	
12b	81	268—270	48.77	2.48	12.38	$C_{14}H_9ClF_3N_3O_2$
			48.93	2.64	12.23	
12c	85	221—223	55.57	3.59	13.17	$C_{15}H_{12}F_3N_3O_2$
			55.73	3.74	13.00	
13a	86	228—230	49.83	3.21	7.93	$C_{15}H_{12}F_4N_2O_4$
			50.01	3.36	7.78	
13b	80	241—243	50.13	3.19	7.95	$C_{15}H_{12}F_4N_2O_4$
			50.01	3.36	7.78	
13c	68	143—145	58.50	4.19	6.37	$C_{22}H_{18}F_4N_2O_4$
			58.67	4.03	6.22	
13d	71	154—156	59.31	4.18	6.19	$C_{23}H_{20}F_4N_2O_4$
			59.48	4.34	6.03	
13e	65	143—145	58.50	4.19	6.37	$C_{22}H_{18}F_4N_2O_4$
			58.67	4.03	6.22	
14a	72	157—159	68.11	4.55	5.52	$C_{28}H_{23}F_3N_2O_3$
			68.29	4.71	5.69	
14b	69	169—171	62.48	4.09	5.76	$C_{26}H_{21}F_3N_2O_3S$
			62.64	4.25	5.62	
16	71	198—200	59.73	5.11	9.21	$C_{23}H_{24}F_3N_3O_4$
			59.62	5.22	9.07	

B. A solution of acylimine **1a** (2.73 g, 0.01 mol) and aminouracil **2a** (1.55 g, 0.01 mol) in DMF (10 mL) was stirred at 20 °C for 1 h. Then Et_3N (0.2 mL) was added and the reaction mixture was heated at 90—100 °C for 5 h, cooled, and poured into water (50 mL). The precipitate that formed was filtered off and recrystallized from 50% EtOH to give compound **4a** (3.3 g, 83%), m.p. 196—198 °C.

Compounds **4a—h**, **10a—g**, **11a—e**, **12a—c**, **13a—e**, **14a,b**, and **16** were obtained analogously from acylimines **1a—l** (0.01 mol) and the corresponding 1,3-bisnucleophiles **2b—d**,

Table 2. ^{1}H and ^{19}F NMR spectra of compounds **4a—h**, **10a—g**, **11a—e**, **12a—c**, **13a—e**, **14a,b**, and **16**

Compound	δ (*J*/Hz)	
	^{1}H	^{19}F
4a	2.43 (s, 3 H, Me); 2.81, 3.43 (both s, 3 H each, MeN); 7.17, 7.55 (both d, 2 H each, CH_{Ar}, *J* = 8.1); 9.38, 11.01, 12.25 (all s, 1 H each, NH)	4.78 (s)
4b	1.98 (s, 3 H, Me); 7.34 (m, 2 H, CH_{Ar}); 7.53 (m, 3 H, CH_{Ar}); 9.45, 11.07, 11.28 (all s, 1 H each, NH)	4.09 (s)
4c	1.96 (s, 3 H, Me); 7.21—7.42 (m, 4 H, CH_{Ar}); 9.45, 11.07, 11.28 (all s, 1 H each, NH)	−33.67 (m, 1 F); 4.10 (s, 3 F)
4d	0.96 (d, 6 H, Me, *J* = 7.9); 2.08 (m, 3 H, CH_2 + CH); 7.33 (m, 2 H, CH_{Ar}); 7.58 (m, 3 H, CH_{Ar}); 9.31, 11.05, 11.08 (all s, 1 H each, NH)	4.13 (s)
4e	7.12, 7.32, 7.48 (all m, 2 H each, CH_{Ar}); 7.63 (t, 2 H, CH_{Ar}, *J* = 7.6); 9.59, 11.24, 11.49 (all s, 1 H each, NH)	−34.95 (m, 1 F); 4.15 (s, 3 F)
4f	7.21 (t, 2 H, CH_{Ar}, *J* = 7.5); 7.33 (m, 3 H, CH_{Ar}); 7.52, 8.04 (both m, 2 H each, CH_{Ar}); 9.79, 11.08, 11.34 (all s, 1 H each, NH)	−30.08 (m, 1 F); 4.75 (s, 3 F)
4g	2.98, 4.22 (both m, 2 H each, CH_2); 7.08—7.38 (m, 7 H, CH_{Ar}); 8.01 (t, 2 H, CH_{Ar}, *J* = 7.8); 9.89, 10.92, 12.12 (all s, 1 H each, NH)	−29.75 (m, 1 F); 4.73 (s, 3 F)
4h	6.52 (m, 1 H, CH_{Fur}); 7.35 (m, 3 H, CH_{Ar} + CH_{Fur}); 7.53 (m, 3 H, CH_{Ar}); 8.72 (m, 1 H, CH_{Fur}); 9.45, 11.18, 11.42 (all s, 1 H each, NH)	4.59 (s)
10a	5.21 (m, 1 H, H_2C=); 5.36 (m, 3 H, CH_2N + CH=); 5.98 (m, 1 H, H_2C=); 7.55 (m, 3 H, CH_{Ar}); 7.98 (d, 2 H, CH_{Ar}, *J* = 7.4); 9.78, 11.96, 12.09 (all s, 1 H each, NH)	4.85 (s)
10b	1.86 (s, 3 H, Me); 4.63 (m, 1 H, H_2C=); 4.92 (m, 3 H, CH_2N + H_2C=); 7.47 (m, 3 H, CH_{Ar}); 7.93 (m, 2 H, CH_{Ar}); 9.91, 12.10, 12.42 (all s, 1 H each, NH)	4.90 (s)
10c	1.82 (s, 3 H, Me); 4.85 (m, 4 H, CH_2N + H_2C=); 7.21 (m, 2 H, CH_{Ar}); 7.47, 7.61 (both m, 1 H each, CH_{Ar}); 9.66, 12.10, 12.41 (all s, 1 H each, NH)	−32.18 (m, 1 F); 4.75 (s, 3 F)
10d	2.41 (s, 3 H, Me); 7.23 (d, 2 H, CH_{Ar}, *J* = 8.2); 7.36 (m, 2 H, CH_{Ar}); 7.54 (m, 3 H, CH_{Ar}); 7.84 (d, 2 H, CH_{Ar}, *J* = 8.2); 9.71, 11.13, 11.39 (all s, 1 H each, NH)	4.85 (s)
10e	5.64 (s, 2 H, CH_2); 7.15—7.58 (m, 7 H, CH_{Ar}); 8.05 (t, 2 H, CH_{Ar}, *J* = 7.8); 9.99, 12.31, 12.48 (all s, 1 H each, NH)	−29.76 (m, 1 F); 4.95 (s, 3 F)
10f	5.66 (s, 2 H, CH_2); 7.02—7.23 (m, 4 H, CH_{Ar}); 7.35, 8.03 (both m, 2 H each, CH_{Ar}); 9.99, 12.28, 12.42 (all s, 1 H each, NH)	−34.78, −29.73 (both m, 1 F each); 4.95 (s, 3 F)
10g	7.42 (s, 3 H, Me); 4.07 (s, 3 H, MeO); 7.06 (t, 1 H, CH_{Ar}, *J* = 7.9); 7.26 (m, 5 H, CH_{Ar}); 7.52 (t, 1 H, CH_{Ar}, *J* = 7.9); 7.91 (d, 1 H, CH_{Ar}, *J* = 7.9); 9.99, 12.28, 12.42 (all s, 1 H each, NH)	3.08 (s)
11a	1.03 (t, 3 H, Me, *J* = 7.8); 1.16 (s, 6 H, Me); 1.42, 1.59 (both m, 2 H each, CH_2); 2.19 (AB system, 2 H, CH_2, *J* = 10.6); 2.64 (s, 2 H, CH_2); 3.57 (m, 2 H, CH_2N); 7.38 (m, 3 H, CH_{Ar}); 7.84 (d, 2 H, CH_{Ar}, *J* = 7.8); 9.61 (s, 1 H, NH)	5.11 (s)
11b	1.02, 1.08 (both s, 3 H each, Me); 2.15 (AB system, 2 H, CH_2, *J* = 10.6); 2.46 (s, 2 H, CH_2); 4.88 (s, 2 H, CH_2N); 7.36 (m, 8 H, CH_{Ar}); 7.95 (d, 2 H, CH_{Ar}, *J* = 7.8); 9.73 (s, 1 H, NH)	5.08 (s)
11c	0.96, 1.02 (both s, 3 H each, Me); 2.12 (s, 2 H, CH_2); 2.16 (AB system, 2 H, CH_2, *J* = 17.4); 2.94, 3.84 (both m, 2 H each, CH_2); 7.22—7.38 (m, 5 H, CH_{Ar}); 7.46 (m, 3 H, CH_{Ar}); 7.94 (d, 2 H, CH_{Ar}, *J* = 7.4); 9.62 (s, 1 H, NH)	5.17 (s)
11d	1.04, 1.11 (both s, 3 H each, Me); 2.22 (AB system, 2 H, CH_2, *J* = 15.2); 2.37, 2.42 (both s, 3 H each, Me); 2.49 (m, 2 H, CH_2); 7.17 (d, 2 H, CH_{Ar}, *J* = 8.0); 7.28, 7.41 (both d, 2 H each, CH_{Ar}, *J* = 8.1); 7.55 (d, 2 H, CH_{Ar}, *J* = 8.0); 7.28, 7.41 (both d, 2 H each, CH_{Ar}, *J* = 8.1) 9.46 (s, 1 H, NH)	5.19 (s)
11e	1.07, 1.14 (both s, 3 H each, Me); 2.28 (AB system, 2 H, CH_2, *J* = 15.2); 2.47 (s, 3 H, Me); 2.53 (m, 2 H, CH_2); 6.56 (m, 1 H, HC=); 7.21—7.40 (m, 4 H, CH_{Ar}); 7.42, 7.72 (m, 1 H, CH_{Ar}); 9.46 (s, 1 H, NH)	4.59 (s)
12a	1.05 (t, 3 H, Me, *J* = 7.5); 2.18 (s, 3 H, Me); 2.27 (q, 2 H, CH_2, *J* = 7.5); 9.17, 11.03 (both s, 1 H each, NH)	2.83 (s)
12b	2.28 (s, 3 H, Me); 7.46, 7.97 (both d, 2 H each, CH_{Ar}, *J* = 8.4); 7.99, 11.22 (both s, 1 H each, NH)	3.64 (s)
12c	2.28, 2.44 (both s, 3 H each, Me); 7.19, 7.36 (both m, 2 H each, CH_{Ar}); 9.88, 11.21 (both s, 1 H each, NH)	3.20 (s)
13a	2.39 (s, 3 H, Me); 3.62 (s, 3 H, MeO); 7.12, 7.99 (both m, 2 H each, CH_{Ar}); 9.25, 10.83 (both s, 1 H each, NH)	−30.82 (m, 1 F); 1.26 (s, 3 F)
13b	2.41 (s, 3 H, Me); 3.67 (s, 3 H, MeO); 7.19 (m, 2 H, CH_{Ar}); 7.47, 7.63 (both m, 1 H each, CH_{Ar}); 8.73 (d, 1 H NH, *J* = 7.2); 10.96 (s, 1 H, NH)	−34.21 (m, 1 F); 2.68 (s, 3 F)
13c	2.42 (s, 3 H, Me); 3.68 (s, 3 H, MeO); 4.93 (s, 2 H, CH_2); 7.17 (m, 2 H, CH_{Ar}); 7.35 (m, 5 H, CH_{Ar}); 8.06 (m, 2 H, CH_{Ar}); 9.49 (s, 1 H, NH)	−30.21 (m, 1 F); 4.68 (s, 3 F)

(*to be continued*)

Table 2 (*continued*)

Compound	δ (*J*/Hz)	
	^{1}H	^{19}F
13d	2.42 (s, 3 H, Me); 2.87 (m, 2 H, CH_2); 3.68 (s, 3 H, MeO); 4.93 (s, 2 H, CH_2); 7.17 (m, 2 H, CH_{Ar}); 7.35 (m, 5 H, CH_{Ar}); 8.06 (m, 2 H, CH_{Ar}); 9.49 (s, 1 H, NH)	−35.12 (m, 1 F); 2.84 (s, 3 F)
13e	2.41 (s, 3 H, Me); 3.70 (s, 3 H, MeO); 4.90 (AB system, 2 H, CH_2, J = 17.0); 7.13 (t, 1 H, HC=, J = 5.1); 7.36 (m, 5 H, CH_{Ar}); 7.62, 8.19 (both d, 1 H each, HC=, J = 5.1); 9.47 (s, 1 H, NH)	4.82 (s)
14a	2.48 (s, 3 H, Me); 2.98, 3.87 (both m, 2 H each, CH_2); 7.22—7.58 (m, 13 H, CH_{Ar}); 7.98 (d, 2 H, CH_{Ar}, J = 7.8); 9.63 (s, 1 H, NH)	5.16 (s)
14b	2.45 (s, 3 H, Me); 2.94, 3.83 (both m, 2 H each, CH_2); 7.14 (t, 1 H, HC=, J = 5.4); 7.43 (m, 10 H, CH_{Ar}); 7.63, 8.17 (both d, 1 H each, HC=, J = 5.4); 9.50 (s, 1 H, NH)	5.24 (s)
16	1.21 (s, 9 H, Me); 2.19 (s, 3 H, Me); 4.55 (d, 2 H, C<u>H</u>$_2$NH, J = 6.3); 6.29 (d, 1 H, CH_{Fur}, J = 3.5); 6.36 (t, 1 H, CH_{Fur}, J = 3.5); 7.39 (d, 6 H, CH_{Ar} + CH_{Fur}); 8.67 (s, 1 H, NH); 9.63 (t, 1 H, CH_2N<u>H</u>, J = 6.3)	5.48 (s)

5a—g, **6a—d**, **7**, **8a—c**, **9**, and **15** (0.01 mol). The yields, melting points, and spectroscopic characteristics of the products are given in Tables 1 and 2.

***N*-(7-Bromomethyl-2,4-dioxo-3-trifluoromethyl-1,2,3,4,7,8-hexahydro-6-thia-1,5,8a-triazaindacen-3-yl)benzamide (17a).** Bromine (0.8 g, 0.005 mol) was added at 20 °C to a suspension of pyrrolo[2,3-*d*]pyrimidine **10a** (2.05 g, 0.005 mol) in EtOH (20 mL). The reaction mixture was stirred for 1 h, diluted with water (50 mL), and neutralized with 10% NaOH. The precipitate that formed was filtered off and recrystallized from 50% EtOH to give indacene **17a** (1.9 g, 78%), m.p. 293—295 °C. Found (%): C, 41.85; H, 2.33; N, 11.56. $C_{17}H_{12}BrF_3N_4O_3S$. Calculated (%): C, 41.73; H, 2.47; N, 11.45. ^{1}H NMR, δ: 3.94 (m, 2 H, CH_2N); 4.51 (m, 3 H, CH_2Br + CHS); 7.48 (m, 3 H, CH_{Ar}); 7.90 (d, 2 H, CH_{Ar}, J = 7.0 Hz); 9.87 (s, 1 H, NH). ^{19}F NMR, δ: 6.37 (s).

***N*-(7-Bromomethyl-7-methyl-2,4-dioxo-3-trifluoromethyl-1,2,3,4,7,8-hexahydro-6-thia-1,5,8a-triazaindacen-3-yl)benzamide (17b)** was obtained analogously from compound **10b** (2.12 g). The yield was 2.1 g (83%), m.p. 313—315 °C. Found (%): C, 43.11; H, 2.68; N, 11.26. $C_{18}H_{14}BrF_3N_4O_3S$. Calculated (%): C, 42.96; H, 2.80; N, 11.13. ^{1}H NMR, δ: 1.83 (s, 3 H, Me); 4.02 (AB system, CH_2N, J = 10.1 Hz); 4.23, 4.68 (both d, 1 H each, CH_2Br, J = 12.0 Hz); 7.47 (m, 3 H, CH_{Ar}); 7.94 (d, 2 H, CH_{Ar}, J = 7.4 Hz); 9.89 (s, 1 H, NH). ^{19}F NMR, δ: 6.34 (s).

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