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RESEARCH ARTICLE

Conceptual Study of Carbon Dioxide Chemistry into the Environnement

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Abstract

Concerning our ongoing research upon decarbonisation, I have disclosed the detailed reaction mechanism of carbon dioxide into the environment. For example, the chemical behaviour of carbon dioxide towards ozone layer including its enzymatic organic reactions as well as the main role of carbon dioxide on rain acidity. Because of the electrophilic character of carbon dioxide, it naturally reacts with water to furnish carbonic acid, which destroys the leaves of plants in the form of acid rain.

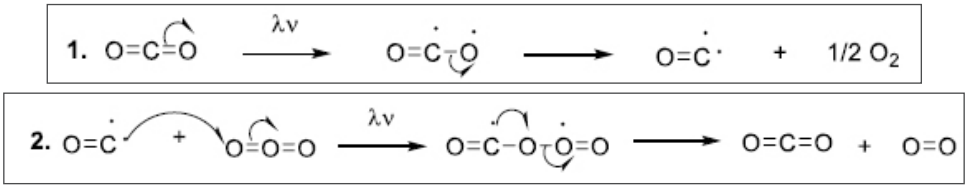
Keywords: Carbon Dioxide, Enzymatic Reaction Mechanisms, Decarbonisation, Phospholipids Hydrolysis, Rain Acidity.

1. Introduction

This paper is about studying the chemical behaviour of carbon dioxide into the environment. In other word, the objective of this paper is to show the electrophilic reactivity of carbon dioxide towards organic compounds, which behave as nucleophiles into the atmosphere of the Earth as well as within the aquatic and soil environments. This study is relevant to our ongoing research projects regarding decarbonisation, and decontamination of the environment. It is also important to mention that this study is innovative because the enzymatic detailed reaction mechanisms developed herein have not been reported in the scientific literature.

2. Ozone Layer Decomposition

Into the atmosphere, carbon dioxide reacts with a photon to generate carbon monoxide.[1] This generated compound is a powerful nucleophile organic entity that degrades the ozone layer to furnish, in turn, a molecule of carbon dioxide including oxygen (Scheme 1, reaction 1). In these photochemical reactions, a photon behaves as an adequate reactive substance.



Scheme 1

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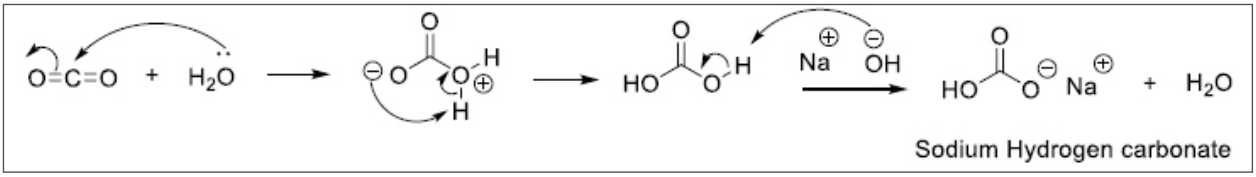
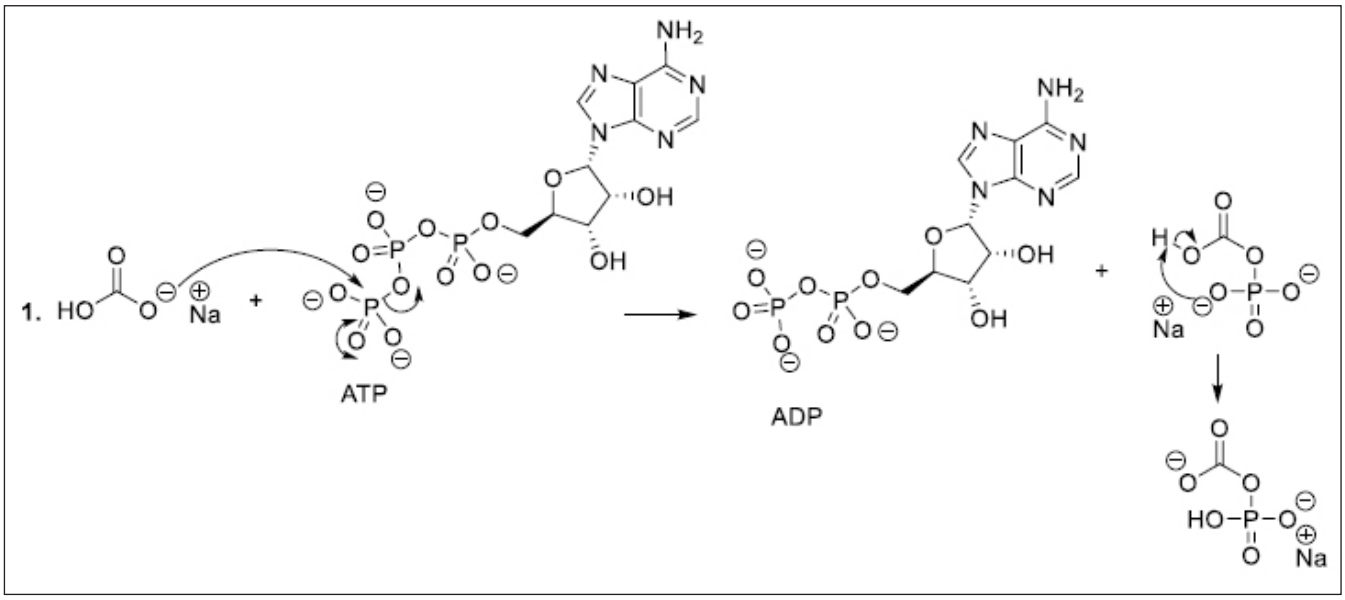
3. Decarbonisation

The atmospheric carbon dioxide is usually captured by green plants and reacts with water to generate carbonic acid, which will react with aqueous sodium hydroxide to provide sodium hydrogen carbonate. This later compound is a conjugate base of the carbonic acid, and it can behave as nucleophile due to its electronic density as well as it can behave as acid because of its hydroxyl group (Scheme 2, scheme 3, reaction 1).

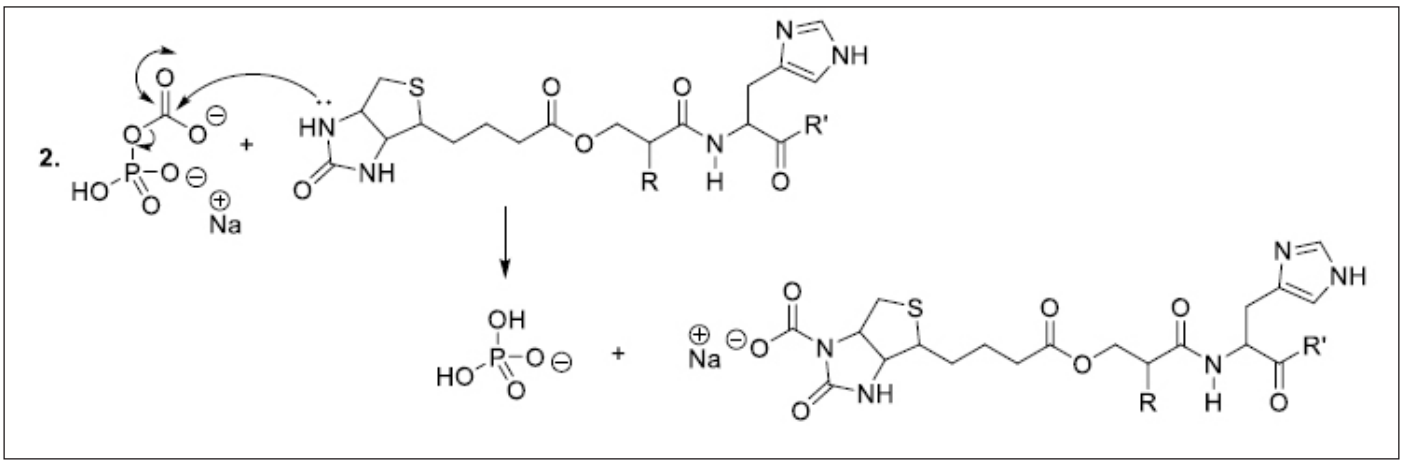


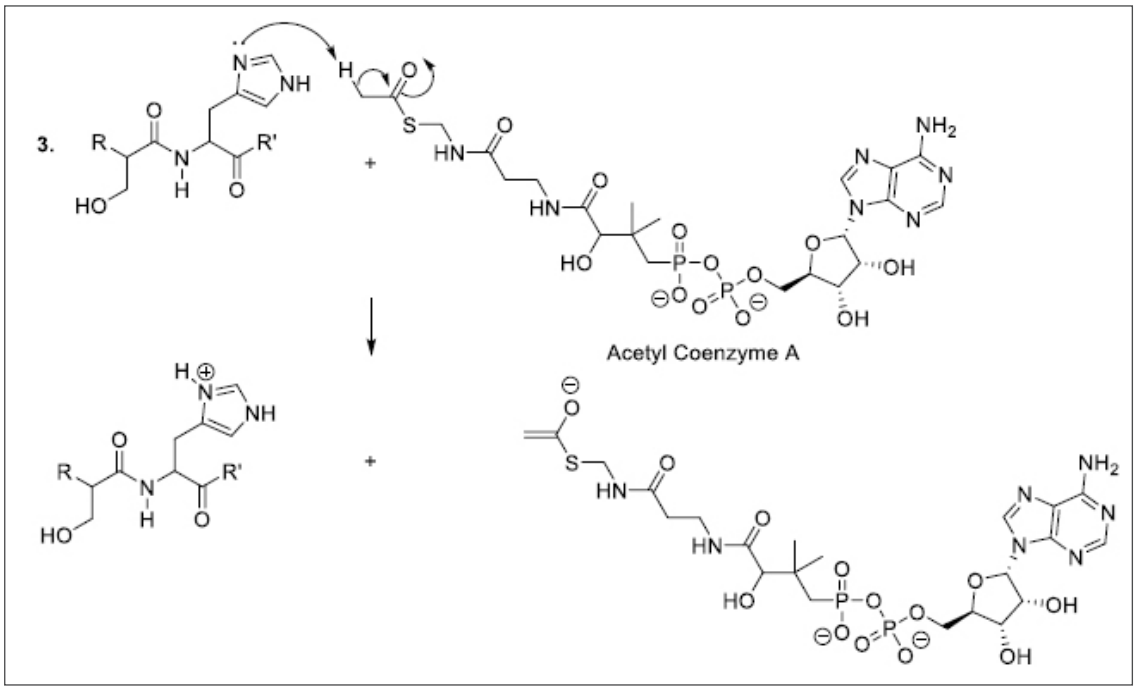
Scheme 2

Sodium carbonate will react with ATP (adenosine triphosphate) in order to furnish ADP (adenosine diphosphate) as well as carbon dioxide linked to phosphate group (Scheme 3, reaction 1).[2-6] This phosphate group bearing carbon dioxide will transfer carbon dioxide to the complex biotin-enzyme (Schema 3, reaction 2). During subsequent step, the enzyme will accept a proton from acetyl coenzyme A group to produce a corresponding anion (Scheme 3, reaction 3). This anion will then react with the biotin-enzyme complex bearing carbon dioxide to generate malonyl Coenzyme A, which is essential to fatty acids biosynthesis (Scheme 3, reaction 4) and finally the biotin-enzyme complex is regenerated (Scheme 3, reaction 5)

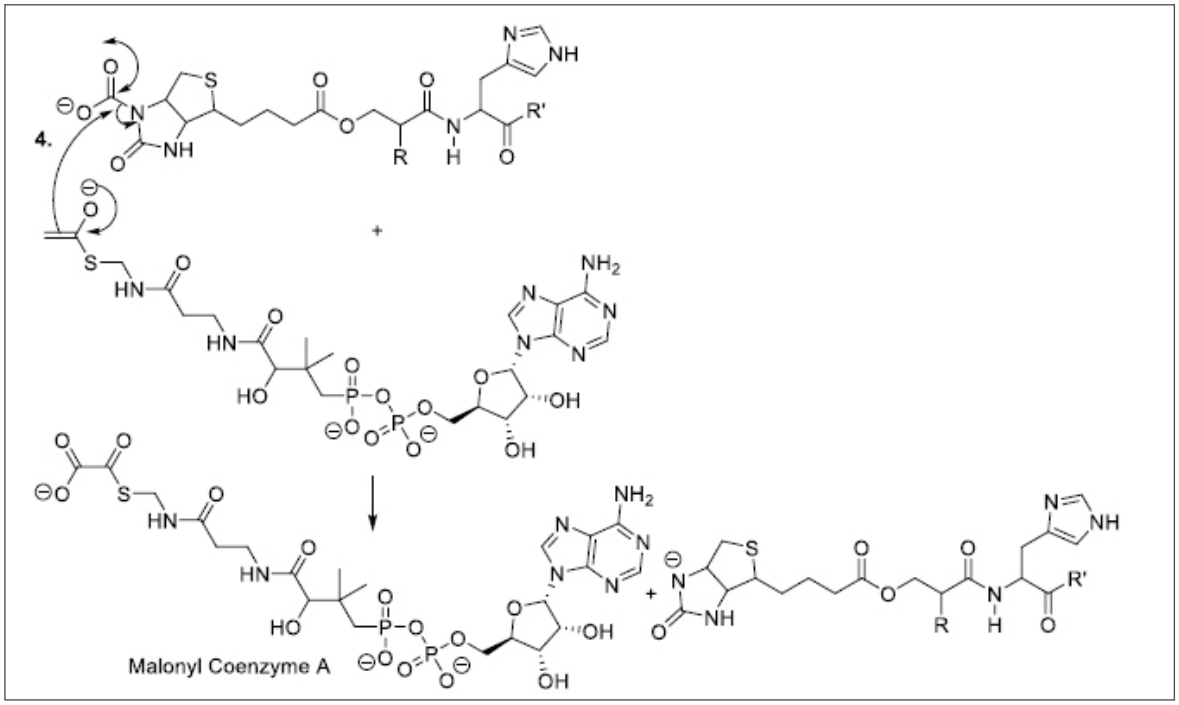


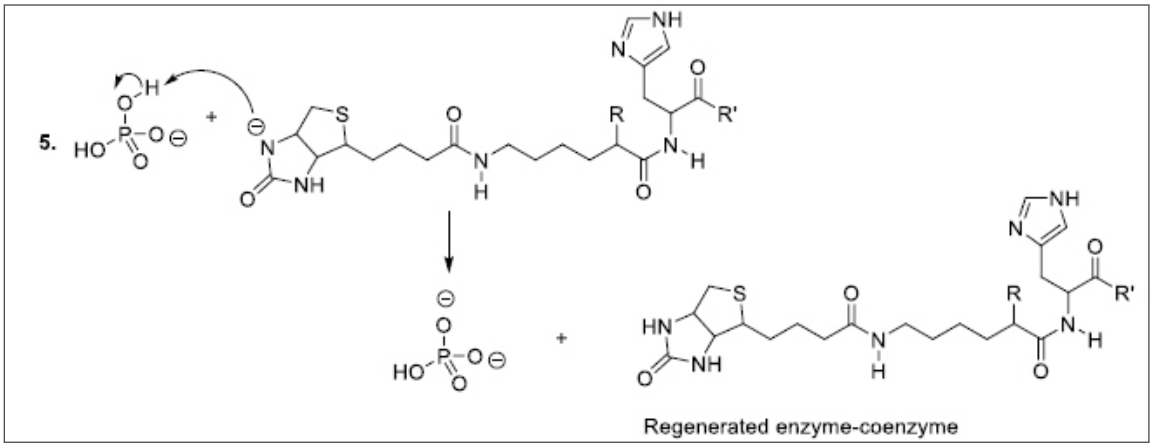
Scheme 3a





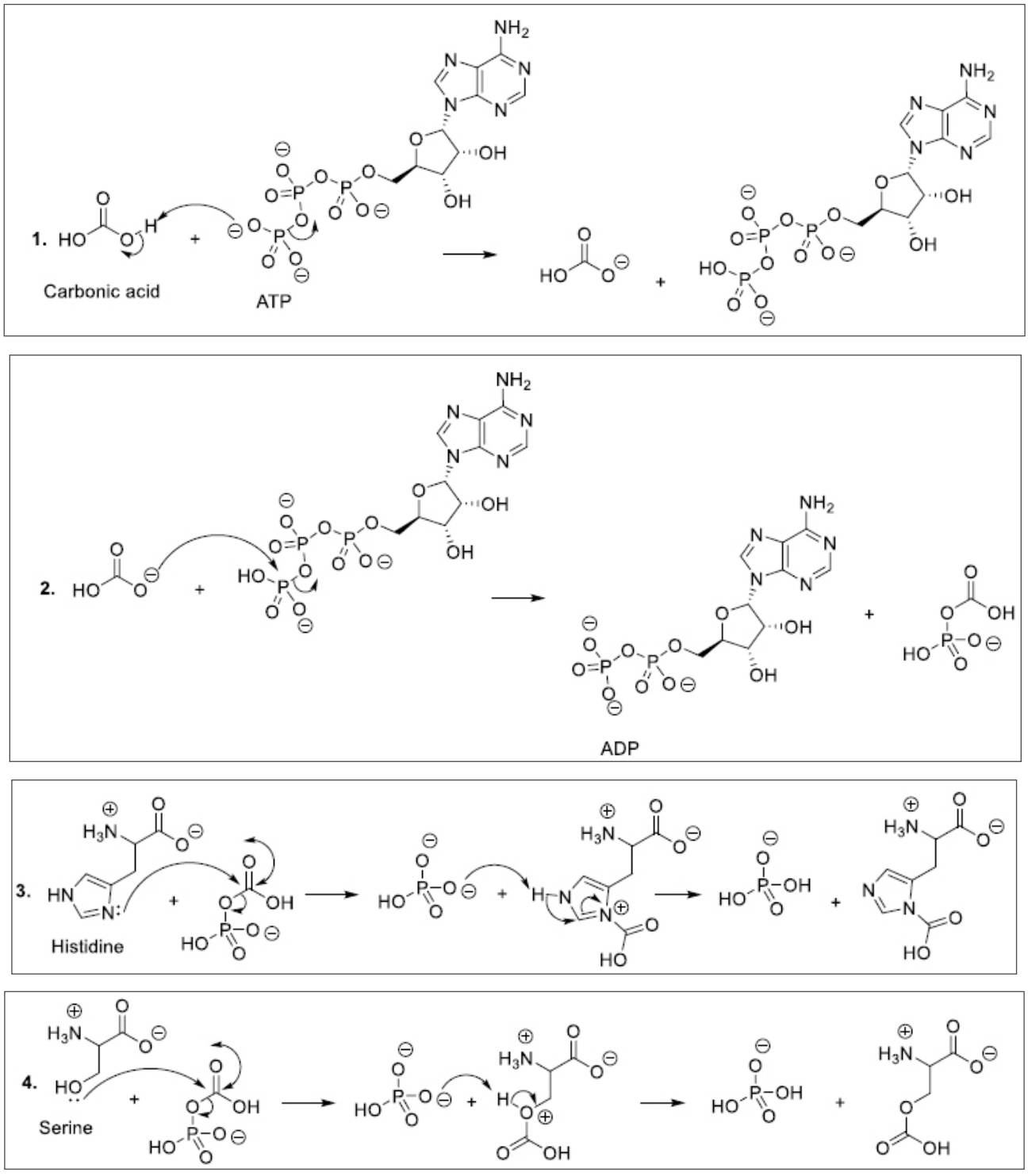
Scheme 3b





Scheme 3c

Carbonic acid could react with plant amino acids to produce carbamates. In this situation, the plausible mechanism involves the reaction between ATP to generate the corresponding products (Scheme 4, reaction 1). The resulting products could combine to furnish ADP and a phosphate group linked to carbon dioxide that will react with amino acids (Scheme 4, reaction 2, reaction 3).

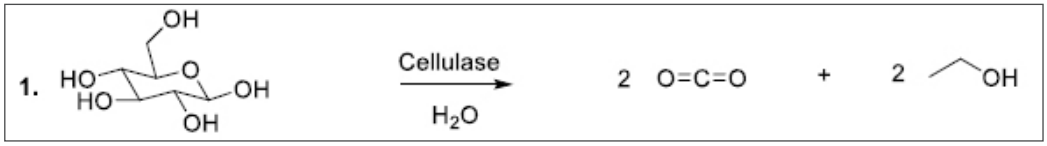


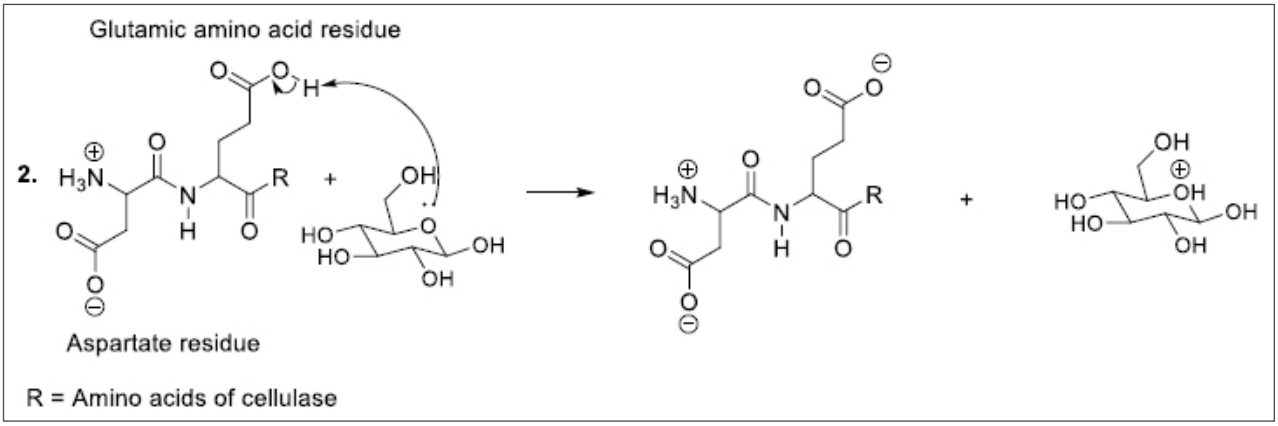
Scheme 4

4. Carbone Dioxide Production

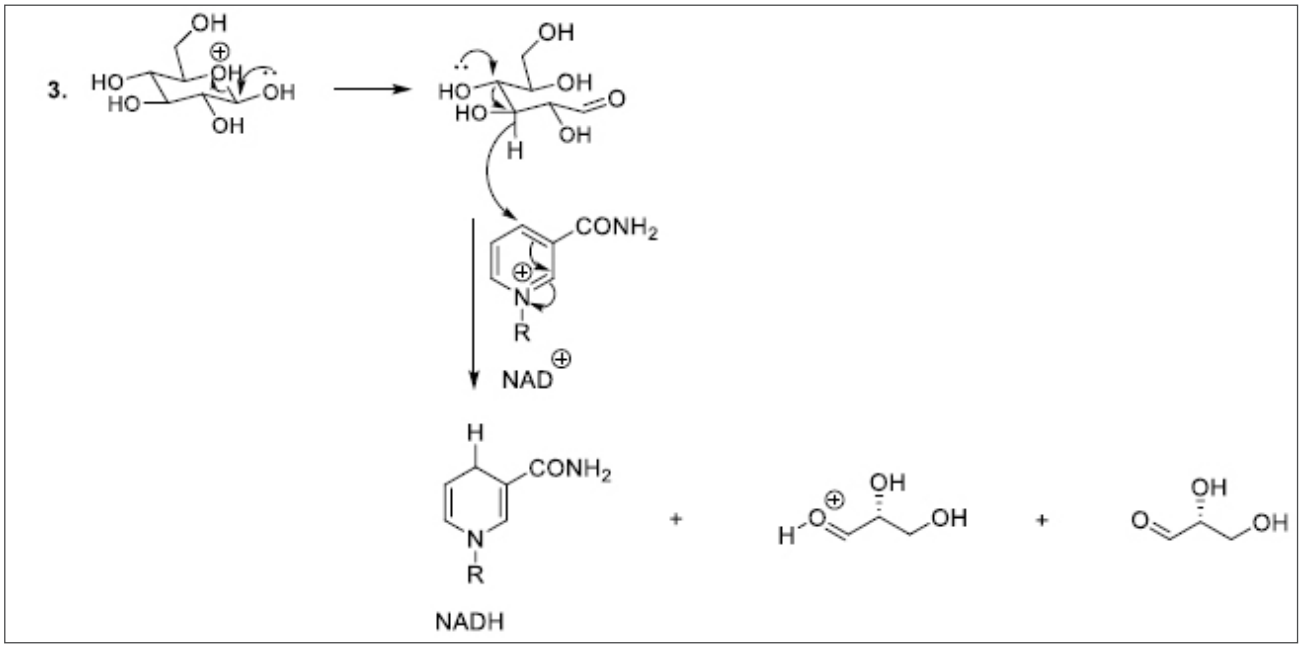
Experimental observations revealed that glutamic amino acid and aspartic amino acid actively participate to the enzymatic degradation of glucose in order to generate carbon dioxide and ethanol.[7-20] This kind of degradation is effective because of the assistance of the coenzyme nicotinamide adenine dinucleotide (NAD^+).[7-20] In this perspective, the glucose intra cyclic oxygen accepts a proton of the glutamic amino acid to produce carboxylate group and cyclic oxonium ion (Scheme 5, reaction 2).This step is followed by the opening of the cyclic oxonium ion to furnish a linear

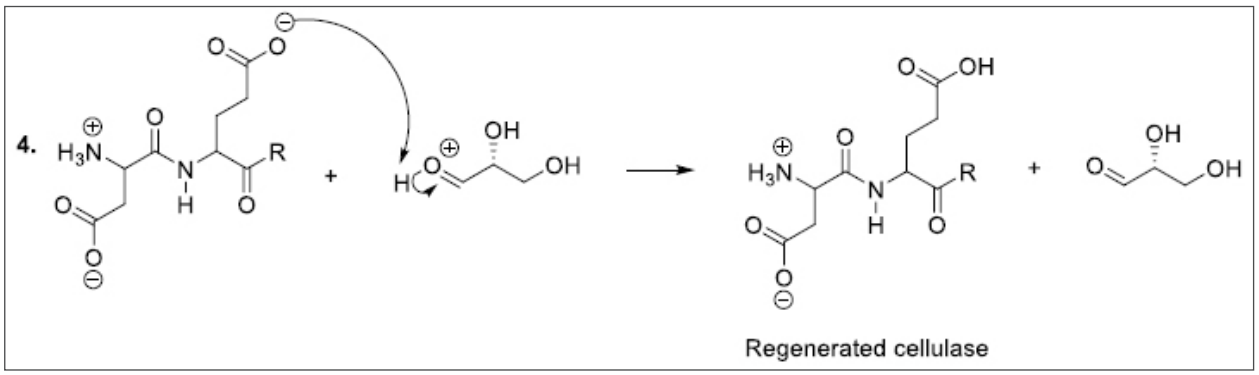
intermediate compound, which donates a hydride to NAD^+ and consequently, it results the formation two aldehydes as well as NADH (Scheme 5, reactions 3-4). The enzymatic oxidation of aldehydes, in the presence of water, favors the formation of alcohols, which are also oxidized to afford two carboxylic acids (Scheme 5, reactions 5-7). The enzymatic degradation of the two carboxylic acids leads to the production of the expected carbon dioxide and ethylene glycol or ethane 1-2-diol (Scheme 5, reactions 8-9). The degradation of ethylene glycol leads to production of the desired ethanol (Scheme 5, reaction 10).

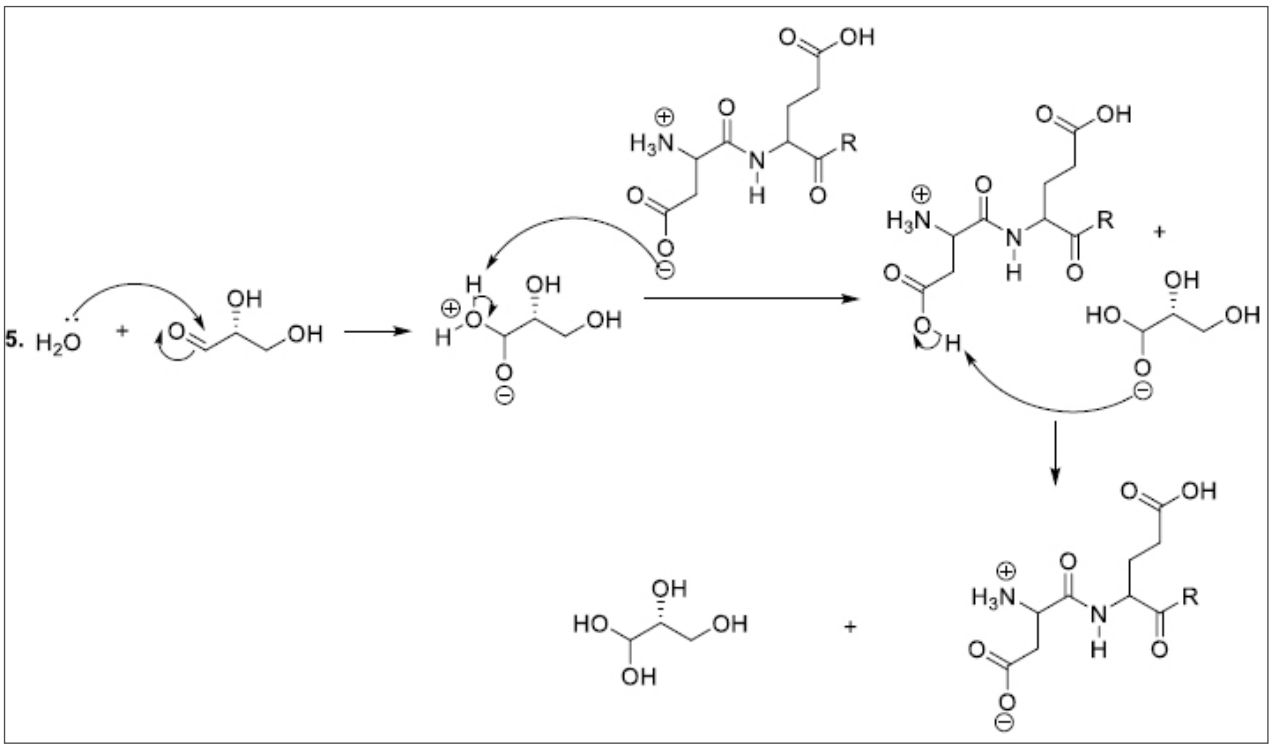




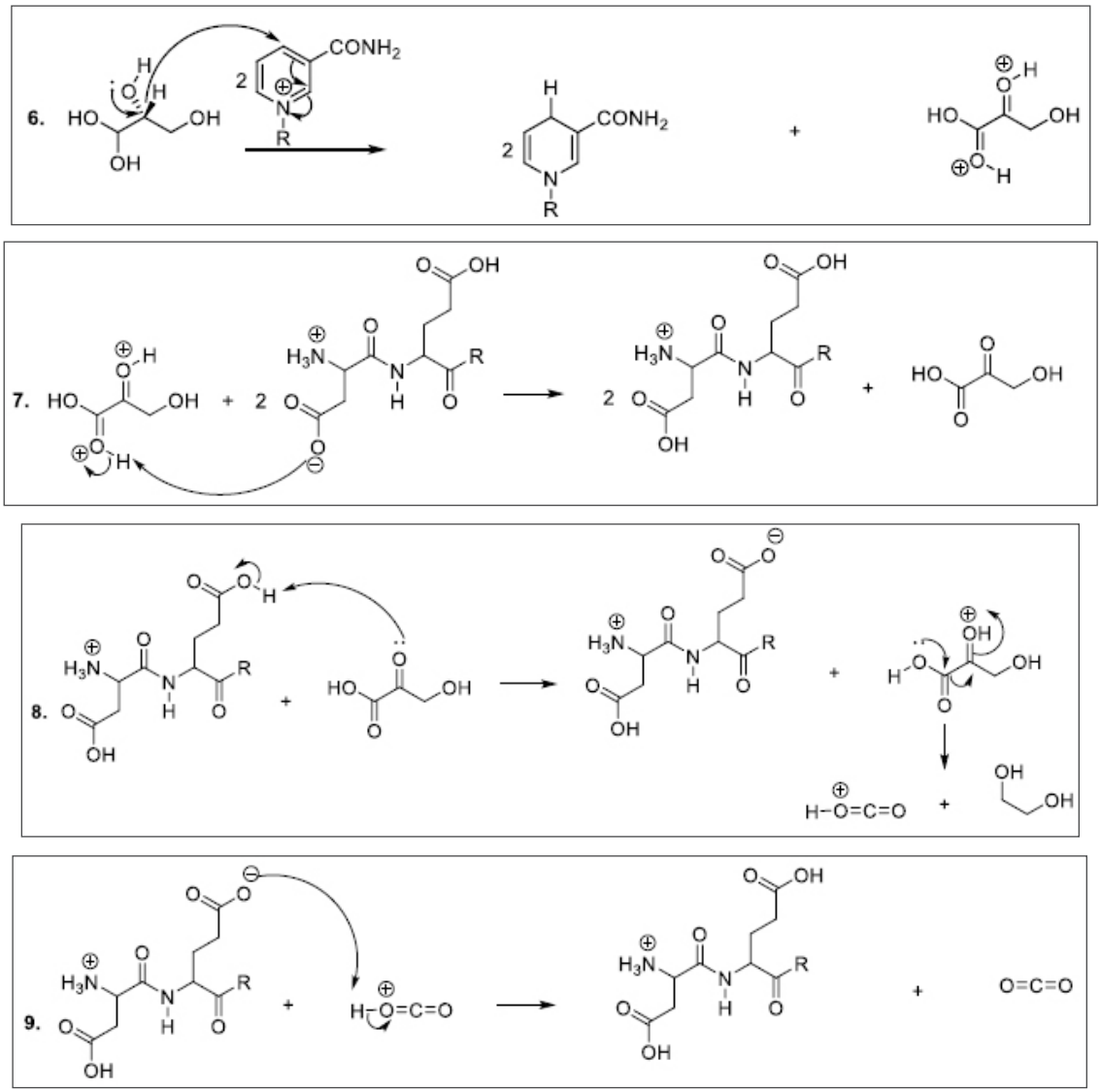
Scheme 5a



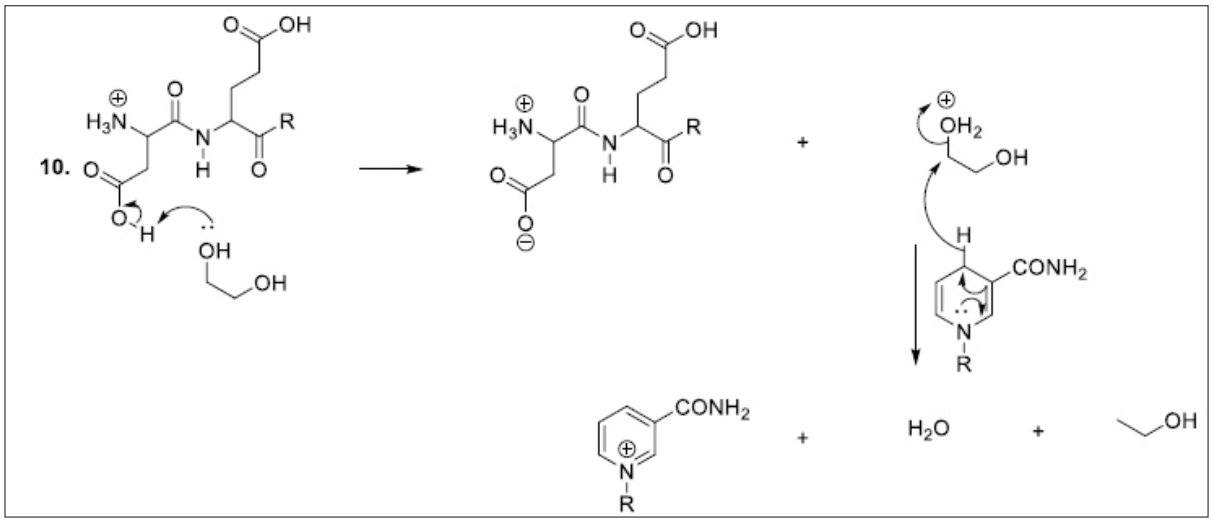




Scheme 5b



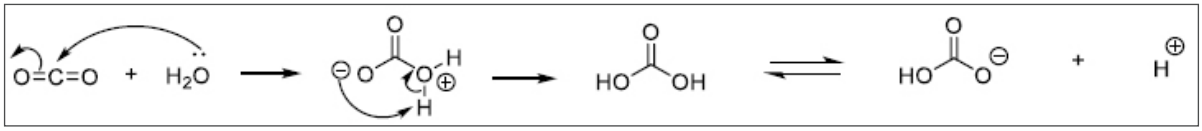
Scheme 5ac



Scheme 5d

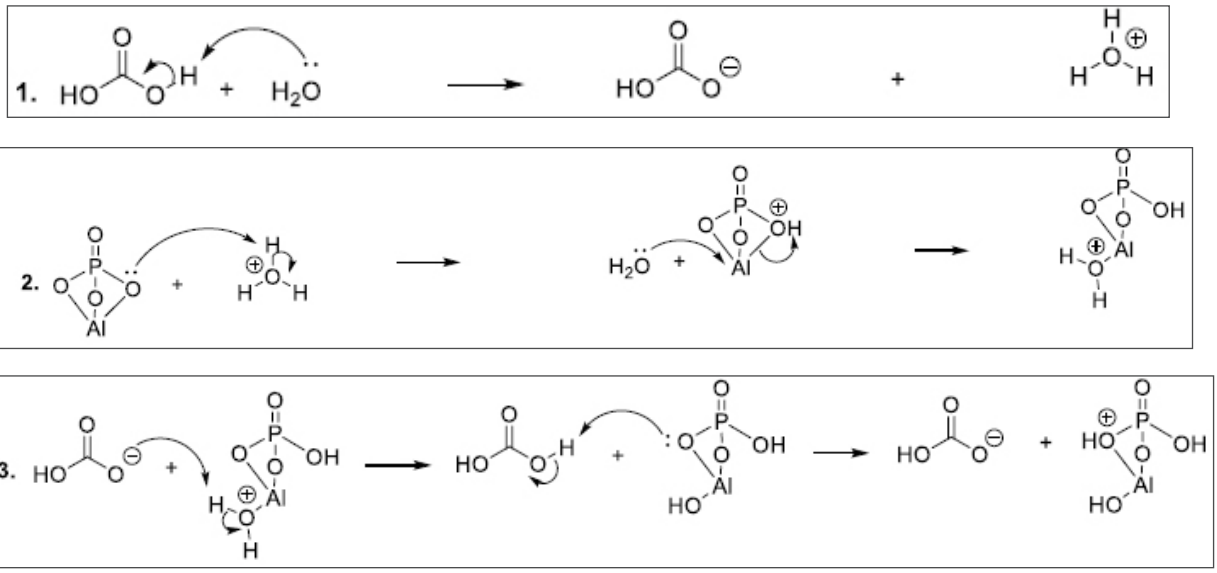
5. Rain Acidity

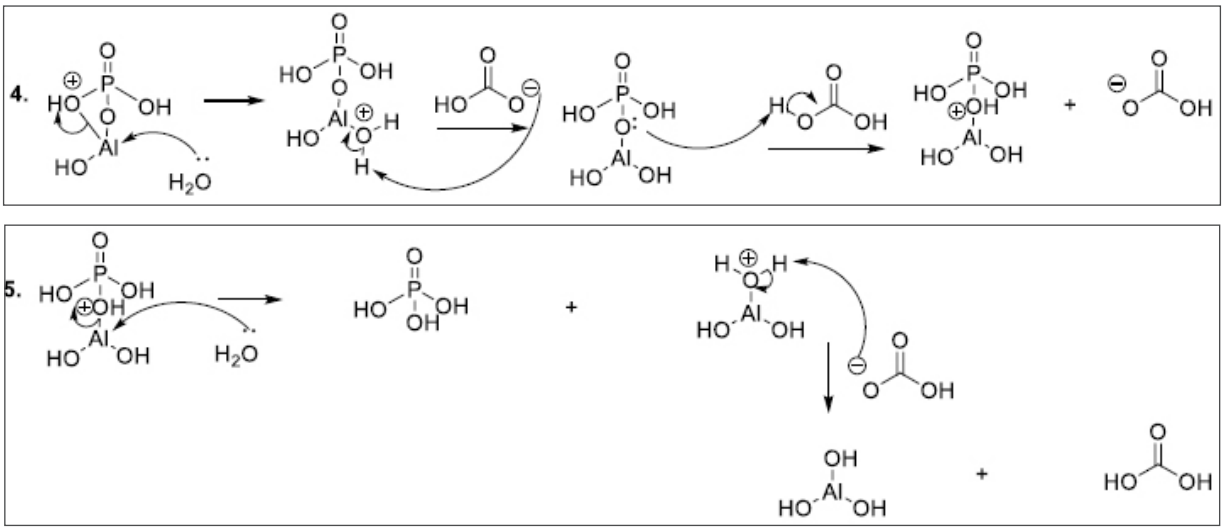
Carbon dioxide derived from the enzymatic decomposition of organic waste such as glucose is the principal source of rain acidity.[21-24] In that context, carbon dioxide reacts with water to generate carbonic acid, which decomposes into hydrogen ion and carbonate ion (Scheme 6). The presence of carbonic acid is the fundamental root that explains hydrogen ions concentration (pH) in the normal rain. Indeed, the pH of pure water equals 7, while the pH of unpolluted natural water equals 5.6. Such acidity is caused, among other chemical substances, by carbon dioxide.[21-24]



Scheme 6

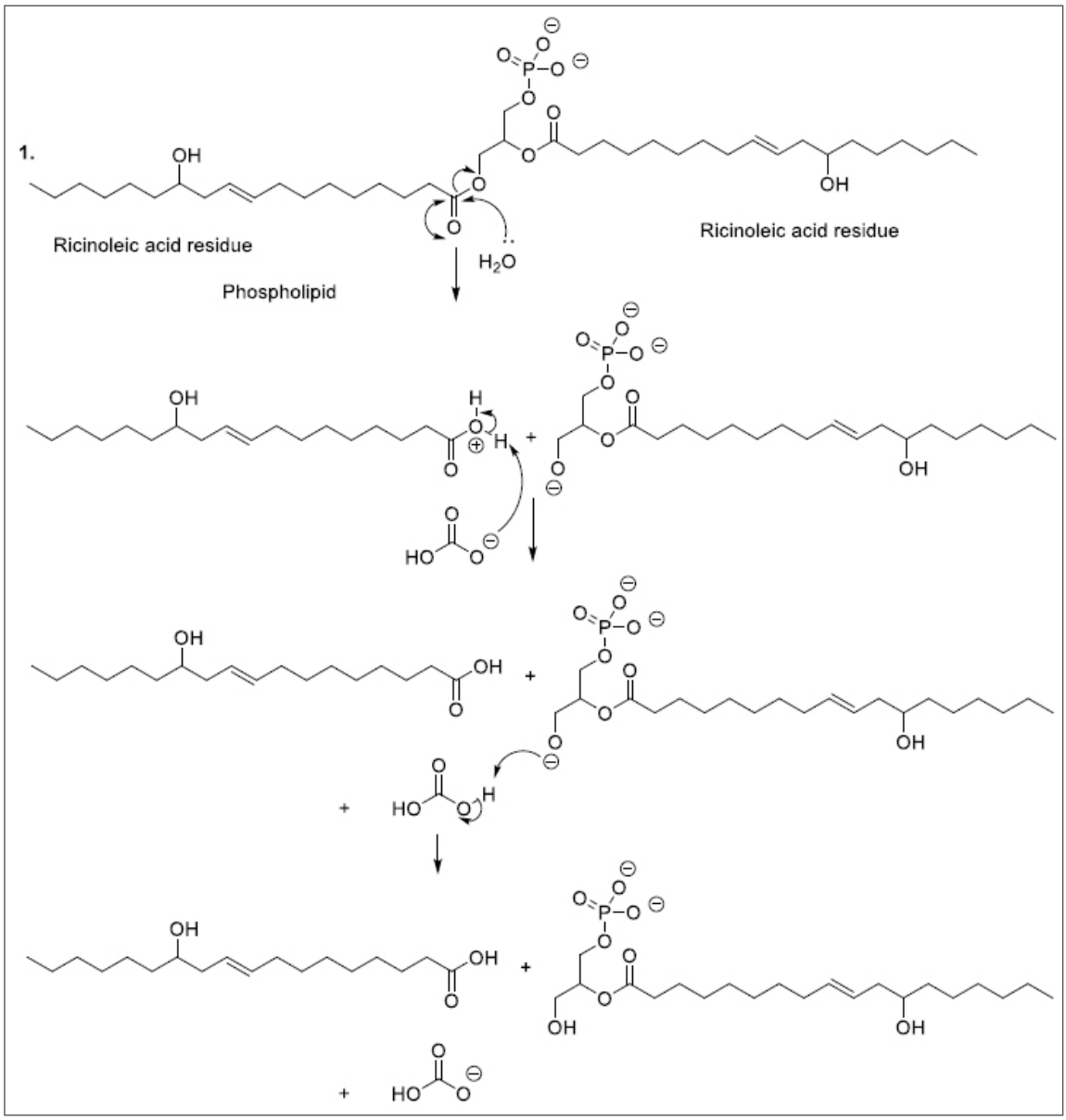
When the acid rain reaches the earth, it flows through the lakes, rivers, humid earths and others aquatic environments. It increases their pH, dissolves toxic metals, which penetrate the soil. The aquatic environment pH being sufficiently acid, the fishes and other type of animals cannot comfortably live there anymore because they do not tolerate water that has become so acidic. Given that the ecosystem is interconnected, the birds can also be affected through the food chain.[21-24] Acid rain also disrupts the forests specifically those situated in the elevated areas. It deprives the soil of essential nutrients and it releases the aluminium into the ground, which does not promote the absorption of water by plants (Scheme 7).[21-24]



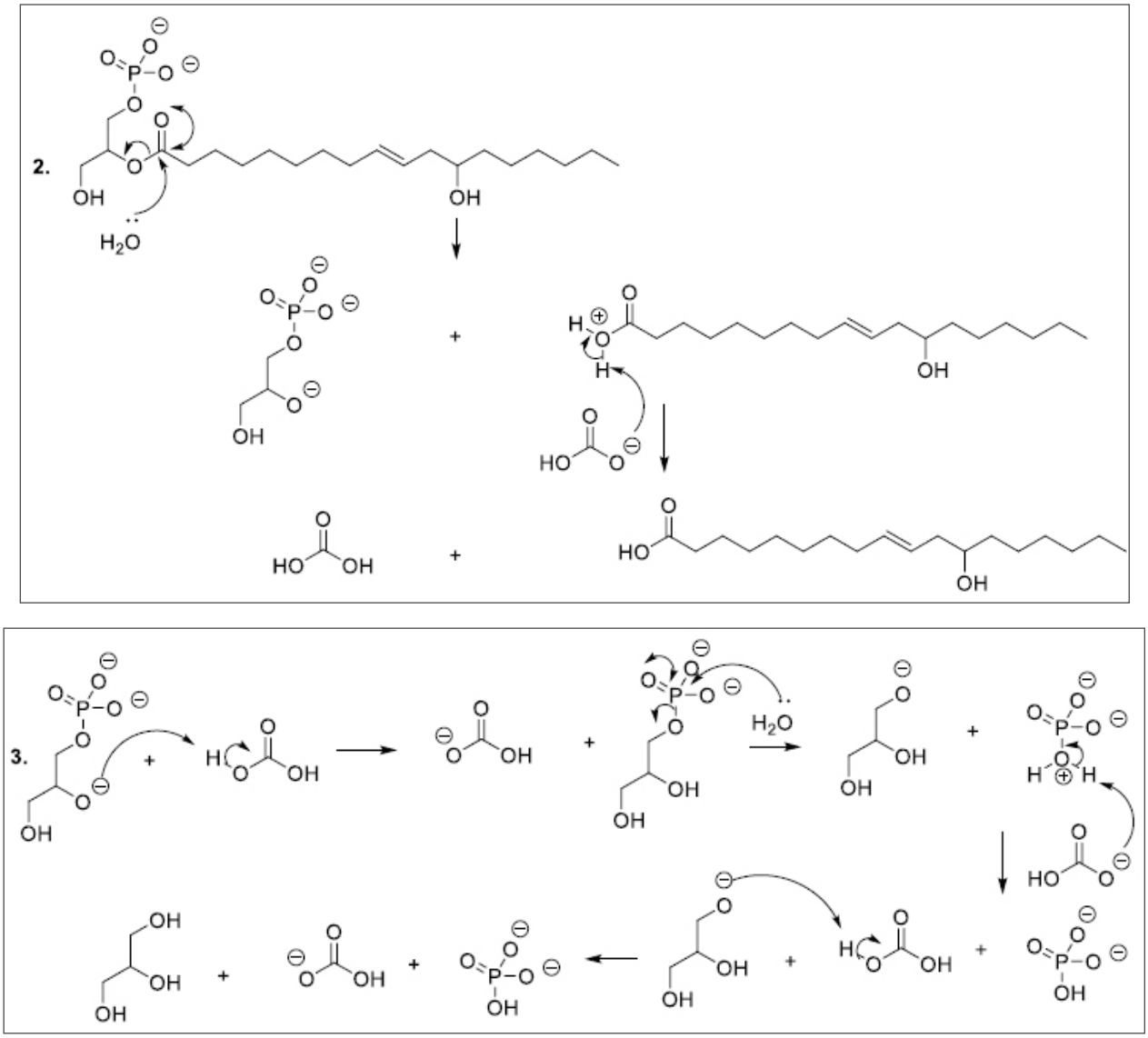


Scheme 7

The leaves of plants are also affected by the acid rain. Indeed, the effects of the acid rain including other environmental factors diminish the resistance of trees and plants against cold temperatures. In this perspective, the insects will easily accede to plants and generate diverse illnesses because acid rain hydrolyzes cellular membrane constituents such as phospholipids under acidic conditions (Scheme 8).

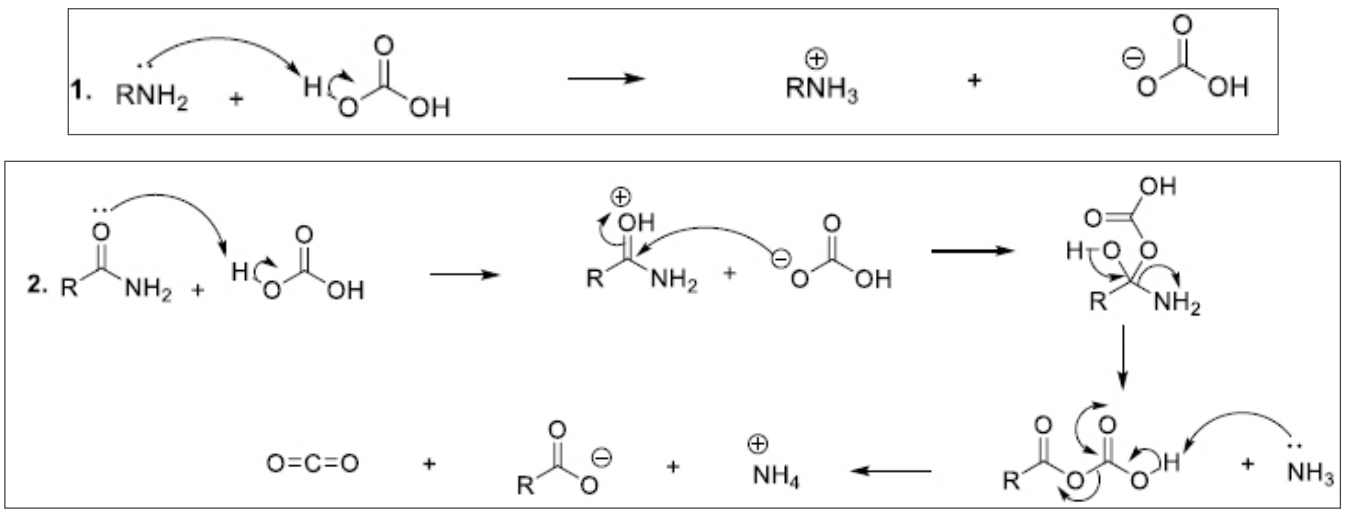


Scheme 8a



Scheme 8b

Certain soils neutralize better the acids than the others and it has been observed that in the soils where the capability to neutralize acids is weak, the harmful effects of acids are significant.[21-24] Indeed, soils rich in organic compounds, which behave as nucleophiles, are more susceptible to destroy acids than poor soils with less nucleophile compounds such as amines or amides (Scheme 9).



Scheme 9

6. Conclusion

This conceptual study has significantly shown detailed organic reactions in order to better illustrate the carbon dioxide chemistry in the environment. In other words, the reaction mechanisms demonstrating the production or the synthesis of carbon dioxide as well as its degradation have been comprehensibly herein detailed. Specifically, the consequents or the harmful chemical behaviours of carbon dioxide towards the ozone layer including the unfavorably acidity impact on soils and plants have been properly demonstrated in this study.

Conflict of Intrest Statement

I declare that I do not have a conflict of interest regarding the publication of this paper.

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