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Acetate Phathway- An Overview

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ABSTRACT

Investigations during the last three decades have shown that acetic acid is one of the most important building units for the synthesis of complex organic molecules found in Nature. This insight is primarily due to the application of tracer techniques to biosynthetic problems.

The mevalonate pathway also known as the isoprenoid or HMG-CoA reductase pathway is an essential metabolic pathway present in eukaryotes, archaea and some bacteria. The pathway produces two five-carbon building blocks called isopentenyl pyrophosphate (IPP) and dimethylallyl pyrophosphate (DMAPP), which are used to make isoprenoids, a diverse class of over 30,000 biomolecules such as cholesterol, vitamin K, and all steroid hormones. The mevalonate pathway begins with acetyl-CoA and ends with the production of IPP and DMAPP. It is best known as the target of statins, a class of cholesterol lowering drugs. Statins inhibit HMG-CoA reductase within the mevalonate pathway. The aim of review this pathway have important role in biosynthesis of saturated and unsaturated fatty acids and terpenoids.

Keywords- Acetate pathway, mevalonate, acetate malonate, acetyl-coA

INTRODUCTION

A metabolic pathway is a biochemical reaction occurring within the cell. The reactants, products, and intermediates of an enzymatic reaction are known as metabolites. Therefore plants are living and solar-powered in which manufactures both primary and secondary metabolites from air, water, minerals and sunlight. The primary metabolites are needed for normal growth & development of plants and also utilized as food by man. The secondary metabolites are biosynthetically derived from primary metabolites.

Since a long time it was believed that acetic acid is involved in the synthesis of cholesterol, squalene and rubber-like compounds. The discovery of acetyl coenzyme A further supported the role of acetic acid in biogenetic pathways. Later, mevalonic acid was found to be associated with the acetate. The pathway begins with acetyl CoA molecule produced from pyruvic acid, which is the end product of glycolysis.

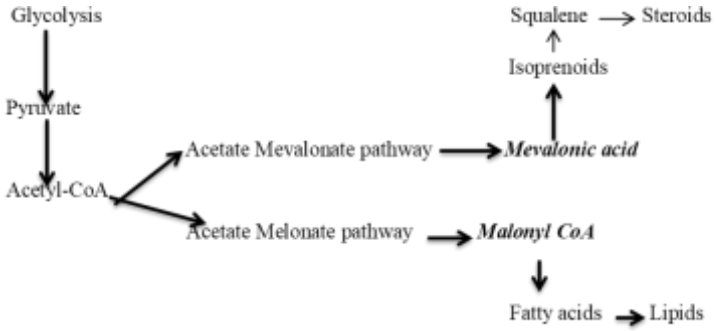
First two molecules of acetyl CoA forms acetoacetyl CoA through Claisen condensation. 3rd molecule of acetyl CoA forms β-hydroxy β-methylglutaryl-CoA by aldol addition. Next on reduction gives rise to mevalonic acid, which is the main precursor for biosynthesis of terpenoids. Mevalonic acid on ATP mediated phosphorylation gives mevalonic acid diphosphate. Which on decarboxylation gives the 1st isoprene unit, isopentyl pyrophosphate (IPP)? By the isomerase enzyme, the IPP gives 2nd isoprene unit Dimethyl allyl pyrophosphate (DMAPP). Electrophilic addition of IPP with DMAPP via enzyme prenyl transferase yield C10 unit, geranyl pyrophosphate (GPP), which is the precursor for synthesis of monoterpenes. Combinations of another IPP unit with GPP give rise to form farnesyl pyrophosphate (FPP), C15 unit which acts as a precursor for the synthesis of sesquiterpenes. Further addition of IPP unit gives C20 geranyl geraniol pyrophosphate (GGPP) to produce a range of Diterpenes. On further addition of IPP unit gives C25 geranyl farnesyl pyrophosphate called sesquiterpenes. The tail to tail addition of two FPP units yields C30 unit, triterpene. Similarly 2 units of GGPP yield C40 unit, tetraterpene.

The acetate mevalonate pathway thus works through IPP and DMAPP via squalene to produce two different skeleton containing compounds, that is, steroids and triterpenoids. It also produces vast range of monoterpenoids, sesquiterpenoids, diterpenoids, carotenoids, polyprenols, and also the compounds like glycosides and alkaloids in association with other pathways.

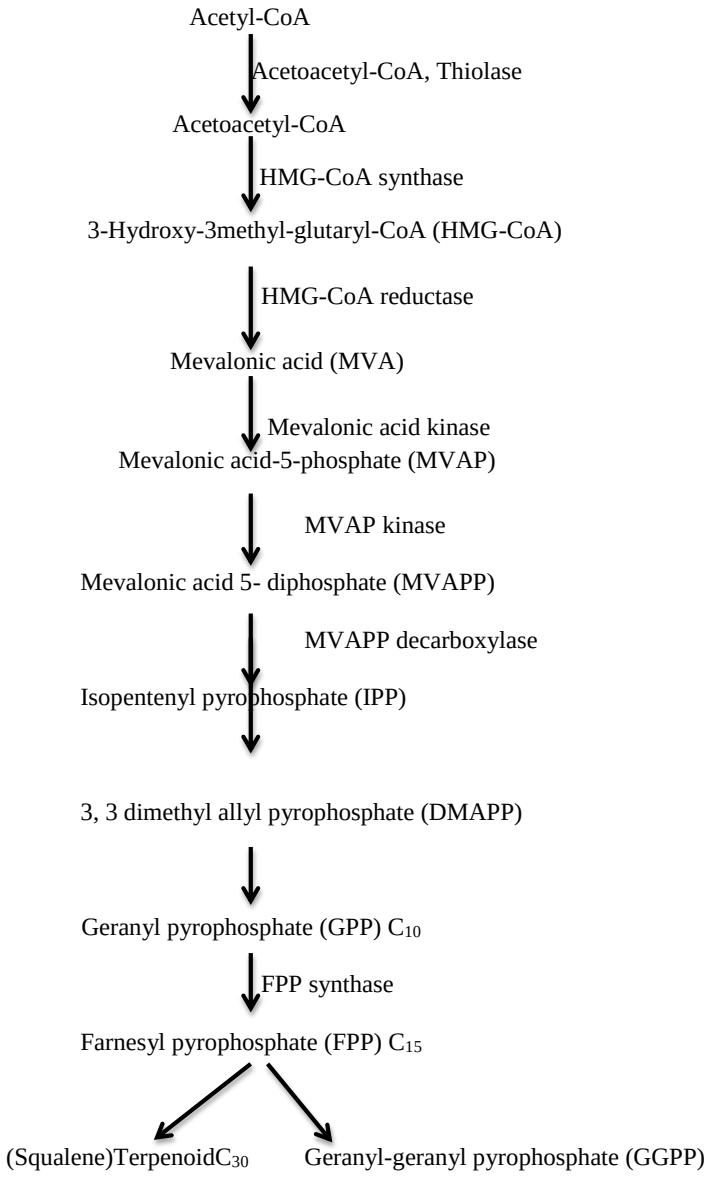
METHODOLOGY

Acetate pathways have to main route, that means there is mainly two main pathway in which this acetate is utilized a starting material.

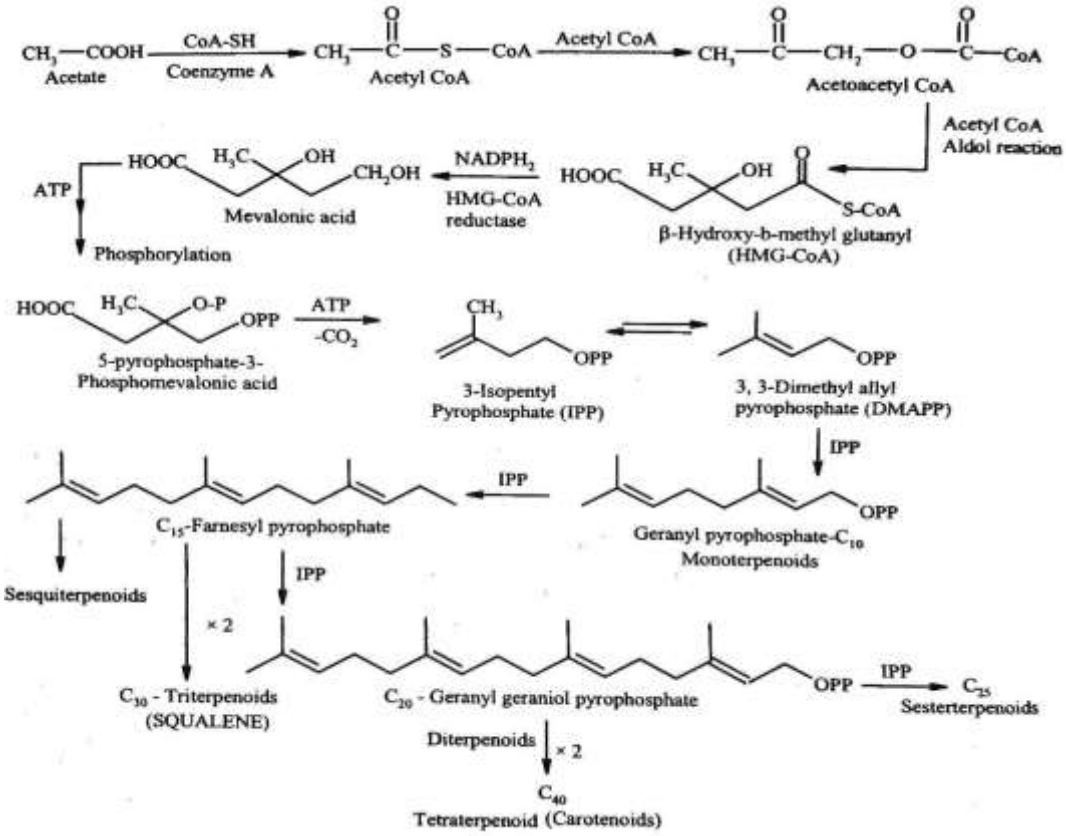
1. Acetate mevalonate pathway/ Isoprenoid pathway; formation of terpenes and steroids.
2. Acetate Melonate pathway; formation of fatty acid and polyketides



Schematic diagram of acetate mevalonate pathway

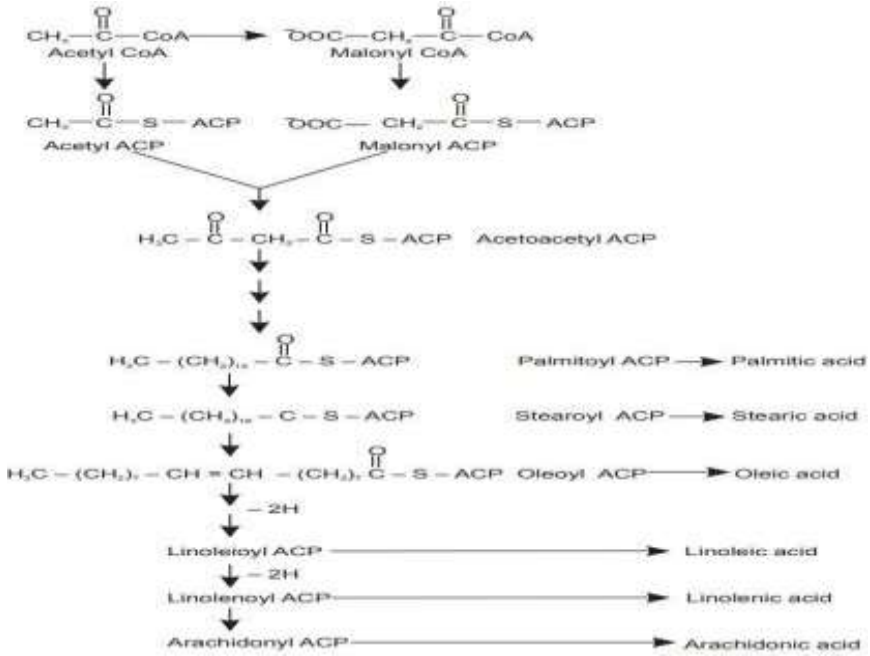


Schematic diagram of acetate mevalonate pathway with chemical structure



Acetate-Malonate Pathway

Acetate-Malonate pathway includes synthesis of fatty acids and aromatic compounds with the help of secondary metabolites. Main precursors of Acetate-Malonate Pathway are Acetyl-CoA and Malonyl-CoA. End product of this pathway can be saturated or unsaturated fatty acids or polyketides, Acetate pathway operates with the involvement of acyl carrier protein (ACP) to yield fatty acyl thioesters of ACP. These acyl thioesters forms the important intermediates in fatty acid synthesis.



CONCLUSION

The acetate mevalonate and acetate malonate biosynthetic pathway is also known as acetate or isoprenoids pathway of leads to understanding the enzyme mediated reaction. The Acetate pathway mainly involved in the formation of terpenoids, steroids, fatty acids, lipids and wax. Therefore there is scientific interest in continuing to investigate the acetate biosynthetic pathway from several points of view such as generates a key intermediate for cholesterol production, a fundamental constituent of cell membranes.

REFERENCES

1. Khadabadi SS, Deore SL and Baviskar BA. Pharmacognosy and Phytochemistry: A Comprehensive Approach. 1st ed. PharmaMed Press; 2014.
2. Dandu G, Basu VR, Kamalakar K, Manasa CH, Lavanya B, Pavani J. A Review on Tracer Technique and Its Applications in Synthesis of Secondary Metabolites in Pharmacognosy. Int. J. Adv. Pharm. Biotech (2019) 5(1) 01–05.
3. Buhaescu I, Izzedine H (2007) Mevalonate pathway: areview of clinical and therapeutical implications. ClinBiochem 40:575–584.
4. Holstein, S. A., and Hohl, R. J. (2004) Isoprenoids: Remarkable Diversity of Form and Function. Lipids 39, 293−309
5. Goldstein, J. L., and Brown, S. B. (1990) Regulation of the mevalonate pathway. Nature 343, 425−430
6. Jump up to:[a] [b] Miziorko H (2011) Enzymes of the mevalonate pathway of isoprenoid biosynthesis. Arch Biochem Biophys 505:131-143.
7. Vinokur JM, Korman TP, Cao Z, Bowie JU (2014) Evidence of a novel mevalonate pathway in archaea. Biochemistry 53:4161–4168.
8. Azami Y, Hattori A, Nishimura H, Kawaide H, YoshimuraT, Hemmi H (2014) (R)-mevalonate-3-phosphate is an intermediate of the mevalonate pathway in Thermoplasma acidophilum. J Biol Chem 289:15957–15967.