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ORIGINAL ARTICLE

A FLASH BACK ON METHYLGLYOXAL

RINKU CHAKRABARTY

Abstract:

Methylglyoxal, also called pyruvaldehyde or 2-oxopropanal (CH_3-CO-CH=O or $C_3H_4O_2$) is the aldehyde form of pyruvic acid. It has two carbonyl groups, so it is a dicarbonyl compound, i.e. it is both an aldehyde and a ketone.

In organisms, methylglyoxal is formed as a side-product of several metabolic pathways.[1] *It may form from 3-amino acetone, which is an intermediate of throenine catabolism, as well as through lipid peroxidation. Since methylglyoxal is highly cytotoxic, the body developed several detoxification mechanisms.*

INTRODUCTION

Methylglyoxal is derived from glycolysis, it has adverse effects on cellular function and has intrinsic role in vivo. It is a major contributor to protein modification and tissue dysfunction seen in diabetic patients.

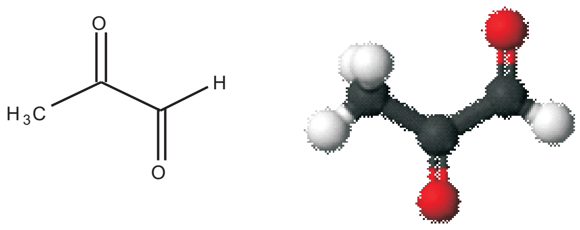

Figure 1: Methylglyoxal (skeletal formula and ball-and-stick model respectively from left to right).

Methylglyoxal can be prepared in a number of pathways one of which is oxidation of acetone by selenium dioxide which is schematically represented in figure 2. Methylglyoxal is a yellow oil with a pungent odour and begins to boil at 72°C to give a light green vapour. The liquid form of methylglyoxal is a dimer and slowly polymerises at r.t. to form a glassy mass.

Title : A FLASH BACK ON METHYLGLYOXAL
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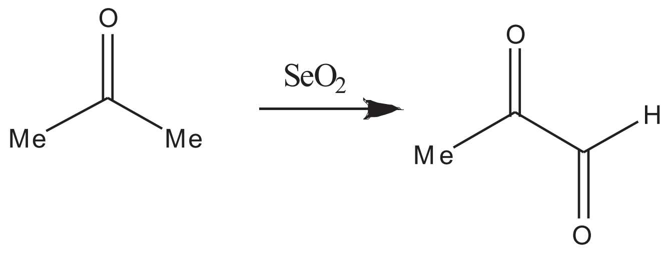

Figure 2: One of the process of preparations of methylglyoxal.

Sareen et. al. showed that methylglyoxal forms lightabsorbing secondary organic material in aqueous ammonium sulfate and ammonium nitrate solutions mimicking tropospheric aerosol particles.[2]

Methylglyoxal (MG) is a phytochemical present in some New Zealand honeys, was found to possess bactericidal activity against S. aureus and a methicillin-resistant strain of S. epidermidis. Inclusion of MG in a hydrogel resulted in an active and stable preparation suitable for treating wound or burn infections, reported by Fidaleo et. al.[3]

Slusarewicz et al characterized the relative efficacies of a number of protein crosslinking agents among which one was methylglyoxal, which had the potential for use in the crosslinking of proteinaceous matrices both in vitro and in vivo.[4]

Zhao et. al. reported that heterogeneous reactions of methylglyoxal decreased with acidity and involve negligible formation of sulfate esters. The results implied that heterogeneous reactions of methylglyoxal contributed to organic aerosol formation in less acidic media and hydration and polymerization of methylglyoxal in the atmospheric aerosol-phase which are dependent on the hygroscopicity, rather than the acidity of the aerosols.[5]

Methylglyoxal is also an important centre of interest for study of different rate coefficients, k, for the gas-phase reaction of CH_3COCHO (methylglyoxal) with the OH and NO_3 radicals.[6]

Methylglyoxal is an important glycating agent produced under physiological conditions. It could react with DNA and proteins to generate advanced glycation end products. Gao et. al. revealed that hemoglobin could be modified by methylglyoxal, and the major form of modification was found to be the hydroimidazolone derivative of arginine residues.[7]

Methylglyoxal can be generated endogenously and exogenously (human body and food system). It was reported as flavour generating agent.[8] It can be detected in food systems by different techniques after derivatization. It plays an important role as precursor of aroma and colour compounds. When combined with amino acids methylglyoxal undergoes Schiff base formation, decarboxylation and a-aminoketone condensation leading to heterocyclic aroma compounds such as pyrazines, pyrroles and pyridines. It attacks amine groups in amino acids, peptides and proteins to form advanced glycation end products (AGEs) and cause carbonyl stress followed by oxidative stress and tissue damage.

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