

# SYNTHESIS OF $\alpha$ -AMINO PHOSPHONATES USING LEMON PEEL POWDER AS AN EFFICIENT CATALYST

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**Abstract :** We have developed  $\alpha$ -amino phosphates from different substituted aromatic aldehyde, aniline, dimethyl phosphite and lemon peel powder as an ecofriendly and efficient natural catalyst. The reaction was performed in different solvents and good yield was obtained in EtOH solvent using catalytic amount of lemon peel powder. In comparison to other reported methods this method has major advantages like simple procedure, use of natural and inexpensive catalyst with good yield and short reaction time at room temperature.

**Keywords:** Different substituted aromatic aldehyde, Aniline, dimethyl phosphite, LPP, EtOH

## I. INTRODUCTION

Aminophosphonate are the organophosphorus compounds. These are structurally similar to amino acids in which carboxylic group is replaced by phosphoric acid.  $\alpha$ -Aminophosphonate are useful as HIV-protease [1], enzyme inhibitor [2] herbicides [3], fungicides [4], and insecticides [5].

$\alpha$ -aminophosphonate containing phosphorus and nitrogen atoms are important class of pharmacologically active compounds [6] and exhibit a wide range of biological activities [7] such as antibacterial [8], antifungal [9], anticancer [10], antiviral [11], anti-inflammatory [12], antioxidant [13], and antimicrobial activity [14].  $\alpha$ -Aminophosphonate have own medicinal importance.

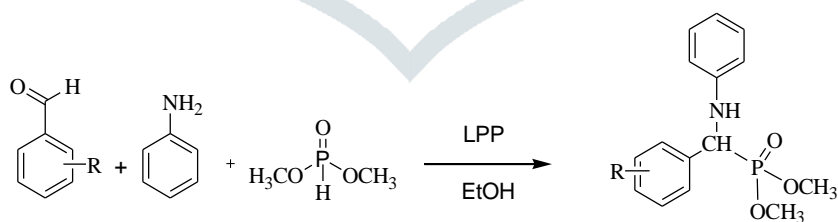
Various synthetic protocol developed for the synthesis of  $\alpha$ -Aminophosphonates, among these Nucleophilic addition of phosphite to imine i.e. Kabachnik-Fields reaction [15] proved to be a convenient route.

Owing to the biological importance, scientists have developed several methodologies for the synthesis of  $\alpha$ -Aminophosphonates by using different catalysts such as; boric acid, [16]  $\text{FeCl}_3$ , [17], Amberlyst-15, [18], cellulose  $\text{SO}_3\text{H}$  [19] H-form zeolite [20], Crystalline copper oxide nanopowder [21].

However besides their advantages these catalyst have some disadvantages also tedious methods, difficulties in separation, prolong reaction time, expensive catalyst. Due to significant bioactivity of  $\alpha$ -Aminophosphonate, in this context an efficient and natural lemon peel powder catalyst were used. These solid powder catalyst was already proved for the synthesis of some heterocyclic compounds. [22] Lemon peel powder (LPP) is a natural and biodegradable material which used as a catalyst. Citric acid is present in lemon. Albedo is the major component of LPP. [23]

In continuation of our efforts to the eco-friendly synthetic approaches for the synthesis of bioactive heterocyclic compounds, herein we wish to report one pot synthesis of  $\alpha$ -Aminophosphonate derivatives by the reaction of aromatic aldehyde, aniline, diethylphosphite and LPP as catalyst, in ethanol at room temperature.

### General Procedure for the Synthesis of $\alpha$ -Aminophosphonate



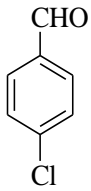
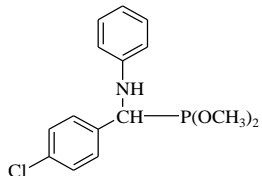
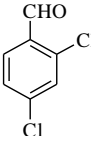
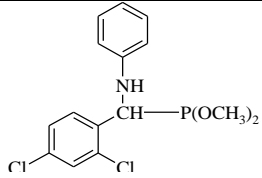
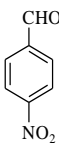
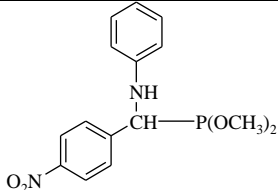
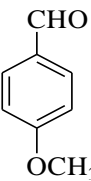
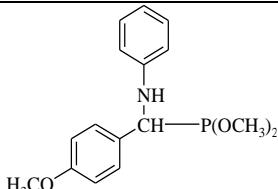
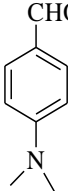
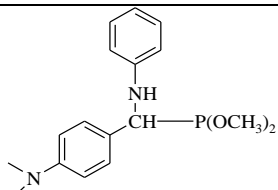
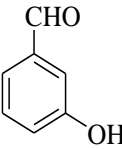
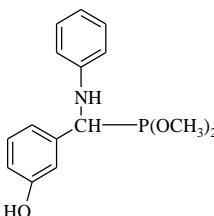
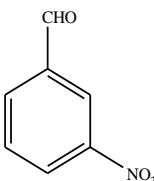
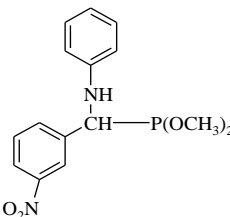
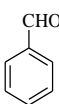
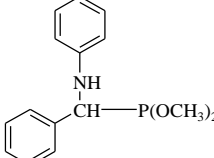
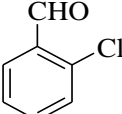
## II. EXPERIMENTAL

All the melting points were determined in open capillaries and were uncorrected. Progress of the reaction was monitored by TLC (n-hexane: ethyl acetate, 7:3) solvent System. <sup>1</sup>H NMR were recorded at 400 MHz with Bruker ARS 400 spectrometer. Chemical shifts were reported in  $\delta$  ppm using tetra methyl silane as the internal standard and  $\text{CDCl}_3$  as a solvent.

### General procedure for the synthesis of $\alpha$ -Aminophosphonate

A mixture of aldehyde (1mmol), aniline (1 mmol) and Dimethylphosphite (1.2 mmol) was stirred in ethanol using Lemon Peel Powder (LPP) (10wt %) (Table 1). The progress of reaction was monitored on TLC plate's 30% ethyl acetate: n-Hexane. After completion of reaction, reaction mixture was poured onto crushed ice, stirred for 10 min. and filtered off to get desired crude product. Crude product finally recrystallized with hot ethanol to obtain pure  $\alpha$ -aminophosphonate.

Table 1: Synthesis of  $\alpha$ -Aminophosphonate

Sr. No.	Aldehyde	Product	Time (hr.)	Yield (%)	M.P. ( $^{\circ}$ C) Found	M.P.[Ref.]
1			1/2	92	138-140	139-140 <sup>(24)</sup>
2			1/2	86	108-110	110-112 <sup>(24)</sup>
3			1/2	94	126-127	127-128 <sup>(24)</sup>
4			1/2	87	122-123	123-124 <sup>(24)</sup>
5			1/2	82	144-145	145-150 <sup>(25)</sup>
6			1/2	93	128-130	130-132 <sup>(24)</sup>
7			1/2	92	130	131 <sup>(26)</sup>
8			1/2	92	91-93	90-92 <sup>(24)</sup>
9			1/2	90	128	130 <sup>(25)</sup>

10			$\frac{1}{2}$	90	128	129 <sup>(26)</sup>

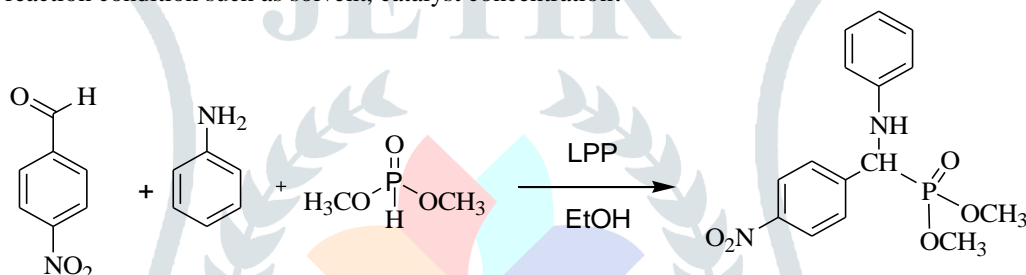
### Spectral data of synthesized compound:

**Dimethyl (4-chlorophenyl)(phenyl amino) methylphosphonate (Table 1, Entry-1)** :  $^1\text{H}$  NMR (400 MHz,  $\text{DMSO}-d_6$ )  $\delta$  ppm 3.52 (d, 3 H) 3.76 (d, 3 H) 4.80 (s, 1H) 7.12 - 7.23 (m, 9 H), IR Bruker( $\text{cm}^{-1}$ ) 3419.18 (NH), 2910.51 (CH  $\text{sp}^3$ ), 2800.30 (C-C), 1492.22 (Aro.C=C) GCMS 325.5 ( $\text{M}+1$ )<sup>+</sup>.

**Dimethyl(4-Methoxyphenyl)(phenylamino) methylphosphonate (Table 1, Entry-4)** :  $^1\text{H}$  NMR (400 MHz,  $\text{DMSO}-d_6$ )  $\delta$  ppm 2.35 (s, 6 H) 3.43 (s, 3 H), 3.77 (s, 1 H) 6.57 (s, 1H) 7.11 - 7.22 (m, 9 H), IR Bruker( $\text{cm}^{-1}$ ) 3898.81(NH), 2901.59 (CH  $\text{sp}^3$ ), 2802.33(C-C), 1418.81 (Aro.C=C) GCMS 323.11 ( $\text{M}+2$ )<sup>+</sup>.

### III. RESULT AND DISCUSSION

A model reaction of 4-nitrobenzaldehyde (1 mmol), aniline (1 mmol), dimethylphosphite (1.2 mmol) and LPP (10 wt %) was used to optimize reaction condition such as solvent, catalyst concentration.



Firstly effect of solvent on model reaction was studied for the synthesis dimethyl (4-Nitrophenyl)(phenyl amino)methyl phosphonates. A mixture of 4-Nitrobenzaldehyde, aniline, dimethylphosphite and Lemon Peel Powder (LPP) was stirred at room temperature.

**Table 2:** Effect of different solvent in the synthesis of  $\alpha$ -Aminophosphonates

Entry	Solvent	Time(hr)	Amount of catalyst	Yield %
1	Without solvent	2	10	Trace
2	$\text{H}_2\text{O}$	$\frac{1}{2}$	10	70
3	EtOH	1	10	94
4	Toluene	1.5	10	62

Trace amount of product obtained under solvent free condition. In water 70 % and in toluene 62% yield obtained but best result was obtained in ethanol solvent 94%. (Table 2) Hence we choose ethanol as the solvent for reaction condition.

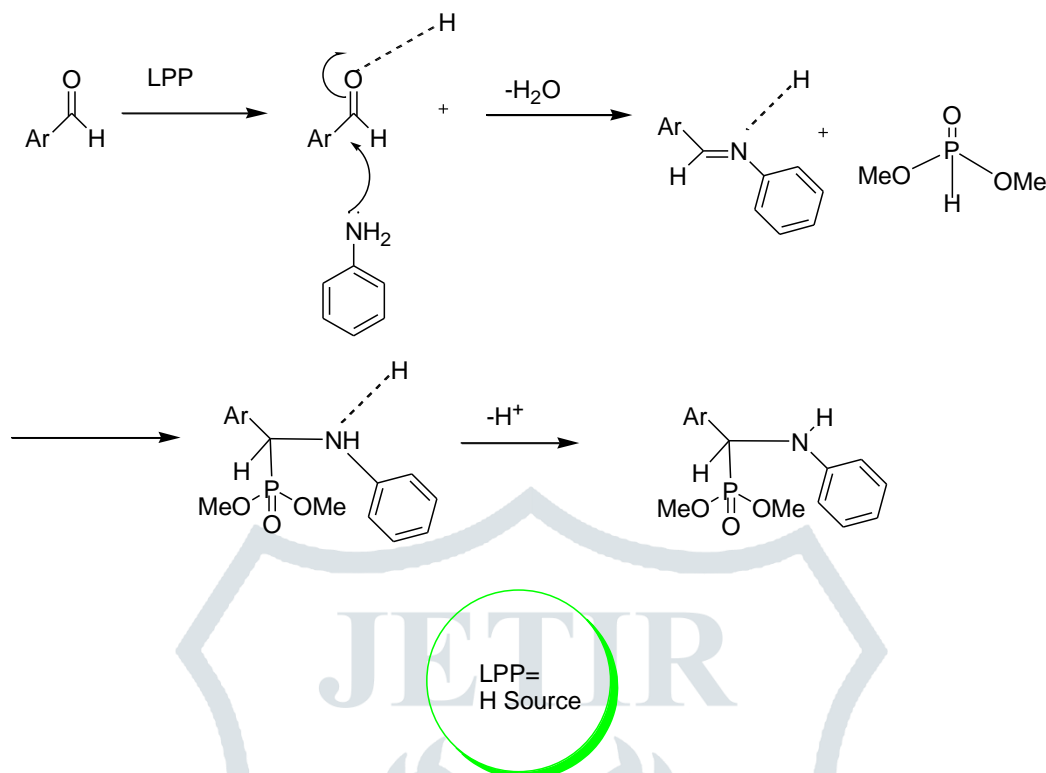
Further we investigated catalyst optimization on model reaction of dimethyl (4-Nitrophenyl) (phenylamino) methyl phosphonates in presence of Lemon Peel Powder (LPP) catalyst. Catalyst efficiency studied at different concentration 5, 10, 15 and 20 mmol%.

Best results were obtained in 10 wt% of the catalyst with excellent yield (94%) in 30 minutes. On increasing the further catalyst concentration did not affect the yield. Further we screened different substituted aldehydes for the synthesis of  $\alpha$ -aminophosphonates Table 1. Different aldehydes well reacted under these optimized condition and provide good to excellent yields. Further the reaction was also investigated for both electron donating and electron withdrawing substituent. It was observed that >82 % of the yield was obtained in both electron donating and electron withdrawing substituent.

**Table 3:** Optimization of catalyst concentration for the synthesis of  $\alpha$ -aminophosphonates

Entry	Catalyst	Yield% @
1	5	50
2	10	94
3	15	95
4	20	95
@ Yields of the product after $\frac{1}{2}$ hr in EtOH at R.T.		

Plausible mechanism has been outlined in **Figure 2**. Initially electrophilicity of carbonyl carbon was enhanced on contact with Lemon Peel Powder (LPP) due to protonation. Protonated aldehydes then reacted with aniline to form imine intermediate. Nucleophilic attack of dimethylphosphite on imine intermediate results in the formation of desired product.



**Figure 2:** Plausible mechanism for the synthesis of  $\alpha$ -aminophosphonates.

Next we examine the recovery of catalyst and its reuse. After completion of reaction, the crude product was obtained through separation technique by addition of ethylacetate to the reaction mixture. The crude product along with catalyst was diluted with hot ethanol and filtered off. Filtrate containing the product was concentrated on rotary evaporator and residue contained the recovered catalyst. Recovered catalyst was used for further reaction. Isolated products were confirmed by physical constants,  $^1\text{H}$  NMR, IR and mass spectral data.

#### IV. CONCLUSION

In conclusion we have developed a simple and clean method to synthesize  $\alpha$ -aminophosphonates. Simple procedure, short reaction time, catalyst easy to recover. Excellent yield obtained by using green solvent. The synthesis was achieved at room temperature using Lemon Peel Powder (LPP) as a natural catalyst.

#### V. ACKNOWLEDGMENT

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