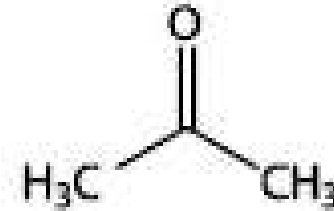


# KETONE BODIES

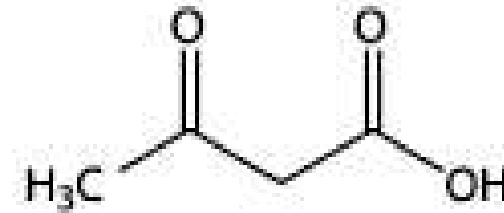
GALGOTIAS  
UNIVERSITY

# Introduction

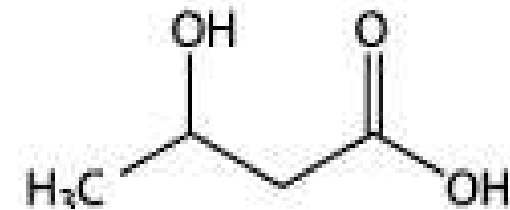
- Ketone bodies are metabolic products that are produced in excess during excessive breakdown of fatty acids.
- Acetoacetate, acetone and  $\beta$ -hydroxybutyrate are collectively known as ketone bodies (acetone bodies).
- Only the first two are true ketones while  $\beta$ -hydroxybutyrate does not possess a keto (C=O) group.
- Ketone bodies are water-soluble and energy yielding.
- In a normal man, concentration of ketone bodies in the blood is usually less than 3 mg/100ml.



**Acetone**



**Acetoacetate**



**2-Hydroxybutyric acid**

# SIGNIFICANCE OF KETONE BODIES

## ❑ Alternate source to glucose for energy needs

- Ketone bodies represent an alternative to glucose for the provision of energy to the cells.

## ❑ Production of ketone bodies under conditions of cellular energy deprivation

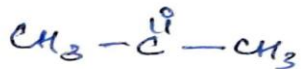
- Ketone bodies are produced when excessive fatty acids are being oxidized (because of increased adipose tissue lipolysis) and glucose availability to the cells is limited.
- Such situations are seen in conditions such as diabetes mellitus and starvation.

## ❑ Utilization of ketone bodies by the brain

- Brain normally utilizes glucose for energy needs.
- Although ketone bodies cannot completely replace glucose for energy needs in the brain, brain gets adapted to oxidize ketone bodies during prolonged fasting and starvation.

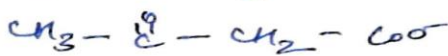
# Ketone Bodies

(I) Acetone



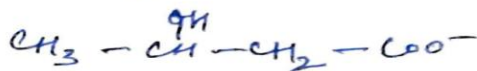
Rothera's test (Urine)

(II) Acetoacetate



→ Gerhardt's test

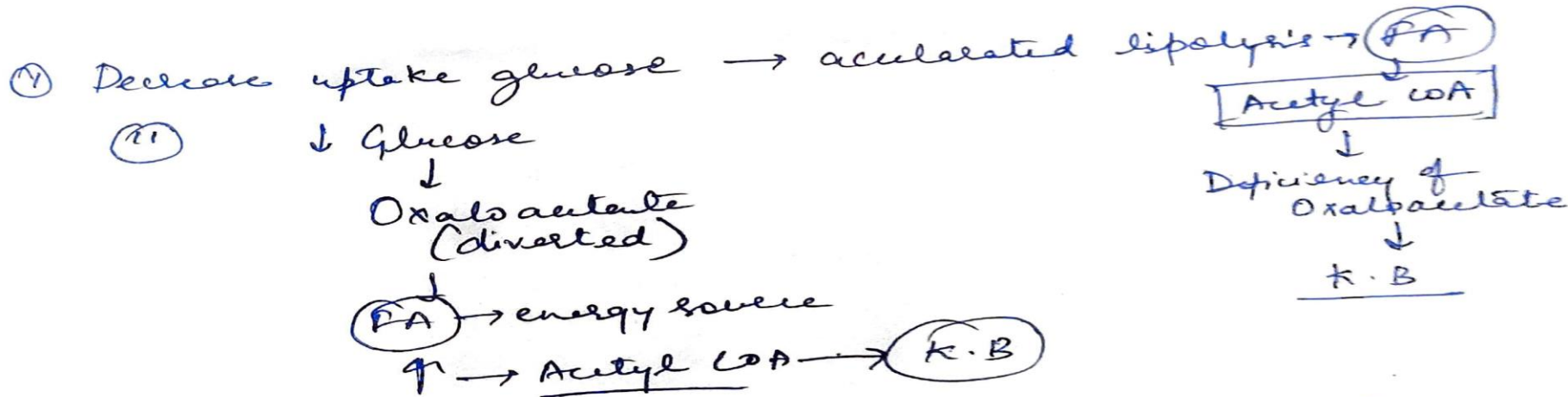
(III)  $\beta$ -hydroxy Butyrate



< 1mg/dl

Site: Mt (liver)

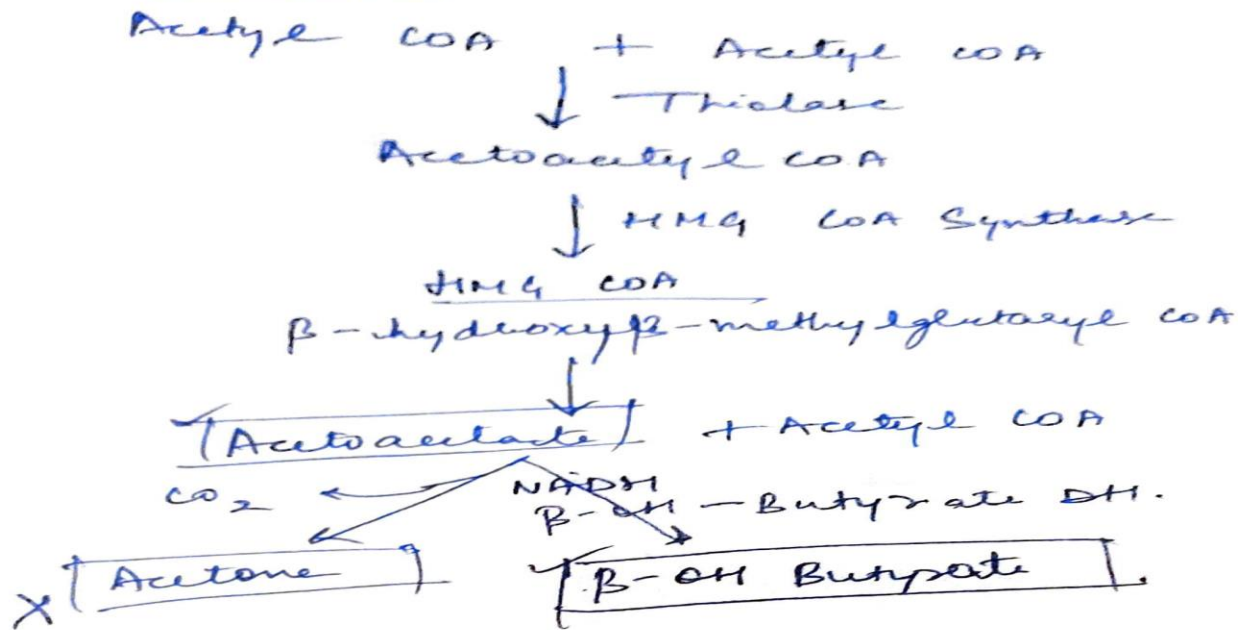
Clinical condition  $\Rightarrow$  1. Uncontrolled DM  
2. Starvation



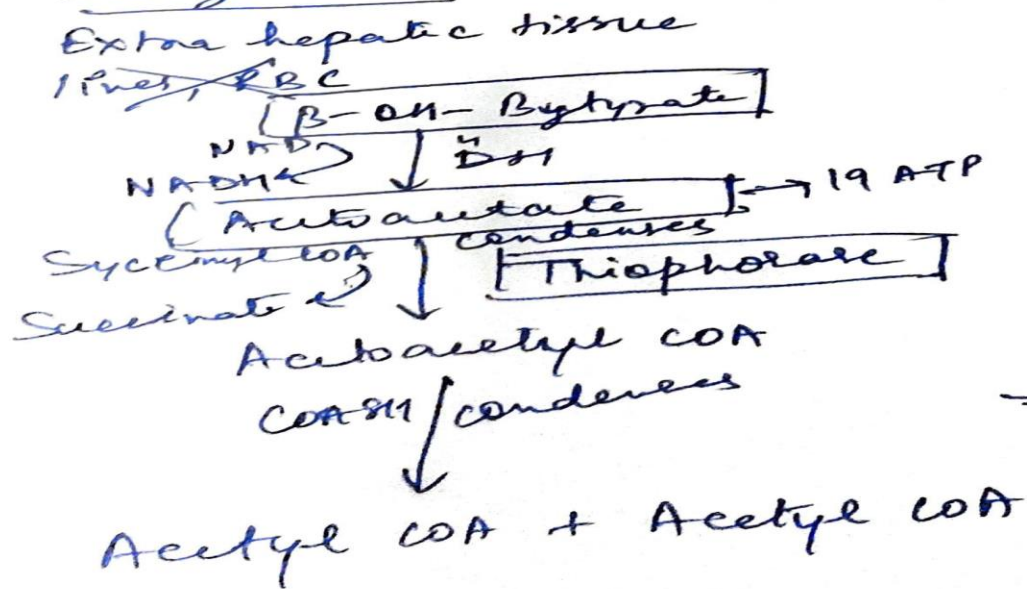
Tissues prefer utilization of K.B over Glucose  $\rightarrow$

Heart muscle  
Renal cortex

## Synthesis



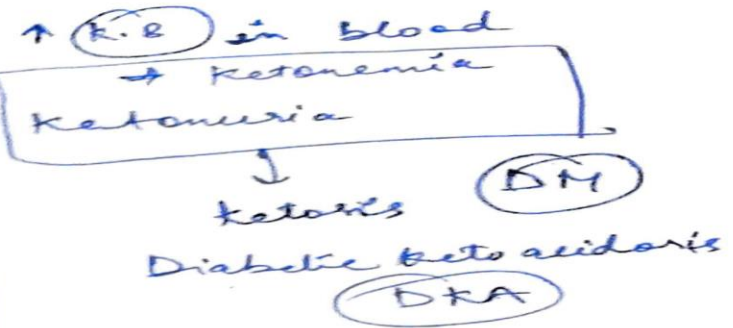
## Utilization



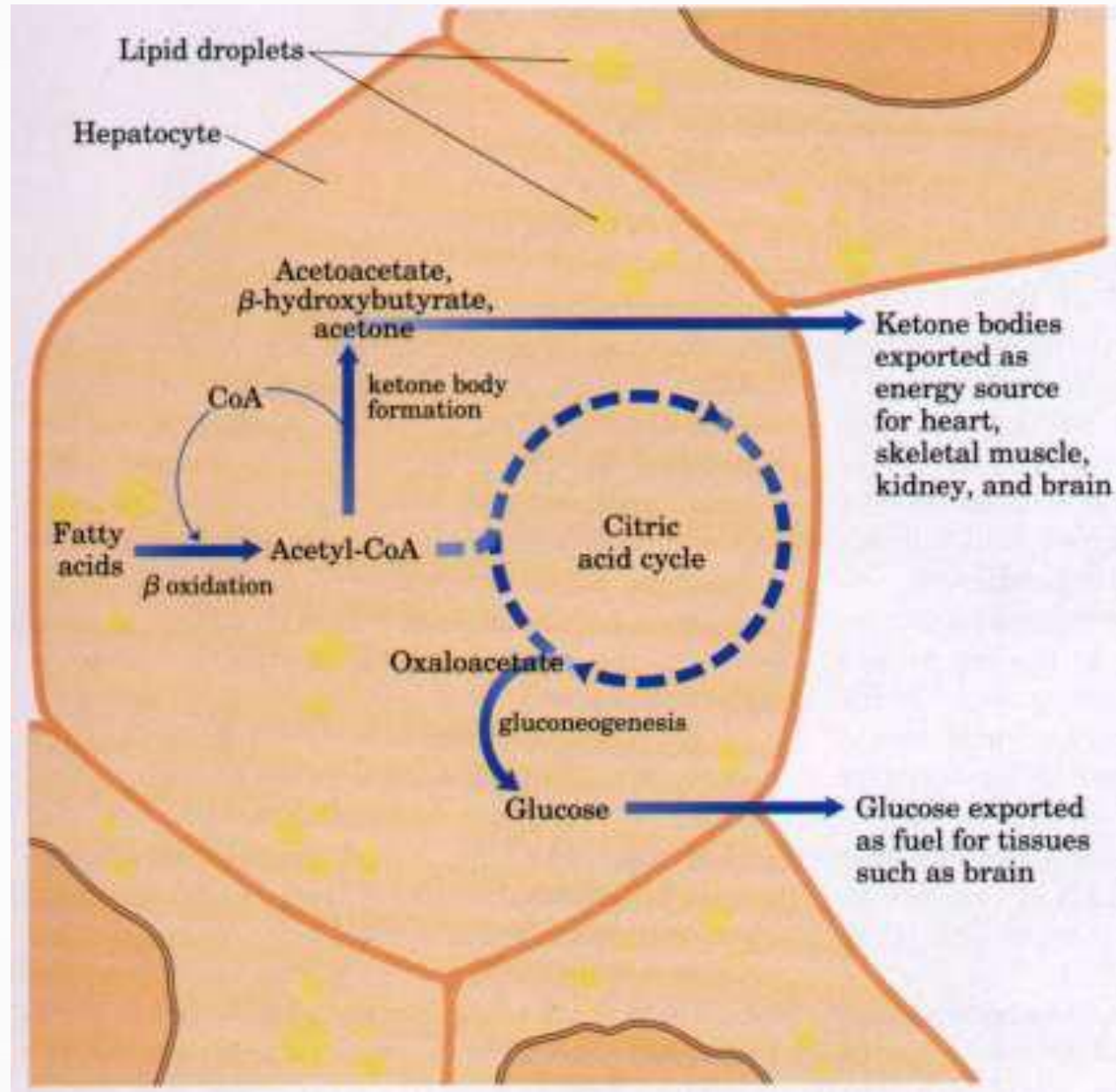
20 ATP  
 2.5 ATP

⇒ 22.5  
 - 1

21.5



## Ketone body formation and export from the liver



# KETOSIS

## □ DEFINITION

- • Ketosis is a disorder of excessive production of ketone bodies.

## □ CAUSE

- • Excessive ketone bodies are produced mainly in two conditions:
  - 1. Starvation (carbohydrate deprivation)
  - 2. Uncontrolled diabetes mellitus (impaired uptake of glucose by the peripheral tissues).

## ❑ BIOCHEMICAL AND CLINICAL FINDINGS

- The important features of ketosis are ketonemia, ketonuria, acetone odor of breath, metabolic acidosis and hyperkalemia.

### 1. Ketonemia

- In ketosis, the plasma concentration of ketone bodies is well above normal limits. The condition is called ketonemia.

### 2. Ketonuria

- When the concentration of ketone bodies significantly increased (above 70mg/dl) in plasma, they appear in urine. The condition is called ketonuria.

### 3. Acetone in breath

- Acetone is also excreted by the lungs and produces a characteristic odor in breath (acetone odor of breath).



## 4. Metabolic acidosis

- Metabolic acidosis is caused by excessive accumulation of  $\beta$ -hydroxybutyrate and acetoacetate.

## 5. Hyperkalemia

- Acidosis results in the shift of potassium from intracellular to extracellular compartment.

## ❑ BIOCHEMICAL DIAGNOSIS

- 1.  $\beta$ -hydroxybutyrate in plasma
- 2. Acetoacetate in urine
- 3. Rothera's test

# MANAGEMENT

## 1. Provision of glucose to the tissues

- Ketosis is suppressed by restoring adequate level of carbohydrate metabolism.

## 2. Correction of electrolyte imbalance and acid-base imbalance

- Metabolic acidosis is corrected by bicarbonate administration.
- Correction of metabolic acidosis also reverses hyperkalemia.

# References

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- Clarke, DD; Sokoloff, L (1999). Siegel, GJ; Agranoff, BW; Albers, RW (eds.). Basic Neurochemistry: Molecular, Cellular and Medical Aspects (6th ed.). Philadelphia: Lippincott-Raven.