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Note

Synthesis of some sulphonamide insect juvenile hormone - Part I

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Regular use of classical insecticides has drastically effected the environment and warm blooded animals. Therefore, there is an urgent need to look for a kind of chemicals which are very specific, targeted in their action and environment friendly. Since long, study on juvenile hormones is in progress to be a potential insecticide. Large no of compounds have been reported in literature with diverse structural features like amides, esters, hydroxamates, incorporated in the side arm which exhibit promising juvenile hormone activities and also decomposes when come in contact with environment. In this regard the synthesis of some of juvenile hormone analogues as a potential pesticide is reported. The synthesis of juvenile hormone analogues **4-29** containing sulphonamide features is presented. Preliminary biological screening of one representative; *N*-(1-methyl-oxo-2-piperidino-ethyl) benzene sulphonamide **24** reveals the positive juvenile hormone activity and chemosterilizing effect against potato tumor moth phthorimaea opercula.

Keywords: JH, Juvenile Hormone; IGR, Insect Growth Regulator;

Chemical used for chemosterlization of insect is one of the promising methods to control the vast insect and pest populations[1]. These chemicals are also known as insect growth regulators (IGR) or third generation insecticides[2, 3].

These IGR's differ from the commonly used insecticides as they wield insecticidal effects through their influence on development, metamorphosis and reproduction of the target insects by disrupting the normal activity of the endocrine system ultimately make them sterile. Though mechanism of action of JHA is still not clear but receptor / binding site has been identified[4].

Large number of synthetic juvenile hormone, acyclic and cyclic, are synthesized and evaluated for their biological activities are reported in literature. Number of juvenoids of the type[1a, b, c] (**Figure 1**) are synthesized, incorporating different structural features like amides, esters, oximes, hydroxamates and carbamates[5-11] in the side chain have showed interesting JH activities. In continuation of this work, juvenile hormone analogues containing sulphonamide function are reported in this paper.

Experimental Section

All the melting points are uncorrected, ^{1}H NMR spectra in $CDCl_3$ /CCl_4 or CF_3COOH diluted with CCl_4 on a Bruker AC 300 FT NMR at 300 MHz (chemical shifts in ppm) using TMS as internal standard and mass spectra on a Varian Mat CH-7 mass spectrometer (values expressed in *m*/*z*).

Potato tuber moth (both sexes) was maintained on the fresh potato leaves in petri dish covers with muslin cloth in the laboratory under the normal environmental conditions (ambient temperature 16-20°C). These petri dishes were kept under constant watch for the egg laying.

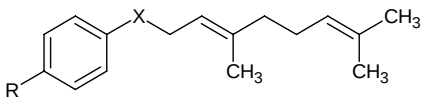
The eggs were collected and four sets (A, B, C and D, containing 50 in each; control and treated eggs) were prepared. Similarly, larvae and pupae were obtained and maintained for the treatment. The compound was dissolved in 50% acetone to obtain solutions with the concentration of 10, 25, and 50 μg/mL respectively. Thus, in each case the sets were managed as shown in **Table I**.

Acetone solution (1 mL) containing the compound was poured on the filter paper in each petri dish and allowed to evaporate. Later, the counted number of eggs/ larvae/ pupae to be treated was transferred to the petri dishes.

Preliminary biological testing of *N*-(1-methyl-2-oxo-2-piperidino-ethyl) benzene sulphonamide **24** for JH/ chemosterilizing activity indicated the positive JH activity. The eggs treated at dose rate of 25 μg/mL

Table I —- Biological testing of *N*-(1-methyl-2-oxo-2-piperidino-ethyl) benzene sulphonamide **24** against Potato Tuber Moth

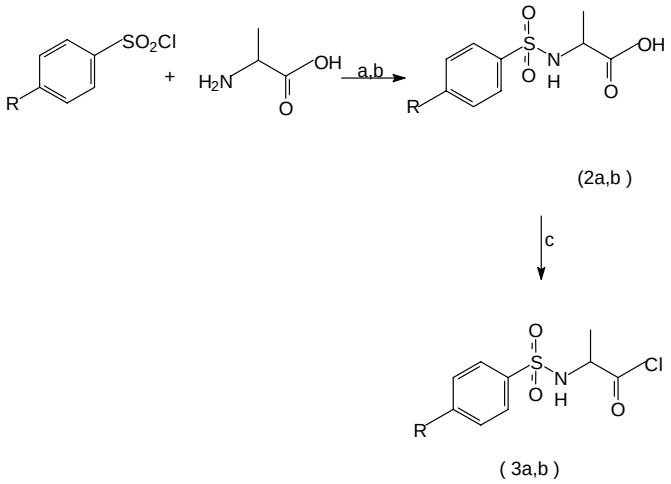
Stag	Untreated A	10μg/mL B	25g/mL C	50μg/mL D
Eggs	50	50	50	50
Larvae	20	20	20	20
Pupae male	20	20	20	20
Pupae female	20	20	20	20



(1)

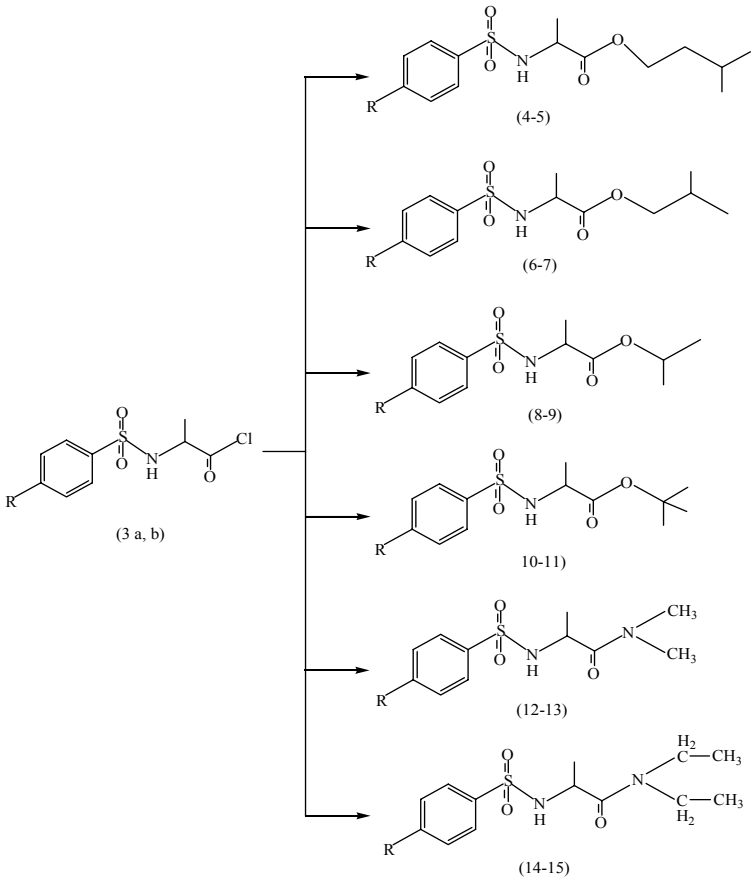
a; X = O; b; X = N; c; X = S

Figure 1



R = H (a), CH_3(b)

Figure 2



R=H, CH_3; Compd 4,6,8,10,12,14:R=H; Compd 5,7,9,11,13,15 : R= CH_3

Figure 3

Table II — Characterization data of *N*-(1,6-dimethyl-2-oxo-3-oxa-heptanyl)benzene sulphonamide and *N*-(1-methyl-2-oxo-3-aza-3-*N*-methyl-butanyl) benzene sulphonamide and their related compounds

Compd	b.p.(°C)	m.p.°C	R_f Value	^{1}H NMR (δ Values)	Mass *(m/z)*
4	95-100 / 7mm	-		7.75 (2H, Ar-*H*); 7.4(3H, Ar-*H*); 5.7(1H, -*NH*-CH(CH_3)-); 4.1 (1H, -NH-*CH*(CH_3)-CO-); 3.9 (t, 2H, -CO-*CH_2*); 1.2-1.9 (complex, 6H, NH-CH(*CH_3*)-CO-O-CH_2-*CH_2*-*CH*(CH_3)$_2$); 9.9(d, 6H, gem.dimethyl)	-
5	190-94 / 1mm	-		7.55(2H, Ar-*H*); 7.35(2H, Ar-*H*); 5.3(1H, -*NH*-CH(CH_3)-); 4.03(1H, -NH-*CH*(CH_3)-CO-); 3.9(t, 2H, -CO-*CH_2*-); 2.4(s, 3H, Ar-*CH_3*); 1.2-1.83(complex, 6H, NH-CH(*CH_3*)-CO-O-CH_2-*CH_2*-*CH*(CH_3)$_2$);	-
6	160-62 /169mm	-	0.8b	7.73(2H, Ar-*H*); 7.41(3H,Ar-*H*) 5.73(1H, -*NH*-CH(CH_3)-); 4.14(1H, -NH-*CH*(CH_3)-CO-); 3.63(d, 2H, -CH-CO-O-*CH_2*-group); 1.46-2.13(multiplet, 1H, -CH_2-*CH*(CH_3)$_2$-); 1.3(d, 3H, -NH-CH(*CH_3*)-); 0.8(d, 6H, gem. Dimethyl)	-
7	215-20 / 44mm	-	0.77b	7.65(2H, Ar-*H*); 7.15(2H, Ar-*H*); 5.3(1H, -*NH*-CH(CH_3)-); 3.83(1H, -NH-*CH*(CH_3)-); 3.63(d, 2H, -CH-CO-O-*CH_2*); 1.46-2.13 (multiplet, 1H, -CH_2-*CH*(CH_3)$_2$-); 1.3(d, 3H, -NH-CH(*CH_3*)); 0.8(d, 6H)	-
8	-	38-40	0.7a	7.7(2H, Ar-*H*); 7.4(3H, Ar-*H*); 5.23(1H,-*NH*-CH(*CH_3*)-); 4.76(m, 1H, -*CH*(CH_3)$_2$); 3.83(1H, NH-*CH*(CH_3)-); 1.26(d, 3H, NH-CH(*CH_3*)-); 1.1(d, 6H, gem. dimethyl)	-
9.	-	44-45	0.71a	7.56(2H, Ar-*H*); 7.1(2H, Ar-*H*); 5.13(1H, -*NH*-CH(CH_3)-); 4.74(m, 1H, -*CH*(CH_3)$_2$); 3.8(m, 1H, -NH-*CH*(CH_3)-); 2.36(s, 3H, Ar-*CH_3*); 1.3(d, 3*H*,-NH-CH(*CH_3*)-); 1.1(d, 6H, gem. dimethyl).	-
10.	-	101-03	0.83a	7.75(2H, Ar-*H*); 7.43(3H, Ar-*H*); 5.23(1H, -*NH*-CH(CH_3)-); 3.96(m, 1H, NH-*CH*-(CH_3) 1.4(9H, O-C- (*CH_3*)$_3$); 1.23(d, 3H, -NH-CH(*CH_3*)-CO-).	-
11	-	72-74	0.69a	7.66(2H, Ar-*H*); 7.2(2H, Ar-*H*); 5.23(1H, -*NH*-CH(CH_3)-); 3.86(m, 1H, NH-*CH*(CH_3)-); 2.4(s, 3H, Ar-*CH_3*); 1.43(9H, O-C-(*CH_3*)$_3$); 1.33(d, 3H, -NH-CH(*CH_3*)-CO-).	-
12	-	128-30	0.4a	7.6(2H, Ar-*H*); 7.4(3H, Ar-*H*); 4.3(m, 1H, NH-*CH*(CH_3)-); 3.03(s, 3H, NH (*CH_3*)$_2$; 2.76(s, 3H, NH (*CH_3*)$_2$); 1.23(d, 3H, -NH-CH(*CH_3*)-).	256[M^+], 184, 141, 77, 72, 125.
13	-	110-12	0.47a	7.56(2H, Ar-*H*); 7.16(2H, Ar-*H*); 4.4(m, 1H, NH-*CH*(CH_3)-); 3.03(s, 3H, NH (*CH_3*)$_2$;); 2.8(s, 3H, NH (*CH_3*)$_2$;); 2.4(s, 3H, Ar-*CH_3*); 1.23(d, 3H, -NH-CH(*CH_3*)-).	-
14	-	111-13	0.54a	7.56(2H, Ar-*H*); 7.33(3H, Ar-*H*); 4.33(m, 1H, NH-*CH*(CH_3)-); 3.35(m, 4H, NH(C_2H_5)$_2$); 1.05-1.46(complex, 9H,); - CH(*CH_3*)-CO	
15	-	79-81	0.68a	7.5(2H, Ar-*H*); 7.06(2H, Ar-*H*); 4.26(m, 1H, NH-*CH*(CH_3)-); 3.06-3.5(m, 4H, NH (C_2H_5)$_2$); 2.36(s, 3H, Ar-*CH_3*); 1.03-1.37(complex, 9H, -CH(CH_3)-CO NH (C_2H_5)$_2$);	-

and 50 μg/mL gave rise to adult with under-developed ovarioles which had abnormal wings that were generally short and curled. From the histological studies, it was observed that compound had a distinct chemosterilizing influence on the ovaries of potato tuber moth at dose rate of 25 μg/mL and 50 μg/mL. The damage to the ovaries was so acute that not a single oocyte could be seen in any of the sections. However at the smaller dose rate of 10 μg/mL, the compound was almost inactive.

Synthesis of *N*-(1,6-dimethyl-2-oxo-3-oxa-heptanyl)benzene sulphonamide and related compounds **4-11**, *N*-(1-methyl-2-oxo-3-aza-3-*N*-methyl-butanyl) benzene sulphonamide and related compounds **12-15**, *N*(1-methyl-2-oxo-2-anilino-ethyl) benzene sulphonamide and related compounds **16-23**, *N*-(1-methyl-2-oxo-2-piperidino-ethyl) benzene sulphonamide and related compounds **24-29** were carried out on following lines

Benzenesulphonyl alanine (**DL**, **2a**). A mixture of alanine (8.9 g, 0.1mole) and benzenesulphonyl

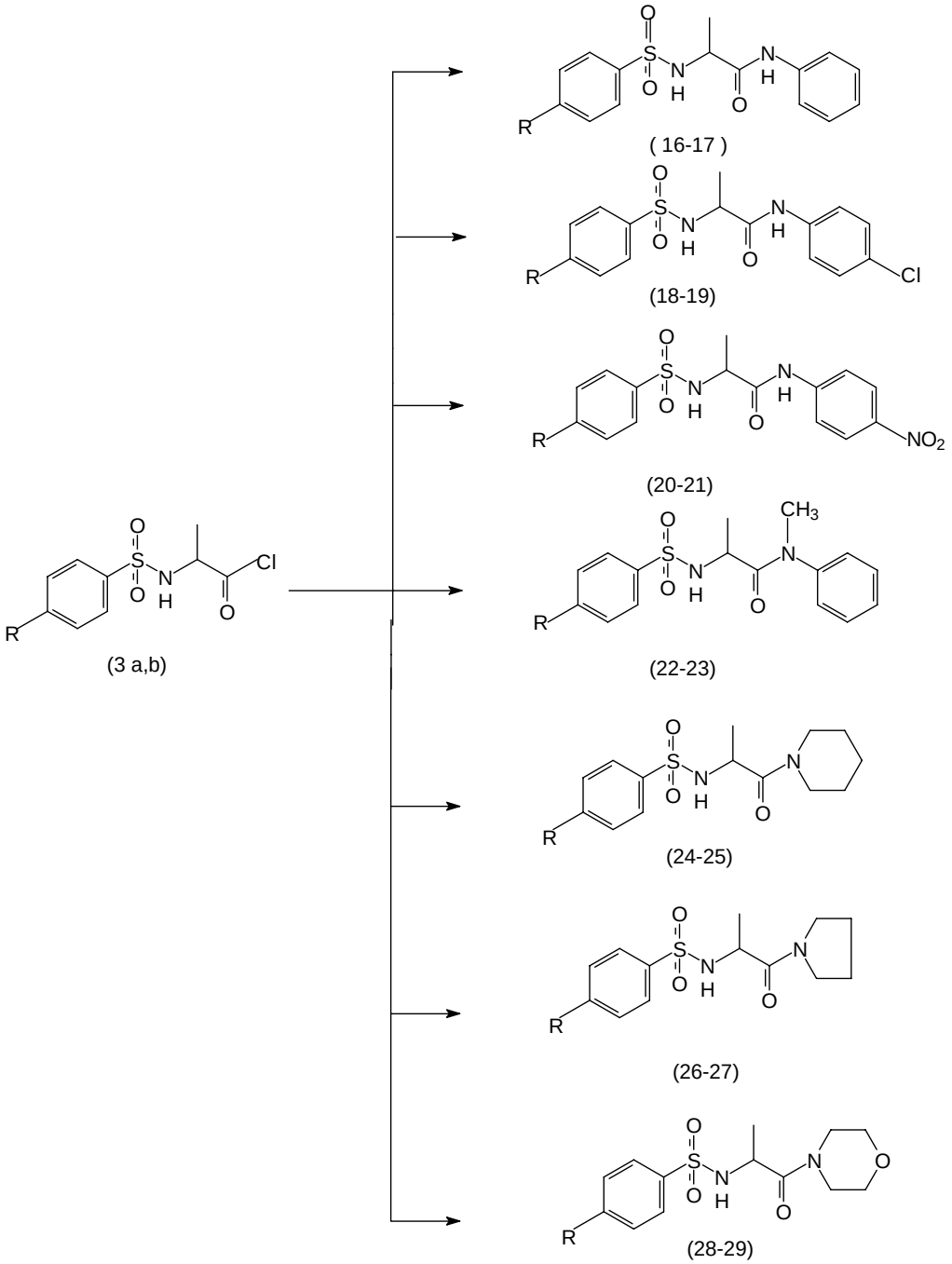


Figure 4

chloride (17.6 g, 0.1mole), and NaOH solution (1*N*, 200 mL) was stirred together at 65-70°C for 4 hr. A clear solution was obtained. The reaction-mixture was cooled to 5°C and treated with concentrated HCl to make it slightly acidic (*p*H 6.5) whereby benzene-sulphonyl alanine separated out as white crystals. It was recrystallized from hot water to give pure benzenesulphonyl alanine (**2a**, 16.02g, 69.95%); m.p. 118-20° (Figure 2).

^{1}H NMR: 7.7 (2H, ortho to Ar-*H*); 7.51 (3H, *meta* to Ar-*H*); 4.03(m, 1H, -C*H*(CH_3)-); 1.4(d, 3H, -CH(*CH_3*)-).

Table III — Characterization data of *N*(1-methyl-2-oxo-2-anilino-ethyl) benzene sulphonamide & *N*-(1-methyl-2-oxo-2-piperidino-ethyl) benzene sulphonamide and related compounds

Compd. No.	m.p. °C	R_f Value	^{1}H NMR (δ)	Mass (*m/z*)	IR (cm^{-1})
16	128-30	0.56a	8.66(1H, -CO-*NH*-Ar); 7.73(2H, Ar-*H*, *ortho* to –SO_2NH- group); 7.56(3H, Ar-*H*, *meta* and *para* to –SO_2NH-group); 7.43(2H, Ar-*H*, *ortho* to –NH-CO-group); 7.26(3H, Ar-*H*, *meta* and *para* to –NH-CO-group); 4.1(m, 1H, NH-*CH*(CH_3)-); 1.33(d, 3H, -NH-CH(*CH_3*)-);	-	-
17	138-40	0.531a	8.76(1H, -CO-*NH*-Ar); 7.64(2H, Ar-*H*, *ortho* to –SO_2NH- group); 7.3(2H, Ar-*H*, *meta* to –SO_2NH-group); 7.2(2H, Ar-*H*, *ortho* to —NH-CO-group); 7.1(3H, Ar-*H*, *meta* and *para* to –NH-CO-group);); 4.1(m, 1H NH-*CH*(CH_3)-); 2.33(s, 3H, Ar-*CH_3*); 1.3(d, 3H, -NH-CH(*$CH_{3)-}$*);	-	-
18	117-19	0.43a	8.76(1H, -CO-*NH*-Ar);); 7.76(2H, Ar-*H*, *ortho* to –SO_2NH- group); 7.6(3H, Ar-*H*, *meta* and *para* to –SO_2NH-group); 7.46(2H, Ar-*H*, *ortho* to —NH-CO-group); 7.3(2H, Ar-*H*, *meta* to —NH-CO-group); 4.16(m, H,NH-*CH*(CH_3)-); 1.33(d, 3H, NH-CH(*CH_3*)-).	-	-
19	141-43	0.53a	8.63(1H, -CO-*NH*-Ar); 7.6(2H, Ar-*H*, *ortho* to -SO_2NH- group); 7.16-7.24(complex, 6H, 2H, Ar-*H*, *meta* to –SO_2NH-group, 2H, Ar-*H*, *ortho* to -NH-CO-group, 2H, Ar-*H*, *meta* to -NH-CO-group); 4.03(m,1H,NH-*CH*(CH_3)-); 2.36(s, 3H, Ar-*CH_3*); 1.3(d, 2H, NH-CH(*CH_3*)-).	-	-
20	163-65	0.5a	9.2(1H, -CO-*NH*-Ar); 8.16(2H, Ar-*H*, *ortho* to -SO_2NH- group); 7.43-7.93(complex, 7H, 3H, Ar-*H*, *meta* and *para* to -SO_2NH-group, 2H, Ar-*H*, *ortho* to -NH-CO-group, 2H, Ar-*H*, *meta* to -NH-CO-group); 4.13(m,1H,NH-*CH*(CH_3)-); 1.33(d,2H,NH-CH(*CH_3*)-).	-	-
21	159-61	0.6b	9.1(1H, -CO-*NH*-Ar); 7.23-8.3(complex, 8H, 2H, Ar-*H*, *ortho* to –SO_2NH- group, 2H, Ar-*H*, *meta* to –SO_2NH-group, 2H, Ar-*H*, *ortho* to –NH-CO-group, 2H, Ar-*H*, *meta* to -NH-CO-group); 4.13(m,1H,NH-*CH*(CH_3)-); 2.46(s, 3H, Ar-*CH_3*); 1.37(d,2H,NH-CH(*CH_3*)-).	-	-
22	123-25	0.53a	7.53(2H, Ar-*H*, *ortho* to -SO_2NH- group); 7.46(3H, Ar-*H*, *meta* and *para* to -SO_2NH-group); 7.33(2H, Ar-*H*, *ortho* to -NH-CO-group); 7.13(3H, Ar-*H*, *meta* and *para* to -NH-CO-group); 3.96(m,1H,NH-*CH*(CH_3)-); 3.2(s, 3H, -CO-N-(*CH_3*)); 1.16(d, 3H, NH-CH (*CH_3*)-CO-group).	-	1630, 1270, 1230, 1100.
23	115-17	0.42a	9.2(1H, -CO-*NH*-Ar); 7.5(2H, Ar-*H*, *ortho* to -SO_2NH- group); 7.26(2H, Ar-*H*, *meta* to -SO_2NH-group); 7.16(2H, Ar-*H*, *ortho* to -NH-CO-group); 7.1(3H, Ar-*H*, *meta* and *para* to -NH-CO-group); 3.9(m. 1H, -NH-*CH*(CH_3)-CO-group); 3.2(s, 3H, -CO-N-(*CH_3*)); 2.36(s, 3H, Ar-*CH_3*); 1.23(d, 3H, NH-CH (*CH_3*)-CO-group).	-	-
24	76-78	0.65a	7.6(2H, Ar-*H*, *ortho* to -SO_2NH- group); 7.46(3H, Ar-*H*, *meta* and *para* to -SO_2NH-group); 4.36(m, 1H, NH-*CH*(CH_3)-CO-group); 3.33(m. 4H, *ortho* to -N-CO-group); 1.56(complex, 6H, *meta* and *para* to -N-CO- group); 1.23(d, 3H, NH-CH (*CH_3*)-CO-group).	-	-
25	110-12	0.70a	7.6(2H, Ar-*H*, *ortho* to -SO_2NH- group); 7.0(2H, Ar-*H*, *meta* to -SO_2NH-group); 4.4(m, 1H, NH-*CH*(CH_3)-CO-group); 3.36(m, 4H, *ortho* to -N-CO- group); 2.4(s, 3H, Ar-*CH_3*); 1.5(complex, 6H, *meta* and *para* to -N-CO- group);1.23(d,3H,NH-CH(*CH_3*)-CO-group).	-	1640, 1340, 1180.
26	128-30	0.44a	7.64(2H, Ar-*H*, *ortho* to -SO_2NH- group); 7.5(3H, Ar-*H*, *meta* and *para* to -SO_2NH-group); 4.26(m, 1H, NH-*CH*(CH_3)-CO-group); 3.3(m, 4H, *ortho* to -N-CO- group); 1.9(complex, 4H, *meta* to -N-CO- group); 1.23(d, 3H, NH-CH (*CH_3*)-CO-group).	-	-
27	120-22	0.49a	7.6(2H, Ar-*H*, *ortho* to -SO_2NH- group); 7.06(2H, Ar-*H*, *meta* to -SO_2NH-group); 4.14(m,1H,NH-*CH*(CH_3)-); 3.23(m, 4H, *ortho* to -N-CO- group); 1.96(complex, 4H, *meta* to -N-CO- group); 1.23(d, 3H, NH-CH(*CH_3*)-).	-	-
28	155-57	0.7a	7.6(2H, Ar-*H*, *ortho* to -SO_2NH- group); 7.43(3H, Ar-*H*, *meta* and *para* to -SO_2NH-group); 4.4(m, 1H, NH-*CH*(CH_3)-); 3.2-3.63(complex, 8H); 1.23(d, 3H, NH-CH(*CH_3*)-).	[M^+] 312, 198, 184, 155, 91, 77, 114, 86, 71.	-
29	121-23	0.4a	7.6(2H, Ar-*H*, *ortho* to –SO_2NH- group); 7.3(2H, Ar-*H*, *meta* and *para* to -SO_2NH-group); 4.16(m,1H,NH-*CH*(CH_3)-); 3.2-3.63(complex, 8H); 1.23(d, 3H,NH-CH(*CH_3*)-).	-	-

Solvent System: a* - Benzene:Methanol, 9:1, b* - Ether: Petroleum Ether: Ethyl acetate, 5:5:2

Anal. Found: C, 47.36; H, 4.55; N, 6.36. $C_9H_{11}O_4NS$ requires: C, 47.16; H, 4.80; N, 6.11%.

***p*-Toluenesulphonyl alanine (DL, 2b)**. The reaction of DL- alanine (2.9g, 0.1 mole) with *p*-toluene sulphonyl chloride (19.01g; 0.1mole) as above furnished *p*-toluenesulphonyl alanine (DL, **2b**; 17.8g; 73.25%, m.p. 128-38° (**Figure 2**).

^{1}H NMR: 7.67 (2H, *ortho* to Ar - *H*); 7.26 (3H, *meta* to Ar - *H*); 4.03 (m, 1H, - C*H*(CH_3) -); 2.41(s, 3H, Ar - C*H*$_3$); 1.43(d, 3H, -CH(CH_3)-).

Anal. Found: C, 49.5; H, 5.66; N, 5.48. $C_9H_{11}O_4NS$ requires: C, 49.50; H, 5.34; N, 5.76%.

Benzenesulphonyl alanine acid chloride 3a. Benzenesulphonyl alanine (**2a**; 1g; 0.004 mole) was dissolved in dry benzene and an excess of freshly distilled thionyl chloride (5.0 g) was slowly added to it and stirred at room-temperature for twenty minutes. The reaction-mixture was gently refluxed for three hr. The solvent and excess of thionyl chloride were then distilled off under reduced pressure to give acid chloride of benzenesulphonyl alanine **3a**. It was used for next reaction without further purification (**Figure 2**).

***p*-Toluenesulphonyl alanine chloride 3b**

p-Toluenesulphonyl alanine (**2b**; 1g; 0.003 mole) was treated with freshly distilled thionyl chloride 5.0 g as above to give acid chloride of *p*-toluene sulphonyl alanine **3b**. It was used for next reaction without further purification (**Figure 2**).

The compounds were prepared by following two methods.

Method A

To the acid chloride of benzenesulphonyl alanine (**3a**; 1.2 g; 0.004 mole) was added (5 g; 0.05mole) of 3-methyl butanol at room-temperature drop wise with continuous stirring for 15 minutes. It was then warmed up to 35-40° C and stirred at this temperature for further three hr. A clear solution was obtained. The excess of 3-methylbutanol was stripped off to give an oily residue, which on further distillation under reduced pressure gave *N*-(1,6-dimethyl -2-oxo-3-oxa-heptanyl) benzene sulphonamide (4; 0.500 g; 33.3%); b.p 95-100°C/7mm; R_f 0.81 (system 'b').

^{1}H NMR: 7.75(2H,Ar-*H*); 7.4(3H,Ar-*H*); 5.7(1H, -N*H*-CH(C*H*$_3$)-); 4.1(1H, -NH-C*H*(CH_3)-CO-); 3.9(t,2H, -CO-C*H*$_2$-); 1.2-1.9(complex, 6H, NH-CH(C*H*$_3$)-CO-O-CH$_2$-C*H*$_2$-C*H*(C*H*$_3$)$_2$-); 0.9(d,6H, gem. dimethyl) .

Anal. Found: C, 56.35; H, 7.31; N, 4.77. $C_{15}H_{21}O_4NS$ requires : C, 56.18; H, 7.02; N, 4.68%.

Similar reactions of these acid chlorides (**3a**, **3b**) with isobutyl alcohol, isopropyl alcohol, tertiary butyl alcohol, *N*, *N*-dimethyl amine and *N*,*N*-diethyl-amine gave *N*-(1,5-dimethyl-2-oxo-3-oxa-hexanyl) benzene sulphonamide **6** and its *p*-substituted derivative 7,*N*-(1,4-dimethyl-2-oxo-3-oxa-pentanyl) benzene sulphonamide **8** and its *p*-substituted derivative **9**, *N*-(1,4,4,trimethyl-2-oxo-3-oxa-pentanyl) benzene sulphonamide 10 and its *para*-substituted derivative **11**, *N*- (1-methyl-2-oxo-3-aza-3-*N*-methyl-butanyl) benzene sulphonamide 12 and *N*- (1-methyl-2-oxo-3-aza-3-*N*-methyl-butanyl) –*p*-toluene sulphonamide **13**, *N*-(1-methyl-2-oxo-3-aza-3-*N*-ethyl-pentanyl) benzene sulphonamide **14** and *N*- (1-methyl-2-oxo-3-aza-3-*N*-ethyl-pentanyl)-*p*-toluene sulphonamide **15** respectively in good yields (**Figure 3**).

Method B

Direct esterification method. Mixture of benzenesulphonyl alanine (**2a**, 1.5g; 0.006 mole) 3-ethyl butanal (5.0 g; 0.05 mole) and conc. H_2SO_4 (1mL) was taken in dry benzene (100 mL) in a round bottom flask fitted with Dean and Stark apparatus. It was refluxed on a steam-bath. Soon some water started separating out which was removed. Refluxing was continued until no more water separated out. The reaction-mixture was allowed to cool. It was then washed with water, 5% $NaHCO_3$ and again with water. After drying over anhydrous Na_2SO_4, the solvent was removed and the residue was distilled under vacuum to give *N*-(1,6-dimethyl-2-oxo-3-oxa-heptanyl) benzene sulphonamide (4; 0.500 g; 41.66%); b.p 95-100°C/7mm; R_f 0.81 (system 'b'), identical with **4** prepared above in all respects.

Similarly compounds **4-11** were also prepared by direct esterification of benzene sulphonyl alanine **2a** and *p*-toluene sulphonyl alanine **2b** with corresponding alcohols in the presence of Conc. H_2SO_4 as a catalyst. The characterization data of the compounds **4-11** synthesized above is reported in **Table II**.

***N*(1-methyl-2-oxo-2-anilino-ethyl) benzene sulphonamide 16, *N*-(1-methyl -2-oxo-2-anilino -ethyl)toluene-*p*-sulphonamide 17, *N*-(1-methyl-2-oxo-2-*p*-chloroanilino-ethyl)benzenesulphonamide 18, *N*-(1-methyl-2-oxo-2-*p*-chloroanilino-ethyl)-toluene-*p*-sulphonamides 19, *N*-(1-methyl-2-oxo-2-p-nitroanilino-ethyl)benzene sulphonanide 20, *N*-(1-methyl-2-oxo-2- *p*-nitroanilino-ethyl) toluene-*p*-sulphonamides 21**. The reaction of acid chlorides 3a and 3b with aniline, *p*-chloroaniline and *p*-nitroaniline as above gave the compounds **16-21** (**Figure 4**).

***N*-(1-methyl-2-oxo-2-*N*-methyl anilino-ethyl) benzene sulphonamide 22, *N*-(1-methyl-2-oxo-2- *N*-methylanilino-ethyl) toluene-*p*-sulphonamides 23.** The reaction of acid chlorides 3a and 3b with *N*-methyl aniline gave **22-23** compounds. The characterization data of the compounds **synthesized above are given in (Figure 4, Table III).**

Recently considerable amount of work has been done on the synthesis and biological activities of heterocyclic juvenoids[10] in which heterocyclic ring is linked with a terpinoid moiety. Some phosphorous amides of nitrogen containing heterocyclic rings have been reported to exhibit good insect chemosterilant activity[11]. It was therefore thought of interest to incorporate heterocyclic ring at the other terminal of sulphonamide JH analogues and to check the biological activities of these compounds. The synthesis of such compounds are reported herein.

***N*-(1-methyl-2-oxo-2-piperidino-ethyl) benzene sulphonamide 24, *N*-(1-methyl-2-oxo-2-pyrrolidinyl-ethyl) benzene sulphonamide 26, *N*-(1-methyl-2-oxo-2-marpholino-ethyl) benzene sulphonamide 28 and the toluene-*p*-sulphonamide derivatives of the above compounds 25**, **27**, **29**. The reaction of acid chlorides **3a** and **3b** with piperidine, pyrolidine and morpholine in dry benzene furnished the desired products **24-29** (**Figure 4**, **Table III**).

Conclusion

Large number of JHA analogues is reported in literature incorporating different kind of structural features which display variation in their biological activities. Incorporation of sulphonamide group in the side chain of JHA further enhances the biological activity of the compound to a greater extent. Number of compounds with sulphonamide feature in the side arm along with additional function group like- esters, amides, as well as heterocyclic rings have been synthesized and the compound *N*-(1-Methyl-2-oxo-2-piperidino-ethyl) benzene sulphonamide **24** exhibited the positive JH activity out of all compounds.

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