A New Entry for Short and Regioselective Synthesis of [1,2,4]Triazolo[4,3-*b*][1,2,4]-triazin-7(1*H*)-ones

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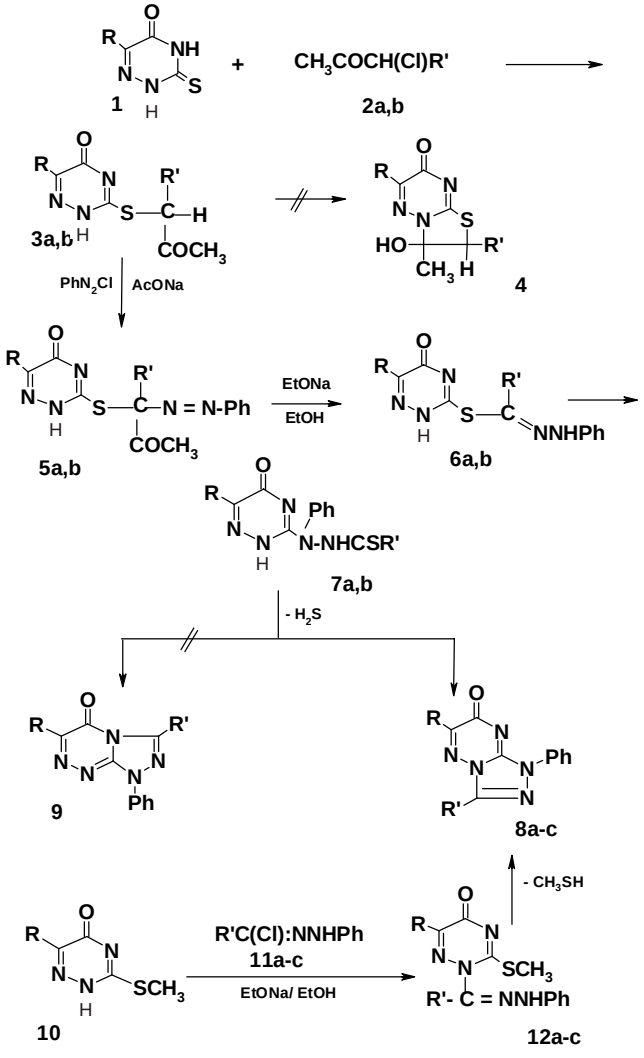
Abstract. Reaction of benzenediazonium chloride with active [1,2,4]triazin-3-ylthio-methylene compounds **3** afforded the azo coupling products **5**, which yielded [1,2,4]triazolo[4,3-*b*][1,2,4]triazin-7(1*H*)-ones **8** upon treatment with sodium ethoxide in ethanol. The latter products **8** were characterized on the basis of alternate synthesis and spectral data. The mechanism of formation of **8** and the regiochemistry of the studied reactions are discussed.

As a part of our research dealing with the chemistry of thiohydrazonate esters [1–3], we were interested in examining the use of such esters in synthesis of heterocyclic fused-ring systems with ring-junction nitrogen atoms. The latter compounds constitute an important class of natural and non-natural products, many of which exhibit useful biological activity [4]. We now wish to report a facile synthesis of [1,2,4]triazolo[4,3-*b*][1,2,4]triazine derivatives **8** *via in situ* formation and rearrangement of [1,2,4]triazin-3-yl thiohydrazonates **6** (Scheme 1). The synthetic strategy adopted in this work depends on the application of two well known reactions namely Japp-Klingemann reaction [5] and Smiles rearrangement [6–8].

Results and Discussion

The desired active [1,2,4]triazin-3-ylthiomethylene compounds **3a**,**b**, which have not yet been reported, were prepared by the reaction of **1** with ethyl α-chloroacetoacetate and α-chloroacetoacetanilide **2a**,**b**, respectively in ethanol in the presence of sodium ethoxide or triethylamine (Scheme 1). Their structures were substantiated by their microanalyses and spectral (mass, IR, ^{1}HNMR) data (Tables 1 and 2). For example, the IR spectrum of **3a** revealed carbonyl bands at 1775, 1705 and 1635 cm^{-1} in addition to NH band near 3241 cm^{-1}. Its ^{1}H NMR spectrum showed, in addition to the aromatic proton multiplet, five characteristic signals at δ 1.40(t), 2.41(s), 3.92(s), 4.50(q), 11.5 (s) assignable to the CH_3CH_2OCO, CH_3CO, =CH- and -NH- protons, respectively. The appearance of such signals and the absence of signals at δ4.75 (1H) and 2.02 (3H) due to resonances of the HO and methyl protons expected for the ring tautomer **4** exclude the assignment of the latter structure to the products isolated [9]. The formation of **3** from **1** and **2** is analogous to the *S*-alkylation of 2,3-dihydro-6-substituted-[1,2,4]triazin-4(1*H*)-one derivatives [10].

Next, we examined the azo coupling of **3** with benzenediazonium chloride in ethanol in the presence of sodium acetate. Based on our previous work in this area of chemistry [2], it was anticipated that such a reaction would yield the expected Japp-Klingemann products namely the thiohydrazonate esters **6** (Scheme 1). However, the elemental analyses and spectral data (mass, IR, ^{1}H NMR) of the products isolated from such reactions were compatible with azo structures **5**. For example, the IR spectra of the latter revealed the me-



Scheme 1 Reaction pathway leading to formation of [1,2,4]triazolo-[4,3-*b*][1,2,4]triazin-7(1*H*)-ones

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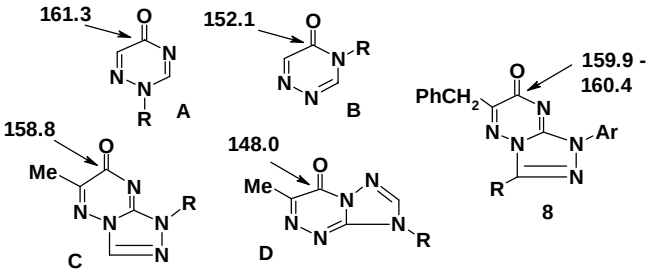
thyl ketone carbonyl stretch at 1680–1670 cm^{-1} and their ^1H NMR spectra showed also the presence of the acetyl proton signal at δ 2.3–2.5.

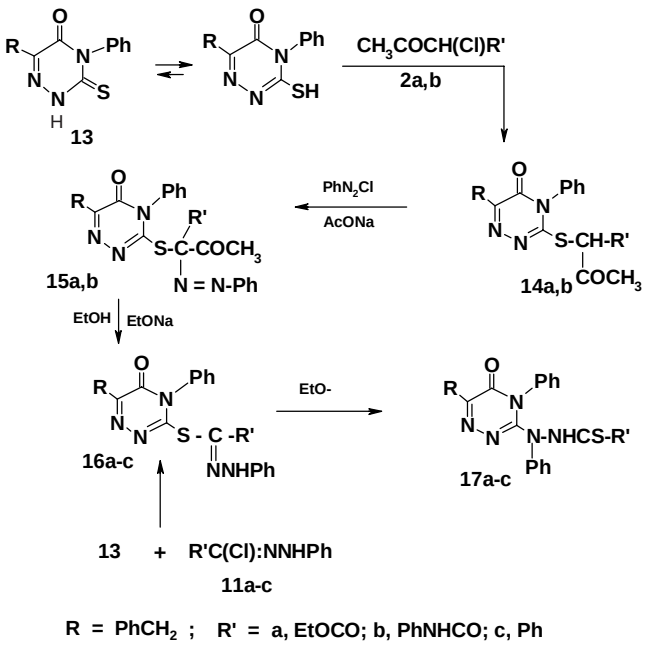
In an attempt to effect elimination of the acetyl group from **5** in order to get the thiohydrazonates **6**, each of compounds **5a**,**b** was treated with sodium ethoxide in ethanol at room temperature. Surprisingly, however, such a treatment afforded products whose microanalyses and mass spectral data showed them to be free of sulfur. Both microanalyses and spectral (IR, ^1H NMR and Mass) data of the isolated products were consistent with either *s*-triazolo-[4,3-*b*]-*as*-triazine structure **8** or s-triazolo[3,4-*c*]-as-triazine structure **9** (Scheme 1). An immediate decision between structures **8** and **9** in favour of the former was reached by comparison of the ^{13}C NMR chemical shifts for our products with those of similar compounds having a 1,2,4-triazine nucleus. Daunis *et al*. [11] have shown that in a 1,2,4-triazinone ring structure the chemical shift for the carbonyl carbon is markedly affected by the nature of the adjacent nitrogen (pyridine type in our structure **8** and pyrrole type in our structure **9**). The reported chemical shift values of 1,2,4-triazinone **A** and **B** and 1,2,4-triazinone condensed systems **C** and **D** are compared with the values of our isolated products **8** (see Formula). Since the values found for the latter products (Table 1) are similar to those of **A** and **C**, products **8** are identified as [1,2,4]triazolo[4,3-*b*][1,2,4]triazinon-7(1*H*)-ones.



To account for the transformation (**5** + $EtO^- \rightarrow$ **8**), it is suggested that the reaction starts with Japp-Klingemann cleavage of the acetyl group to yield the thiohydrazonates **6** which undergo *in situ* Smiles rearrangement under the employed reaction conditions into the respective thiohydrazides **7**. Then the latter cyclize regioselectively with concurrent elimination of hydrogen sulfide to give **8** as the end products (Scheme 1).

The assignment of structure **8** to the isolated products was confirmed by their alternate synthesis from 6-benzyl-3-methylthio[1,2,4]triazin-5(4*H*)-one **10** (Scheme 1). Thus, treatment of **10** with hydrazonoyl chlorides **11** in ethanol in the presence of sodium ethoxide yielded products identical in all respects (*m.p.*, mixed *m.p.*, IR and ^1H NMR) with **8** obtained above (Scheme 1). The formation of **8** from **10** and **11** is compatible with literature data. Thus, literature reports indicated spectroscopically [12] and chemically [13] that 3-substituted 1,2,4-triazin-5(4*H*)-ones exist predominantly in the tautomeric form namely 1,2,4-triazin-5(2*H*)-one and their reactions with alkyl halides and acyl halides usually lead to the respective 2-substituted derivatives [14]. Accordingly, it is not unreasonable to conclude that the reaction of **10** with **11** proceeds through the amidrazone intermediate **12** which in turn cyclizes with elimination of methanethiol to give **8** as outlined in Scheme 1.

In order to get an evidence for the involvement of the thiohydrazonate esters of type **6** as intermediates and their *in situ* rearrangement into thiohydrazides **7** under the reaction conditions employed in the foregoing conversion of **5** into **8** (Scheme 1), the reactions of 6-benzyl-2,3-dihydro-4-phenyl-3-thioxo-5(4*H*)-one **13** with **2a**,**b** and the azo coupling of the resulting products were investigated. Thus, reaction of **13** with **2a**,**b** in ethanol in the presence of triethylamine at room temperature yielded **14a**,**b**, respectively (Scheme 2). The structures of the latter products were established from microanalyses and mass, IR and ^1H NMR spectra which showed all the expected signals (Tables 1–3). Like **3**, when **14** were treated with benzenediazonium chloride in ethanol in the presence of sodium acetate, they yielded the respective stable azo products **15** (Scheme 3). Structural assignments of the products **15** isolated were made on the basis of their mass, ^1H NMR and IR data and elemental analyses (Tables 1–3).



Scheme 2 Synthesis and Smiles-rearrangement of thiohydrazonate esters

Treatment of **15** with sodium ethoxide in ethanol at reflux afforded products that proved to be the thiohydrazides **17** as the end products. The latter products resulted undoubtedly *via in situ* Smiles rearrangement of the Japp-Klingemann thiohydrazonates **16** (Scheme 2). This conclusion was substantiated by alternate synthesis of **16** and their base-catalyzed rearrangement into **17**. Thus, treatment of **13** with hydrazonoyl chlorides **11a**–**c** in ethanol in the presence of sodium ethoxide at room temperature afforded the thiohydrazonate esters **16a**–**c**, respectively. The structures of the latter were established from their microanalyses and spectra (mass, IR and ^1H NMR) (Tables 1–3). For example, as with other heteroaryl thiohydrazonates [15], loss of the elements of the corre-

Table 1 Spectral data of the products **3**–**17**

Compd. no.	IR νNH / νCO (cm^{-1})	^{1}H NMR [a]) δ/ppm
3a	3241 1775, 1705, 1636	1.40 (t, *J* = 7 Hz, 3H), 2.41 (s, 3H), 3.97 (s, 2H), 4.50 (q, *J* = 7 Hz, 2H), 6.0 (s, 1H), 7.0–7.8 (m, 5H), 11.5 (s, 1H)
3b	3273, 3138 1674, 1643, 1630	2.51(s, 3H), 3.9 (s, 2H), 4.57 (s, 1H), 7.0–8.0(m, 10H), 10.3 (s, 1H), 10.59 (s, 1H)
5a	3199 1726, 1685	1.44 (t, *J* = 7 Hz, 3H), 2.28 (s, 3H), 3.8 (s, 2H), 4.51 (q, *J* = 7 Hz, 2H), 7.07–7.63 (m, 10H), 12.68 (s, 1H)
5b	3273, 3205 1720, 1676, 1643	2.52 (s, 3H), 3.70 (s, 2H), 7.0–8.0 (m, 15H), 10.6 (s, 1H), 11.0 (s, 1H)
8a	– 1745, 1660	1.43 (t, *J* = 7 Hz, 3H), 4.21 (s, 2H), 4.51 (q, *J* = 7 Hz, 2H), 7.2–8.72 (m, 10H)
8b	3147 1672, 1665	4.35 (s, 2H), 7.17–8.21 (m, 15H), 9.4 (s, 1H)
8c	– 1660	4.25 (s, 2H), 7.27–8.23 (m, 15H)
14a	– 1741, 1693, 1640	δ 1.32 (t, *J* = 7 Hz, 3H), 2.30 (s, 3H), 3.7 (s, 2H), 4.30 (q, *J* = 7 Hz, 2H), 6.8–7.6 (m, 10H);
14b	3135 1724, 1664	2.34 (s, 3H), 3.81 (s, 2H), 3.94 (s, 1H), 6.99–7.56(m, 15H), 9.8 (s, 1H)
15a	– 1730, 1680, 1662	1.24 (t, *J* = 7 Hz, 3H), 2.24 (s, 3H), 3.23 (two d, 2H), 4.1 (q, *J* = 7 Hz), 7.15–8.16 (m, 15H)
15b	– 1735, 1672, 1650	2.18 (s, 3H), 3.97 (two d, 2H), 7.07–7.54 (m, 20H), 8.14 (s, 1H)
16a	3307 1743, 1649	1.45 (t, *J* = 7 Hz, 3H), 4.04 (q, *J* = 7 Hz, 2H), 7.03–7.76 (m, 15H), 11.33 (s, 1H)
16b	3346, 3267 1685, 1654	4.33 (s, 2H), 7.16–8.20 (m, 20H), 11.60 (s, 1H)
16c	3303 1651	4.34 (s, 2H), 7.12–7.60 (m, 20H), 11.8 (s, 1H)
17a	3361 1741, 1676	1.32 (t, *J* = 7 Hz, 3H), 4.04 (s, 2H), 4.40 (q, *J* = 7 Hz, 2H), 7.07–7.89 (m, 15H), 9.78 (s, 1H);
17b	3350 1664, 1637	4.01 (s, 2H), 6.95–7.87 (m, 20H), 8.97 (s, 1H), 9.2 (s, 1H)
17c	3353 1660	4.31 (s, 2H), 7.34–7.68 (m, 20H), 9.4 (s, 1H)

[a]) ^{13}C NMR : **8a**: δ/ppm 159.9, 155.8, 154.2, 148.2, 135.8, 135.5, 134.6, 129.4, 129.2, 128.2, 128.1, 126.6, 121.3, 62.9, 36.8, 14.0; **8b**: δ/ppm 160.4, 156.2, 152.0, 148.2, 137.4, 137.3, 136.0, 135.9, 129.6, 129.5, 129.2, 128.6, 128.2, 126.9, 125.2, 121.3, 120.8, 36.7; **8c**: δ/ppm 160.3, 155.3, 147.8, 142.4, 136.2, 136.0, 131.6, 129.5, 129.4, 128.9, 128.2, 127.9, 127.3, 126.6, 123.7, 120.5, 36.8.

Table 2 Mass spectral data of the products **3**–**17**

Compd. no.	*m/z* (%)
3a	347 (M+, 38), 305 (63), 269(27), 259(57), 231(100), 117(15), 91(54), 88(13), 77(13).
3b	394 (M+, 24), 353 (38), 259(40), 231(51), 117(17), 93(100), 91(39), 77(18)
5a	451 (M+, 3), 361 (19), 276(52), 250(69), 175(77), 145(29), 131 (100), 118(35), 103(98), 91(84), 77(63).
5b	500 (M^++2, 2), 499 (M^++1, 5), 485(54), 442(23), 398(25), 333 (21), 309(15), 217(37), 162(11), 118(100), 91(38), 77(49)
8a	376 (M^++1, 100), 258 (23), 231(26), 213(44), 186(81), 145(58), 117(39), 91(100), 77(62).
8b	423 (M+, 82), 305 (46), 213 (100), 145 (54), 117 (29), 104(17), 91(20), 77(68)
8c	379 (M+, 40), 262 (100), 194 (18), 176 (12), 149 (53), 117 (14), 104(24), 103(34), 91(73), 77(19)
14a	423 (M+, 94), 382 (20), 336(20), 279(25), 218(74), 145(24), 135 (24), 118(37), 103(23), 91(100), 77(13)
14b	471 (M+, 69), 428 (21), 384(19), 261(50), 233(68), 174 (18), 146(28), 125(30), 118(100), 77(36)
15a	527 (M+, 6), 526 (34), 487 (15), 459 (18), 434 (50), 402 (91), 398 (21), 336 (22), 295 (15), 262 (100), 233 (38), 198 (51), 170 (29), 118 (92)
15b	574 (M+, 16), 532 (19), 412(50), 411(100), 238(14), 237(8), 185 (12), 149(18), 117(36), 91(71), 77(62)
16a	485 (M+, 46), 395 (13), 365(77), 363(16), 296(3), 149(26), 117(18), 91(100), 77(49)
16b	532 (M^++1, 65), 411 (62), 176(14), 149(18), 117 (19), 118(44), 91(100), 77(78)
16c	490 (M^++1, 23), 489 (20), 473 (18), 389 (12), 370 (26), 296 (57), 154 (24), 125 (45), 91 (100), 77 (43)
17a	485 (M+, 77), 365 (31), 364(100), 176(12), 149(53), 117 (15), 104(24), 103(34), 91(73), 77(19)
17b	532 (M^+, 16), 411 (47), 176(13), 149(15), 117(21), 91(100), 77(81)
17c	490 (M^++1, 22), 489 (20), 384 (31), 316 (39), 180 (47), 121 (59), 92 (100), 77 (78)

Table 3 Physical constants and analytical data of the products **3**–**17**

Compd. no.	Yield %	*m.p.* °C (solvent) [+]	Molecular formula	Anal. C %	Calcd. / H %	Found N %
3a	75	152–154	$C_{16}H_{17}N_3O_4S$	55.33	4.93	12.10
		(a)	(347.4)	55.40	4.60	12.20
3b	80	184–186	$C_{20}H_{18}N_4O_3S$	60.90	4.60	14.20
		(b)	(394.4)	60.70	4.80	14.30
5a	72	183–184	$C_{22}H_{21}N_5O_4S$	58.53	4.65	15.58
		(c)	(451.5)	58.70	4.70	15.40
5b	78	196–197	$C_{26}H_{22}N_6O_3S$	62.64	4.45	16.86
		(c)	(498.5)	62.80	4.50	16.90
8a	67	218–219 [e])	$C_{20}H_{17}N_5O_3$	63.99	4.56	18.66
		(b)	(375.4)	63.80	4.40	18.50
8b	64	250–251	$C_{24}H_{18}N_6O_2$	68.20	4.29	19.89
		(b)	(422.4)	67.90	4.30	20.10
8c	80	243 [g])	$C_{23}H_{17}N_5O$	72.80	4.54	18.47
			(379.4)	72.60	4.70	18.50
14a	75	157–158	$C_{22}H_{21}N_3O_4S$	62.40	5.00	9.92
		(c)	(423.5)	62.10	5.10	10.20
14b	80	167-8	$C_{26}H_{22}N_4O_3S$	66.37	4.71	11.91
		(a)	(470.5)	66.30	4.60	11.80
15a	72	189–190	$C_{28}H_{25}N_5O_4S$	63.74	4.78	13.27
		(c)	(527.6)	63.40	4.80	13.30
15b	75	168–169	$C_{32}H_{26}N_6O_3S$	66.88	4.56	14.62
		(d)	(574.6)	66.60	4.70	14.80
16a	75	143 [h])	$C_{26}H_{23}N_5O_3S$	64.31	4.77	14.42
		(b)	(485.5)	64.50	4.60	14.30
16b	80	180	$C_{30}H_{24}N_6O_2S$	67.65	4.54	15.78
		(c)	(532.6)	67.90	4.30	15.90
16c	80	176 [i])	$C_{29}H_{23}N_5OS$	71.14	4.74	14.30
		(b)	(489.6)	70.80	4.60	14.60
17a	66	157–158	$C_{26}H_{23}N_5O_3S$	64.31	4.77	14.42
		(a)	(485.5)	64.50	4.60	14.50
17b	70	186–188	$C_{30}H_{24}N_6O_2S$	67.65	4.54	15.78
		(c)	(532.6)	67.80	4.20	15.90
17c	75	200	$C_{29}H_{23}N_5OS$	71.14	4.74	14.30
		(c)	(489.6)	71.20	4.50	14.40

[+]solvent of crystallization: (a) MeOH; (b) AcOH; (c) EtOH; (d) $MeOH/H_2O$
[e]) Lit. *m.p.* 217–219 °C [21]; [g]) Lit. *m.p.* 243–245 °C [21]
[h]) Lit *m.p.* 143–144 °C [21]; [i]) Lit. *m.p.* 176–178 °C [21]

sponding thiol **13** from the molecular ions was a characteristic feature of the mass spectra of **16a**–**c**. When the esters **16a**–**c** were refluxed in ethanol in the presence of sodium ethoxide, they underwent Smiles rearrangement [6–8] and afforded the respective thiohydrazides **17a**–**c**, respectively in overall good yields (Scheme 2). Their structures were established from their microanalyses and their spectral data (IR, ^{1}H NMR) (see Experimental).

The foregoing results indicate that both transformations namely [**5** + (EtO^-) → **8**] and [**15** + (EtO^-) → **17**] proceed *via* the thiohydrazonate esters **6** and **16** as transient intermediates which in turn undergo *in situ* rearrangement to give the thiohydrazides **7** and **17**, respectively. Unlike **17**, the thiohydrazides **7**, due to the presence of the heterocyclic NH group, undergo further regioselective cyclization with concurrent elimination of hydrogen sulfide to give **8**, rather than the regioisomers **9**, as end products (Scheme 1). This regioselective cyclization can be rationalized in terms of the overall electronic distribution in **7** which indicates that N-2 is more nucleophilic than N-4 because the latter is situated between two electron-deficient carbon atoms. Thus, cyclization of **7** at N-2 is more favourable than at N-4 to give **8** (Scheme 1). This rationalization is compatible with other literature data [16].

Experimental

Melting points were determined with a Gallenkamp electrothermal apparatus and are uncorrected. IR spectra (KBr pellets) were obtained with a Fourier Transform Infrared and Pye-Unicam SP-300 instruments. ^{1}H NMR spectra were recorded with a Varian Gemini 200 NMR spectrometer using TMS as internal standard. Mass spectra were recorded on a GCMS-Q 1000-EX spectrometer. Elemental analyses were carried out at the Microanalytical Laboratory of Cairo University, Giza, Egypt.

The starting α-chloromethylene compounds **2a**,**b** [17]; triazinethiones **1** [18] and **13** [19], hydrazonoyl chlorides **11a**–**c** [20]; and 3-methylthiotriazinone **10** [10] were prepared as previously reported.

Synthesis of 3-Oxo-2-[(6-benzyl-5-oxo-1,2,4-triazin-3-yl)thio]butanoic acid Derivatives 3a,b and **3-Oxo-2-[(6-benzyl-5-oxo-4-phenyl-1,2,4-triazin-3-yl)thio]butanoic acid Derivatives 14a,b (General Procedure)**

To a mixture of equimolar quantities of the appropriate chloromethylene compound **2** and triazinethione **1** (or **13**) (10 mmole each) in absolute ethanol (40 ml) was added triethylamine (1.4 ml, 10 mmol). The mixture was stirred for 15 h at room temperature, then the solvent was evaporated. The solid left was collected and crystallized from the appropriate solvent. Use of sodium ethoxide (10 mmol) in lieu of triethylamine and stirring the reaction mixture for 24 h afforded also the same products **3** and **14**. The physical constants of the products **3a**,**b** and **14a**,**b** obtained are given in Table 3.

Synthesis of 2-Phenylazo-3-oxo-2-[(6-benzyl-5-oxo-1,2,4-triazin-3-yl)thio]butanoic acid Derivatives 5a,b and **2-Phenylazo-3-oxo-2-[(6-benzyl-5-oxo-4-phenyl-1,2,4-triazin-3-yl)thio]butanoic acid Derivatives 15a,b (General Procedure)**

To a solution of the appropriate **3** (or **14**) (10 mmol) in ethanol (40 ml) was added sodium acetate trihydrate (3 g) and the mixture was cooled in ice bath to 0–5 °C while being stirred. To the resulting cold solution was added portionwise a cold solution of benzenediazonium chloride, prepared as usual by diazotizing aniline (10 mmol) in hydrochloric acid (6 ml, 6M) with sodium nitrite (0.7 g, 10 mmol) in water (10 ml). After all diazonium salt solution was added, the reaction mixture was stirred for further 30 min with cooling in an ice bath. The solid that precipitated was filtered, washed with water, air dried and finally crystallized from the appropriate solvent to give the corresponding phenylazo derivatives **5** (or **15**). The products **5a**,**b** and **15a**,**b** prepared are listed in Table 3.

Synthesis of 1,3,6-Trisubstituted [1,2,4]triazolo[4,3-*b*][1,2,4]triazin-7(1*H*)-ones 8, **Ethanedioic acid mono[(2-phenyl)-2-[(6-benzyl-4,5-dihydro-5-oxo-4-phenyl-1,2,4-triazin-3-yl)]thiohydrazide] Derivatives 17a,b** and **2-Phenyl-2-[(6-benzyl-,4,5-dihydro-5-oxo-4-phenyl-1,2,4-triazin-3-yl)]benzenecarbothioic acid hydrazide 17c (General Method)**

To a stirred sodium ethoxide solution, prepared from sodium metal (0.23 g, 10 mg.atom) and absolute ethanol (20 ml) was added the appropriate phenylazo derivative **5** (10 mmol) and the mixture was stirred at room temperature for 12 h. During this period the reactant **5** dissolved and the crude product precipitated. The latter was collected by filtration, washed with water, air dried and finally crystallized from the appropriate solvent to give the corresponding **8** in 65–70% yield. Use of **15** in place of **5** in this procedure yielded the respective thiohydrazides **17**. The physical constants of the products **8** and **17** are given in Table 3.

Alternate Synthesis of 1,3,6-Trisubstituted [1,2,4]triazolo-[4,3-b][1,2,4]triazin-7(1H)-ones **8**

To a stirred ethanolic solution of sodium ethoxide, prepared from sodium metal (0.23 g, 10 mmol) and absolute ethanol (20 ml), was added **10** (10 mmol). After 10 min, the appropriate hydrazonoyl chloride **11** was added. The reaction mixture was refluxed till all methanethiol ceased to evolve (4–6 h), then cooled. The precipitated solid was filtered, washed with water and finally crystallized from the appropriate solvent to give the respective **8**. The products **8a**,**b** proved identical in all respects with those obtained above.

Preparation of [(6-Benzyl-4,5-dihydro-5-oxo-4-phenyl-1,2,4-triazin-3-yl)thio](phenylhydrazono)acetic acid Derivatives 16a,b and **(6-Benzyl-4,5-dihydro-5-oxo-4-phenyl-1,2,4-triazin-3-yl) *N*-phenyl-benzenecarbothiohydrazonate 16c**

To an ethanolic sodium ethoxide solution, prepared from sodium metal (0.23 g, 10 mg. atom) and absolute ethanol (30 ml), was added the thione **13** (2.95 g, 10 mmol) with stirring. To the resulting solution was added the appropriate hydrazonoyl chloride **11** (10 mmol) and the mixture was stirred at room temperature for 24 h. During this period compound **11** dissolved and a new product precipitated. The latter was filtered, washed with water, dried and crystallized from acetic acid or ethanol to give the respective **16**. The physical constants of the isolated products **16a–c** are listed in Table 3.

Rearrangement of 16a,b into Ethanedioic acid mono[2-phenyl-2-(6-benzyl-5-oxo-1,2,4-triazin-3-yl)thiohydrazide] Derivatives 17a,b

A mixture of equimolar quantities of **16** and sodium ethoxide (10 mmol each) in absolute ethanol (20 ml) were refluxed for 4 h and cooled. The solid that precipitated was filtered off, washed with water and dried. Crystallization of the crude product from ethanol afforded the respective thiohydrazide **17**. The products **17a–b** were obtained in 66–70% yields and proved identical in all respects with those obtained above by treatment of **15a–b** each with sodium ethoxide in ethanol, respectively.

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