LAYERED DOUBLE HYDROXIDE (LDH) AS AN ECOFRIENDLY AND BETTER CATALYST FOR THREE-COMPONENT AND ONE-POT REACTION BETWEEN AMMONIA ,ALDEHYDE AND β-KETOESTER

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ABSTRACT:- LDH (Layered Double Hydroxide) has been shown to be an ecofriendly and better catalyst for multicomonents reaction. An improved three-component reaction of beta-keto ester with aldehyde and ammonia is described. The reaction using LDH gave higher yields and took less time than earlier reported catalyst for this multicomponents reaction. The reaction was carried out by classical refluxing method and microwave assisted method. The microwave assisted method gave better yield with in a very short span of time.

KEYWARDS: Three-component Reaction, Ammonia, Aldehydes, Beta- keto ester, Microwave.

INTRODUCTION:-

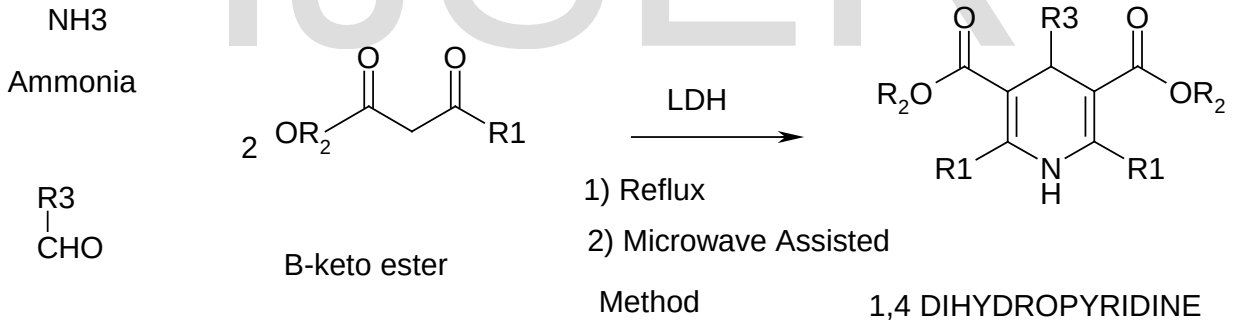
Modern synthetic design demands high efficiency in terms of minimization of synthetic steps together with maximization of complexity (1). One of the ways to fulfill these goals is the development and use of multicomponent reactions which consist of several simultaneous bond-forming reactions and allow the high efficient synthesis of complex molecules starting from simple substrates in a one-pot manner (2,3). An important subject that attracted a great deal of attention from organic and bioorganic chemists during the last few decades has been the developing of new strategies for the synthesis of complex molecular structures from easily available substrates by short and effective routs (4,5) .The most important of these strategies has been the developing of multi-component reactions (MCRs), a reaction in which three or more compounds connect together by covalent bonds to produce a complex molecule contains the main structure of all the starting materials (6-9). As MCRs are one-pot reactions, they are easier to carry out than multistep syntheses. The three component reaction between beta-keto ester ,

aldehyde and ammonia was first reported by Hantzsch, The same MCR was also reported by Italian chemist Pietro Biginelli in 1883.

RESULTS AND DISCUSSION:-

In this communication we are exploring the utility of LDH for three component one pot reaction between β-keto ester, aromatic aldehyde and ammonia. The reaction was carried out using two mole of beta- keto ester and one mole each of aromatic aldehyde and ammonia. The reaction was performed in two different ways viz. classical method and microwave assisted method. In a representative reaction one mole of benzaldehyde and one mole of ammonia were added and the reaction mixture was refluxed for 3 hours. The progress of reaction was monitored using TLC, after completion of reaction, LDH was removed by filtration and cold filtrate was poured into ice water when a solid precipate separated out after stirring. It was filtered and washed with ethanol. It was purified by recrystalisation through ethanol to afford 1,4 dihydropyrimidine derivative. The same reaction of beta- keto ester, benzaldehyde and ammonia was repeated using microwave assisted technique. It has been observed that by using microwave, reactions are completed within few minutes. The melting point of dihydropyrimidine synthesized has been recorded as 203^{O}C which tallied with literature value. The IR of compound showed characteristic absorption bands for (-NH), Ar-C-H, C-O, C=O, etc bands. 1H NMR of compound displayed signals due to Me, CH_2, Ar-C-H, C-H, and N-H protons.

Reaction:-



It has been observed that the directing influence of the substituent's present on aromatic ring of aldehyde has shown effect on the overall yield of final product. When the electron donating groups are present on aromatic ring, they increase the yield of final product. When electron withdrawing group is present on aldehyde moiety then the yields are fount to decrease.

Optimization of reaction conditions with variable amount of LDH:-

For optimizing the amount required to provide maximum yield the variable amount of LDH was used with the same mole ratio of reactants. From the table given below it is clear that 2g amount of LDH give maximum yield of the products.

Sr. No.	Amount of LDH	Time	Yield %
1	1.0g (0.002 mole)	3h	60
2	1.5g (0.003 mole)	3h	70
3	2.0g(0.00 4 mole)	3h	85
4	2.5g (0.005 mole)	3h	85

LDH is known as layered double hydroxide catalyst. It is prepared by dissolving $Mg(NO_3)_2.6H_2O$ and $Al(NO_3).9H_20$ in equiv-molar amount in a double distilled water and then adding drop wise 50 % NaOH and maintaining $_PH$ close to 10(10-11) .

Recently, we have reported one-pot three component procedure for preparation of 1,4 dihydropyridine using b-keto ester, aldehyde and ammonia using LDH (Layered double hydroxide) catalyst. The reported procedure was very simple effective and eco-friendly. Our observation in this work was to study effectiveness of LDH as a catalyst for the preparation of multicomponents reactions.

Table 1:- Synthesis of 1,4 dihydropyridine derivatives using LDH(Layered double hydroxide catalyst) by classical condensation method:-

Entry	R1	R2	Ar	Amonia	Time(h)	Yield %	M.P.
A	Et	Me	Ph	NH_3	3.0	85	200
B	Et	Me	4-CI-Ph	NH_3	2.5	82	210
C	Et	Me	4-Me-Ph	NH_3	2.5	87	198
D	Et	Me	4-MeO-Ph	NH_3	3.0	91	211
E	Et	Me	4-F-Ph	NH_3	3.5	80	187
F	Me	Me	Ph	NH_3	2.5	86	215
G	Me	Me	4- Me- Ph	NH_3	3.5	88	225
H	Me	Me	4-Cl-Ph	NH_3	3.0	78	213
I	Me	Me	4 MeO-Ph	NH_3	3.5	87	196

Table 2:- Synthesis of 1,4 dihydropyridines using LDH(Layered double hydroxide catalyst) by Microwave Assisted method:-

Entry	R1	R2	Ar	Solvent	MW Time(s)	Yield	M.P.
A	Et	Me	Ph	-	60	88	200
B	Et	Me	4-CI-Ph	-	90	85	210
C	Et	Me	4-Me-Ph	-	90	88	198
D	Et	Me	4-MeO-Ph	-	120	92	211
E	Et	Me	4-F-Ph	-	90	83	187
F	Me	Me	Ph	-	90	88	215
G	Me	Me	4- Me- Ph	-	120	89	225
H	Me	Me	4-CI-Ph	-	90	80	213
I	Me	Me	4-MeO-Ph	-	90	89	196

MATERIALS AND METHODS:-

Melting points were determined with an Electro thermal 9100 apparatus. Elemental analyses were performed using a Heraeus CHN–O–Rapid analyzer. IR spectra were recorded on a Shimadzu IR-470 spectrometer. 1H and 13C spectra were recorded on Bruker DRX-400 Avance spectrometer in CDCl3 using TMS as the internal standard.

GENERAL PROCEDURE:-

Benzaldehyde (1 m mol), ammonia (1 m mole) were taken in round bottom flask and to it was added in β-keto ester (2 m mol). The reaction mixture was heated at 100^0 C using electrical Heater by adding LDH (Layered double hydroxide) catalyst. After three hours reaction mixture was cooled in ice bath. The resulting precipitate was collected and washed with 5 ml of ethanol to afford the title compounds. It was further purified by recrystallation through ethanol.

Solid, M. P. 203^0C, IR in cm -1:- 3387 (-NH) , 3028,3059 (-CH-R1) ,2880 (-C-H-R3), 1169,1191(C-O) , 1590,1597(RO-C=O), 765,693(CH-m-sub), 1H NMR in δ ppm:-(1.08-1.11,t 6H), (2.2, s 6H), (2.6,s,3H),(3.7-4.0,q,4H),(5.28,s,1H),(5.53,sNH).

CONCLUSION:-

We have reported the three-component reaction between aldehydes , ammonia and β-ketoester in the presence of layered double hydroxide (LDH) as a ecofriendly catalyst to form 1,4

dihydrpyrimindine derivatives in good yields. The present method does not involve any hazardous organic solvent and the catalyst is economical. Therefore, this procedure could be classified as green chemistry method using LDH as a eco-friendly, better catalyst for above conversion.

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