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Microwave promoted synthesis and plant growing activity of substituted Schiff bases

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ABSTRACT

Schiff bases have a wide range of applications such as corrosion inhibitor, intermediates in various reactions, in perfumery etc. Some are known to be used in many potential drugs and are known to possess broad spectrum of biological activities such as antiviral, antifungal, antiparasitic, antibacterial, anti-inflammatory. A series of substituted Schiff bases have been synthesized by microwave irradiation reactions between substituted aryl amine and heteroaryl methyl ketones and evaluated for their antibiotic activity. The structures of the synthesized chalcones were established by IR and ^{1}H-NMR analysis. Plant growth activity testing were carried on wheat seeds (Triticum durum) at concentrations (1x10^{-5}M). Activity was enhanced on unprocessed seeds concentration.

Key words: Synthesis of Schiff bases, characterization, antibiotic activity.

INTRODUCTION

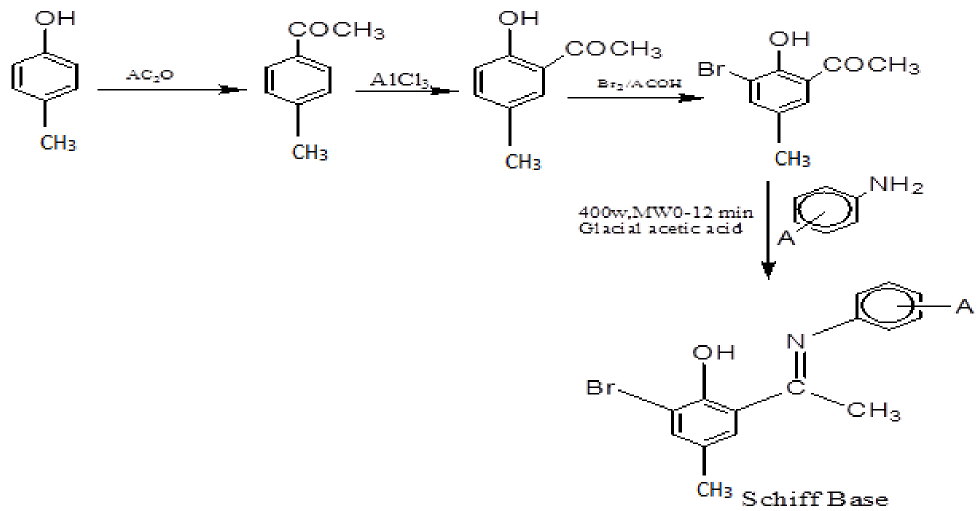
In light of these significances, a variety of synthetic strategies have been developed for the preparation of Schiff base, despite the progress, the synthesis of these compounds remains less ideal[1]. Thus, the development of environmentally friendly benign (Green Chemistry), high-yielding and clean approaches for the synthesis of Schiff base is still remains a highly desired goal in organic synthesis[2]. Synthetic methodologies now a day should be designed to use and generate substances that possess little or no toxicity to human health and the environment. Schiff bases belong to a widely used group of organic intermediates important for production of specialty chemicals, e.g. pharmaceuticals, or rubber additives[3] and as amino protective groupsin organic synthesis[4,5]. They also have uses as liquid crystals [6]and in analytical,[7,8,9]medicinal[10] and polymer chemistry[11]. In general, ketones react more slowly than aldehydes and higher temperatures and longer reaction times are often required as a result. In addition, the equilibrium must often be shifted, usually by removal of the water, either azeotropically by distillation or with suitable drying agents [12]. In recent years, environmentally benign synthetic methods have received considerableattention and some solvent-free protocols have been developed[13]. Grinding together solid substituted aryl amines and aryl methyl ketones yielded various kinds of Schiff bases[14]. Based on these facts, we decided to synthesize some Schiff bases by Microwave irradiation.In the past, many decades since penicillin was discovered and introduced as a powerful antibacterial agent, antibiotics have become critical in the fight against infectious diseases caused by bacteria and other microbes. However, widespread antibiotic use has promoted the emergence of antibiotic-resistant pathogens, including multidrug resistant strains. At present, the appearance of more and more pathogenetic bacterial speciesresistant to conventional antibiotics has resulted in either high expenses or failure in the treatment of infectious diseases. Analarming increase in resistance of bacteria that cause community acquired infections has also been documented, especiallyin Staphylococci and Pneumococci, which are prevalent causes of disease and mortality. In addition, the risk of opportunistic fungal infections increases rapidly accompanied with AIDS disease, and as an obviously consequence invasive infections represent a major cause of mortality for these patients[15]. With the emergence of new microbial strains resistant tomany conventional available antibiotics there is growing interest in the discovery of new antibiotic agents[16,17]. According to the known structure and activity relationships, it is considered that certain small heterocyclic molecules act as highly functionalized scaffolds and are known pharmacophores of a number of biologically active and medicinally useful molecules[18,19].

MATERIALS AND METHODS

Melting points were obtained using DBK programmed melting point apparatus and are uncorrected. The purification of synthesized compounds was performed by recrystallization with appropriate solvent system. The purity of the compounds was checked using TLC technique, spots were developed by exposure to iodine vapors and UV cabinet. Infrared spectra were recorded on FTIR spectrophotometer 8400S, Shimadzu corporation. Nuclear Magnetic Resonance spectra were recorded with AVANCE 300MHz, using $CDCl_3$.

General microwave procedure for the synthesis of Schiff bases (SB-1 to 8).

To a mixture of substituted aryl amine(0.1M) and substituted aromatic aldehyde (0.1M) in methanol, catalytic amount of glacial acetic acid added. The contents were subjected to microwave irradiation at an interval of 1 min at 400 W for about 8-10 min; progress of the reaction was monitored by TLC. After the completion of the reaction, the obtained product was poured into water, stirred well; solid obtained was recrystallized from ethanol.



***Protocol for the Plant Growth* Activity on Wheat Seeds**

Wheat seeds of local variety, DWR- 2006 (Triticumdurum) were selected to investigate the growth activities of the synthesized compounds. The solutions of Schiff bases were prepared by dissolving in minimum quantity of DMSO (~1 mL). Seed germination experiments were carried out according to literature method (Warham et al, 1995) with slight modifications. The significant activity was observed with the seeds treated for 3 minutes. The seeds treated for 3 minutes are taken for further studies. The seeds were then arranged on the moistened germination paper placed on polythene sheet. One more moistened germination paper was placed over the seeds and loosely rolled. Each roll was labelled and kept upright in the seed germinator maintained at 2^oC and 70±5% humidity, for six days with proper illumination. After six days, percentage germination was calculated. Further, 10 seeds were randomlyselected from each roll for root and shoot length measurements.The experiments were performed in triplicate.

RESULTS AND DISCUSSION

The different Schiff bases studied in the present work were prepared by green method by irradiation of microwave radiation and the yields were found to be about 50-75%. The structures of the Schiff bases were confirmed by different analytical and spectroscopic methods. The analytical data of the prepared ligands and selected IR bands are found to be identical which are depicted in Tables-1 and Table-2 respectively.

Table-1

Compound	Substituent	MF	Mol. Wt.
SB-1	-H	$C_{15}H_{14}NOBr$	303
SB-2	4-methyl	$C_{16}H_{16}NOBr$	317
SB-3	2-amino	$C_{15}H_{15}N_2OBr$	318
SB-4	4-hydoxy	$C_{15}H_{14}NO_2Br$	319
SB-5	4-bromo	$C_{15}H_{13}NOBr_2$	381
SB-6	4-chloro	$C_{15}H_{13}NOBrCl$	337.5
SB-7	2-nitro	$C_{15}H_{13}N_2O_3Br$	348
SB-8	3-nitro	$C_{15}H_{13}N_2O_3Br$	348

Table-2

Compound	IR spectrum (KBr) cm^{-1}	^{1}H-NMR spectrum (δ, ppm)	Melting Point	% Isolated Yield
SB-1	3457 (-OH), 3011 (C-H aromatic), 1585 (C=N), 1591 (C=C), 1254 (C-Br)	2.0 (s, 3H), 2.4 (s, 3H, $-CH_3$), 7.1–8 (m,6H, Ar-H), 11.8 (s, 1H,-OH)	115-116°C	62
SB-2	3427 (-OH), 3027 (C-H aromatic), 1575 (C=N), 1541 (C=C), 1194 (C-Br)	1.7 (s, 3H), 2.1 (s, 3H, $-CH_3$), 6.9–8 (m,6H, Ar-H), 11.5 (s, 1H,-OH), 2.3 (s, 3H)	108-110°C	68
SB-3	3475 (-OH), 3048 (C-H aromatic), 1525 (C=N), 1498 (C=C), 1182 (C-Br), 3345 (C-N)	1.8 (s, 3H), 2.1 (s, 3H, $-CH_3$), 6.9–8 (m,6H, Ar-H), 11.5 (s, 1H,-OH), 2.3 (s, 3H), 3.0 (s, 2H, NH_2)	122-123°C	75
SB-4	3398 (-OH), 3028 (C-H aromatic), 1485 (C=N), 1480 (C=C), 1202 (C-Br), 1248 (C-O)	1.9 (s, 3H), 2.2 (s, 3H, $-CH_3$), 7.2–8 (m,6H, Ar-H), 12.4 (s, 1H,-OH), 2.0 (s, 3H), 5.0 (s, 1H, -OH)	120-122°C	70
SB-5	3458 (-OH), 3088 (C-H aromatic), 1492 (C=N), 1489 (C=C), 1211 (C-Br)	2.1 (s, 3H), 2.4 (s, 3H, $-CH_3$), 7.3–8 (m,6H, Ar-H), 12.1 (s, 1H,-OH), 2.3 (s, 3H)	112-113°C	59
SB-6	3472 (-OH), 3096 (C-H aromatic), 1502 (C=N), 1498 (C=C), 1311 (C-Br), 1208 (C-Cl)	2.3 (s, 3H), 2.5 (s, 3H, $-CH_3$), 7.2–8 (m,6H, Ar-H), 12.3 (s, 1H,-OH), 2.3 (s, 3H)	105-106°C	58
SB-7	3501 (-OH), 3100 (C-H aromatic), 1512 (C=N), 1458 (C=C), 1351 (C-Br), 1115 (C-N)	2.4 (s, 3H), 2.6 (s, 3H, $-CH_3$), 7–8 (m,6H, Ar-H), 12.8 (s, 1H,-OH), 2.4 (s, 3H)	102-103°C	55
SB-8	3503 (-OH), 3108 (C-H aromatic), 1521 (C=N), 1458 (C=C), 1358 (C-Br), 1128 (C-N)	2.3 (s, 3H), 2.6 (s, 3H, $-CH_3$), 7.2–8 (m,6H, Ar-H), 12.8 (s, 1H,-OH), 2.4 (s, 3H)	103-104°C	52

Significant differences have been observed in the present experiment in different parameters. The data presented in Table-3which was revels that lowest period of germination was observed under SB-2 (7.56 days) which was maximum for control. Significantly highest percentage of germination (81.25) was measured for SB-2 followed by SB-8 (80.78). Data indicates that Schiff bases and control statistically imparted an almost same result, but the compound especially SB-2 andSB-8 are more efficient in seed germination.

Table 3. Plant Growth Activity on Wheat Seeds

Sr. No.	Period of germination in days	Germination (%)	RootLength(cm)		ShootLength(cm)	
			15 days	30 days	15 days	30 days
SB-1	9.23	79.54	5.45	11.78	7.15	10.54
SB-2	7.56	80.25	5.84	11.24	7.26	10.12
SB-3	8.45	77.23	5.89	10.54	6.98	9.45
SB-4	8.86	78.45	6.75	12.88	7.75	11.78
SB-5	8.98	79.86	5.88	10.89	6.96	9.68
SB-6	9.02	78.56	5.24	9.98	6.44	8.85
SB-7	10.15	79.23	6.00	11.73	7.14	10.08
SB-8	10.12	80.78	6.12	12.22	7.46	11.12
control	11.22	78.20	5.20	10.02	6.23	9.12

Perusal of data, presented in Table- 3, reveals Schiff bases significantly affect the growth of young seedlings of Wheat. Observations were taken at 15thand 30thdays after germination. In both cases, more or less similar trend has been observed under different parameters. Schiff bases having concentration 1 x 10^{-5}M showed varied range of measurements in seedling growth, root growth. In all cases, SB-4 showed prominent and positively marked results. A similar trend was also observed in all these cases, that was the effect of compound were statistically identical with the control, but all the compounds were showing satisfactory results specifically the SB-4 one. The trend of compound imparted identical trajectory at both the 15^{th}day and 30^{th}day interval after the seed germination.A significant variation was also observed in leaf zinc content of papaya seedlings. Hence, all observations revealed that every compounds has some effects on the parameters measured in this discussion whereas the Schiff bases have not imparted such drastic effects and the results were moreor less identical with the control. From that we can come to the conclusion that the Schiff bases which is responsible for such changes.

CONCLUSION

From the findings of the present experiment, it is clear that seed germination parameters and seedling growth parametersvaried with variation of treatments as it most of the parameters under control (no treatment) was lowest or minimum and the Schiff bases used showed such level of statistical increment from the control. Thus, control and compounds may be suggested as plant growth stimulator for Wheat. Perusal of the seed germination and seedling growth, and other parameters reveal the better effect of compounds than control. The parity and correlation of root length and shoot length content with the seed germination parameters and seedling growth parameters in campus the direct relation of schiff bases on those parameters. Use of different substituted Schiff bases in the present experimentclearly shows that SB-4 and SB-8 has the maximum beneficial effect on germination and seedling growth of Wheat. Hence, SB-4 and SB-8 may be used as an effective seed soaking chemical for Wheat. However, SB-4 and SB-8 would be further studied in order to confirm it's superiority in multi locations.

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