Lactose Intolerence

} ½ of world's adult
90% of African & Asian adults

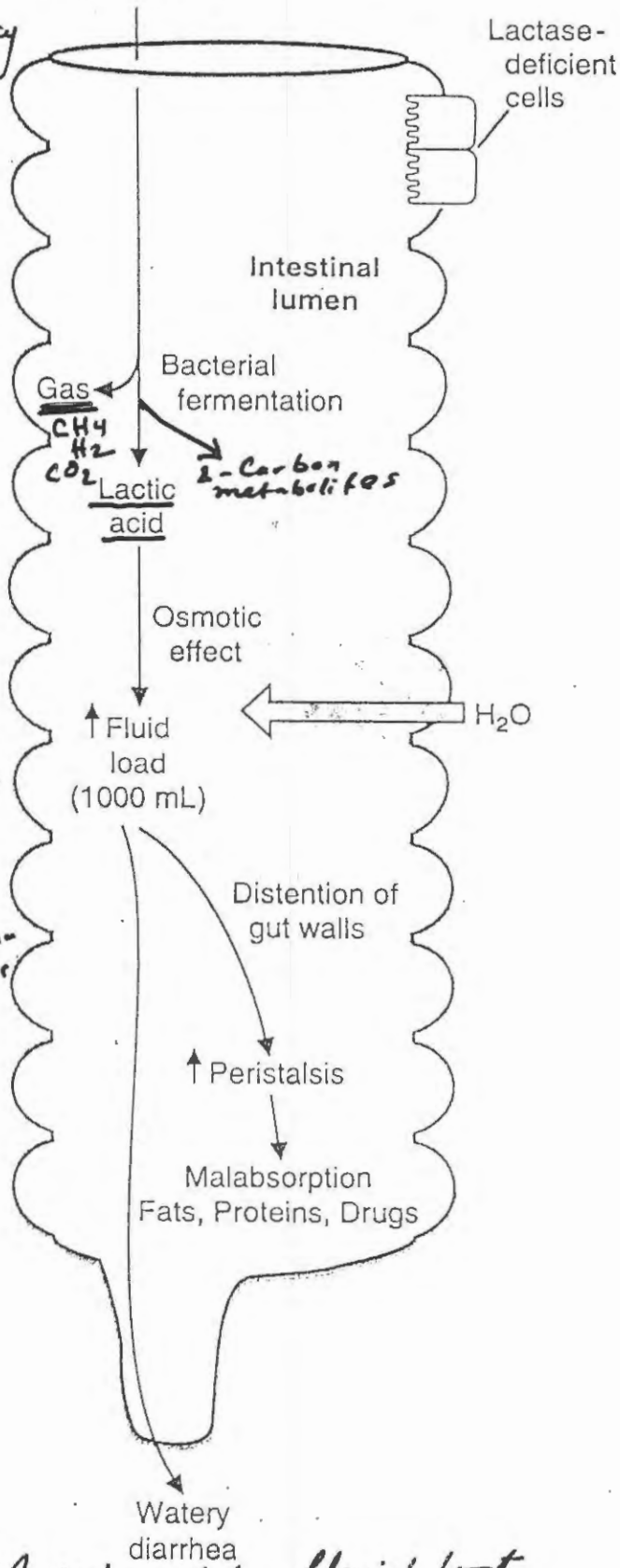
5

- Deficiency
  - Lactase deficiency
  - Intestinal mucosa injury

Abnormal Degradation of Disaccharides

- Variety of intestinal diseases
- Malnutrition
- Injury of mucosa
- severe diarrhea

Isomaltase-sucrose deficiency
1% Eskimos
2% of North European are heterozygotes



1 l of extracellular fluid lost per 9 gm of lactose in 1 glass of milk

Transporter | Occurance | Function

I Sodum dependent-Transporter:- SGLT

Small intestine and kidney

Active uptake from lumen of intestine, reabsorption of glu in proximal tubule of kidney against conc. gradient

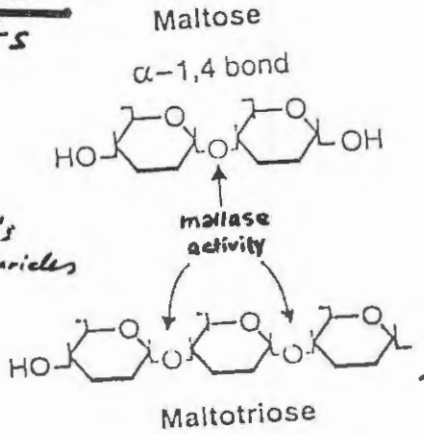
(7)

II Facilitative Bidirection Transporters

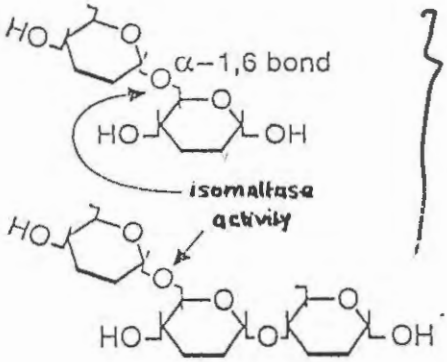
GLUT-1	Erythrocyte + Blood-brain barrier, also retinal, placental, testis-barriers	uptake of Glu $K_m = 1mM$
GLUT-2	Liver, Pancreatic β-cell small Intestine, kidney (serosal surface) Bidirectional	Rapid uptake and release of Glu • $K_m = \sim 15mM$ • High V_{max} • Glucose sensor
GLUT-3	brain, kidney, placenta (Major transporter in CNS)	uptake of Glu $K_m = \sim 1mM$ (High affinity)
GLUT-4	Heart and skeletal muscle, adipose tissue	Insulin stimulated uptake of glu $K_m = \sim 5mM$
GLUT-5	Small intestine & spermatozoa	absorption of fructose
GLUT-7	at endoplasmic reticulum membrane of glucogenic tissue (liver and kidney)	

II Glucoamylase Complex

- two different subunits
  - small difference in specificity
- Exoglucosidase activities → hydrolysis of α-1,4 bonds in oligosaccharides
- Also maltase activity
- Location: Jejunum



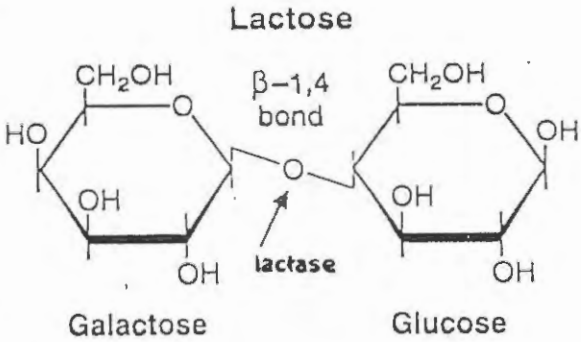
Complex II both subunits



Complex I isomaltase subunit

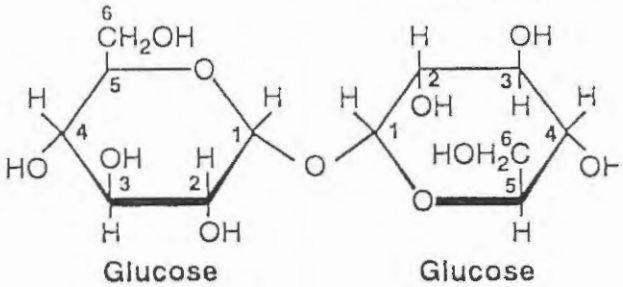
III β-Glycosidase (Lactase)

- Location – as for sucrase
- Activity – low and rate-limiting for lactose absorption
- Highest upto 5-7 yr.
- Secondary lactase deficiency

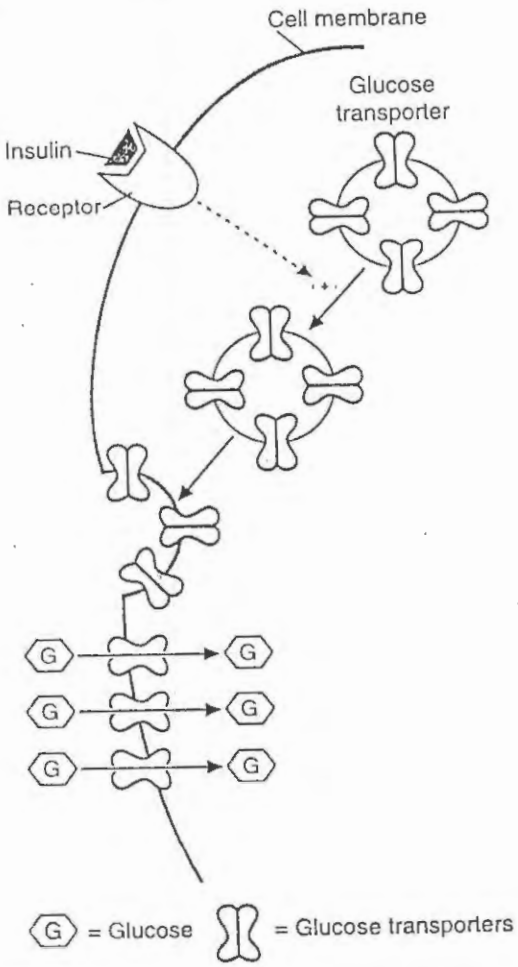


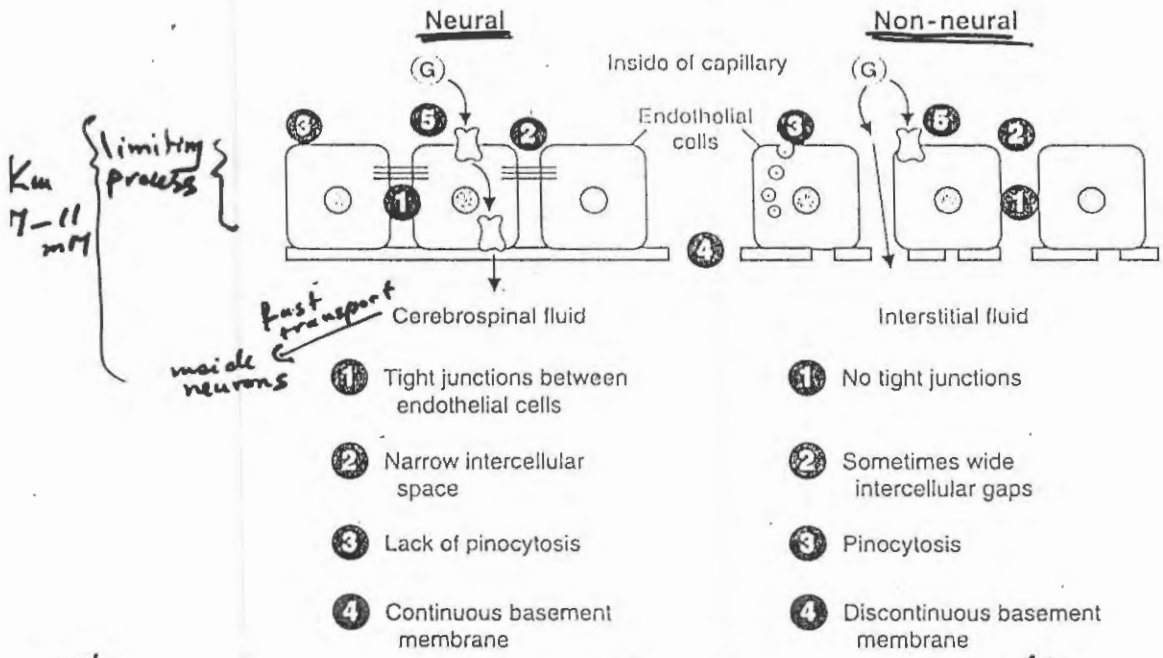
IV Trehalase

Trehalose (sugar in insects, algae, mushroom ...)



stimulation by Insulin of Glucose Transport into muscle and adipose Tissues





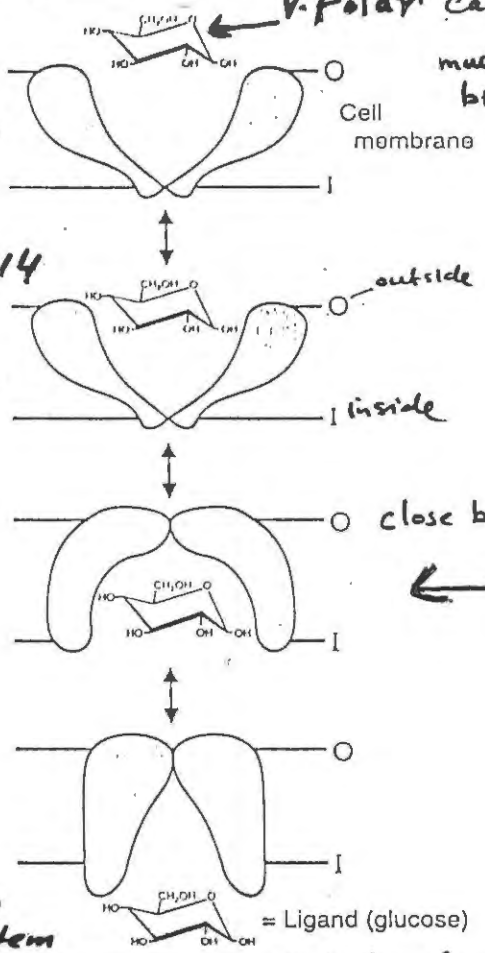
Glucose transport through the Capillary Endothelium

Absorption of Sugars

A- Na^+ - independant facilitated diffusion transport

V. polar can not diffuse

multiple gr. on protein bind - OH of glu and close behind it



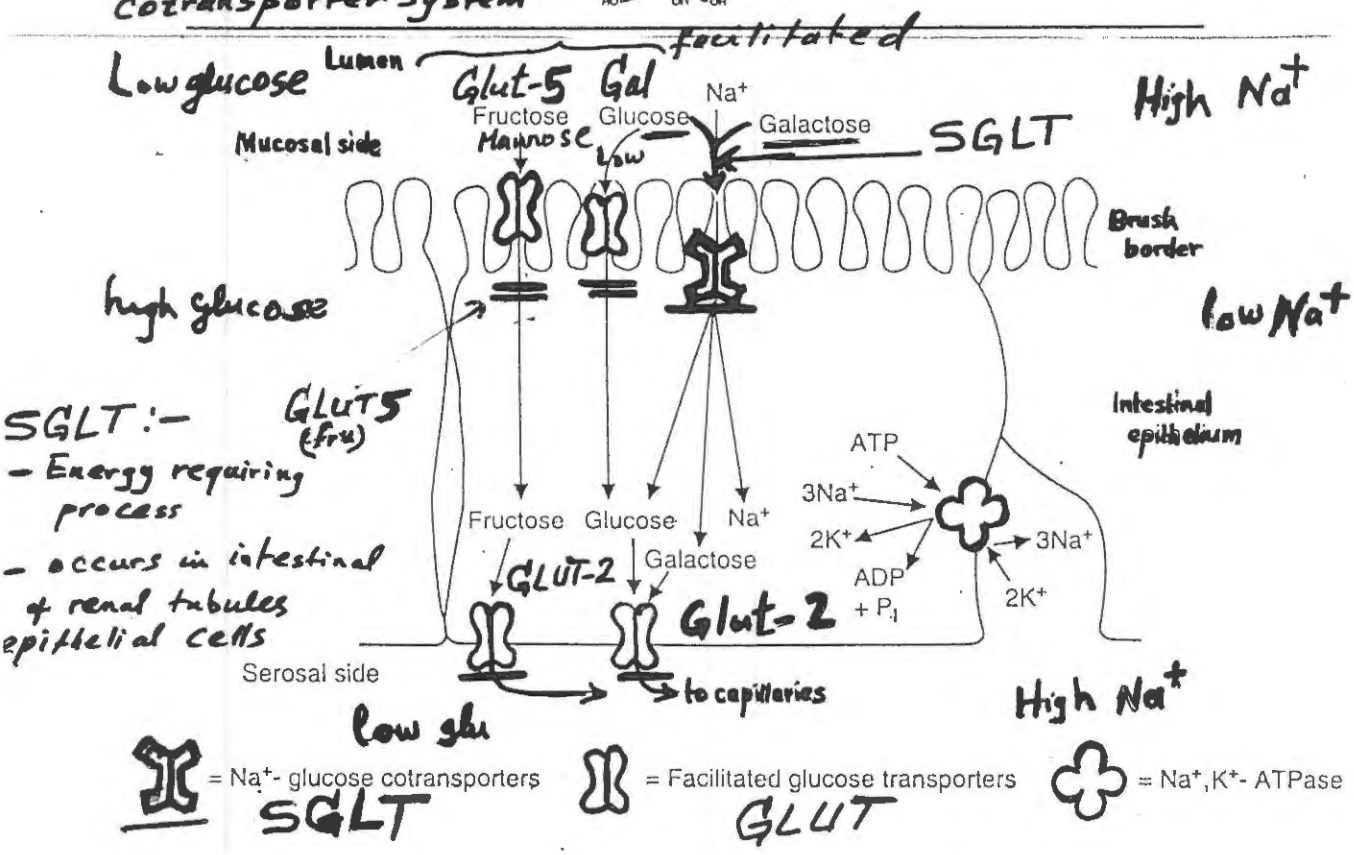
- Glut-1 → Glut-14

- Glu movements follow conc. gradient

- two conformational states

two conformational states

B- Na^+ (SGLT) - monosaccharide cotransporter system



SGLT :-
- Energy requiring process
- occurs in intestinal & renal tubules epithelial cells

= Na^+- glucose cotransporters SGLT

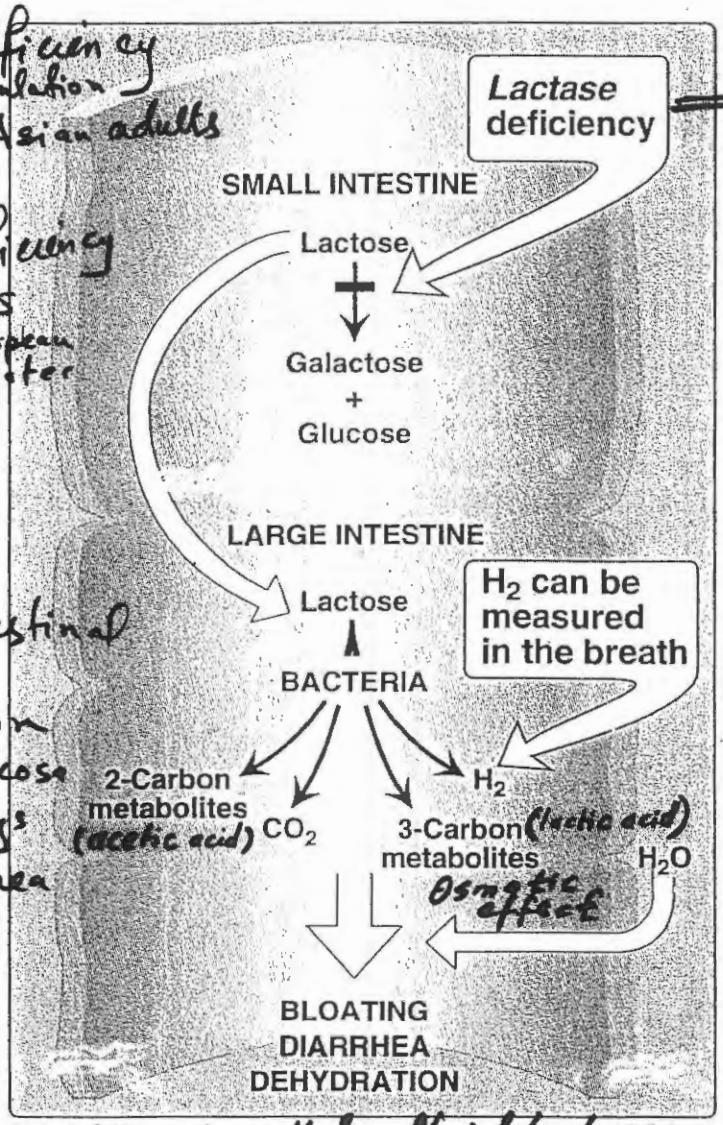
= Facilitated glucose transporters GLUT

= Na^+,K^+- ATPase

Abnormal Degradation of Disaccharides

- Lactase deficiency
  - > ½ World's population
  - 90% African + Asian adults
- Sucrase (isomaltase) deficiency
  - 10% Askimos
  - 2% North European are heterozygoter

Causes:-
- Genetics
- Variety of Intestinal diseases
- Malnutrition
- Injury of mucosa e.g. by drugs
- Severe diarrhea

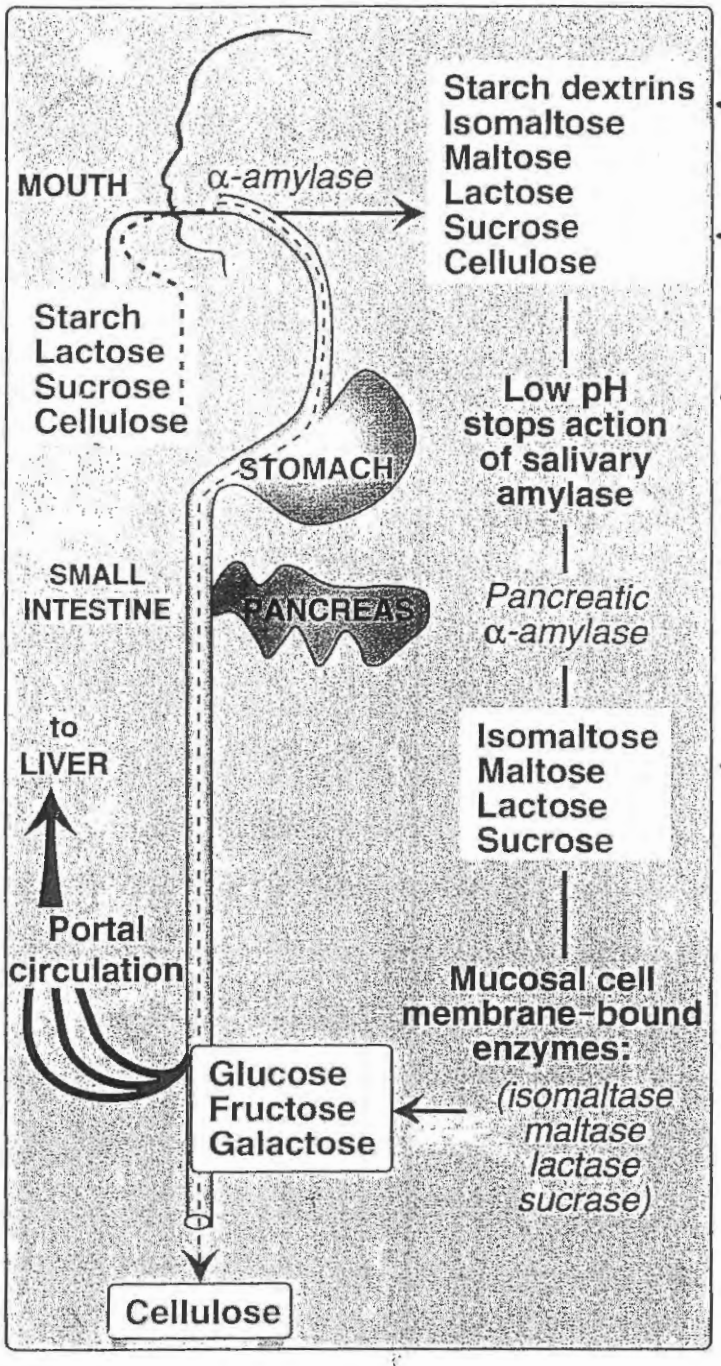


ADULT HYPOLACTASIA

1 l of extracellular fluid lost per 9 gr of lactose in 1 glass of milk.

Maximal activity → 1 month of age
declines → adult level at 5 to 7 yr. age (10% of Infant level)

Digestion of Carbohydrate 3a



- Isomaltase:- α-1→6 in Isomaltose
- Maltase α-1→4 in maltose and maltotriose
- Sucrase α-1→2 in sucrose
- Lactase β-1→4 in Lactose
- Trehalase α-1→1 in trehalose in mushrooms and other fungi

- $\underbrace{\text{Sucrase + isomaltase}}_{\text{single protein}} \xrightarrow{\text{split}}$ two associated subunits complexed
- $\underbrace{\text{maltase + exoglucosidase}}_{\text{similar complex}}$ (glucoamylase) $\xrightarrow{\text{no split}}$ $\underbrace{\text{glucoamylase}}_{\alpha\text{-}1,4 \text{ in limit dextrins}}$
- Trehalase

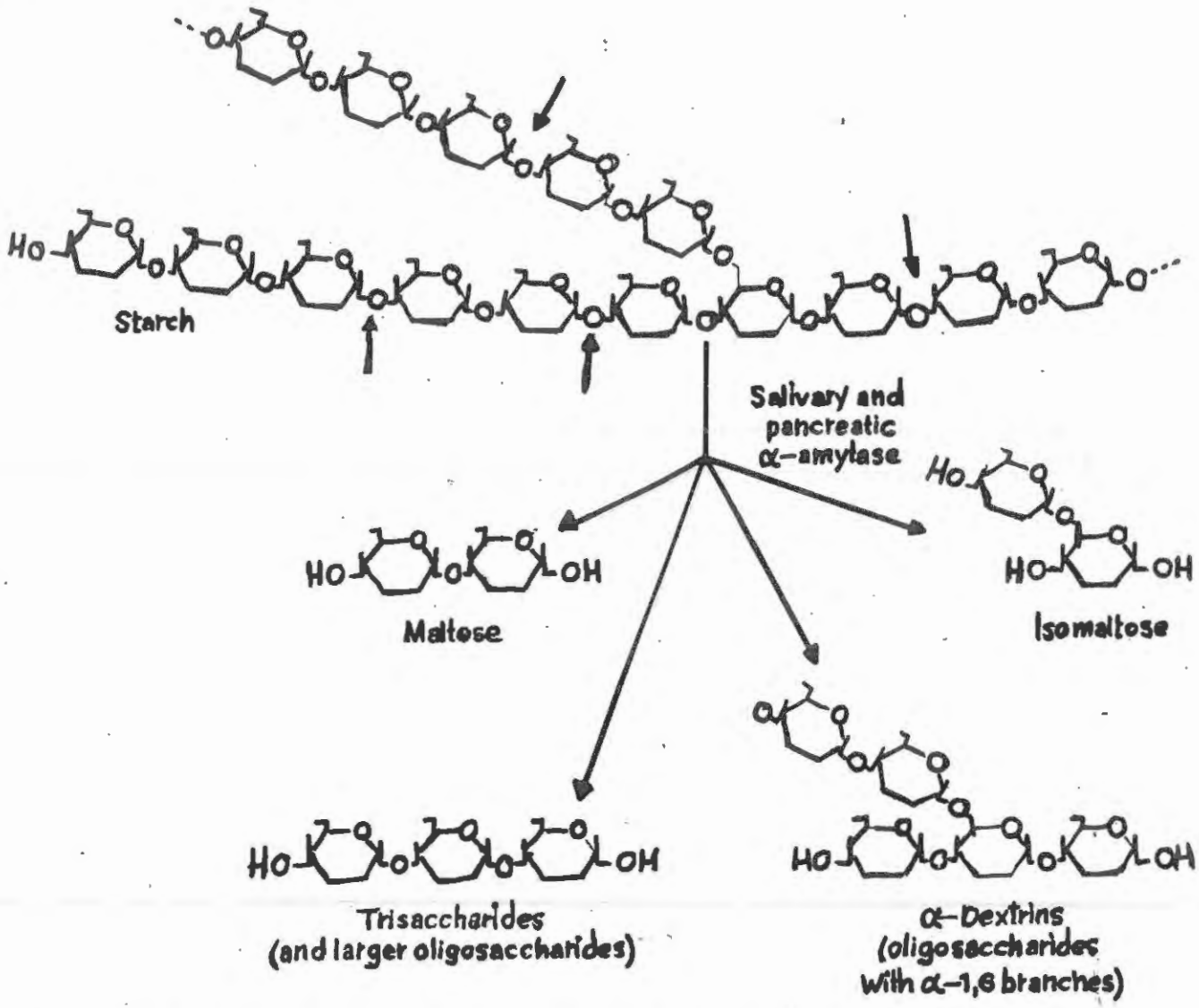
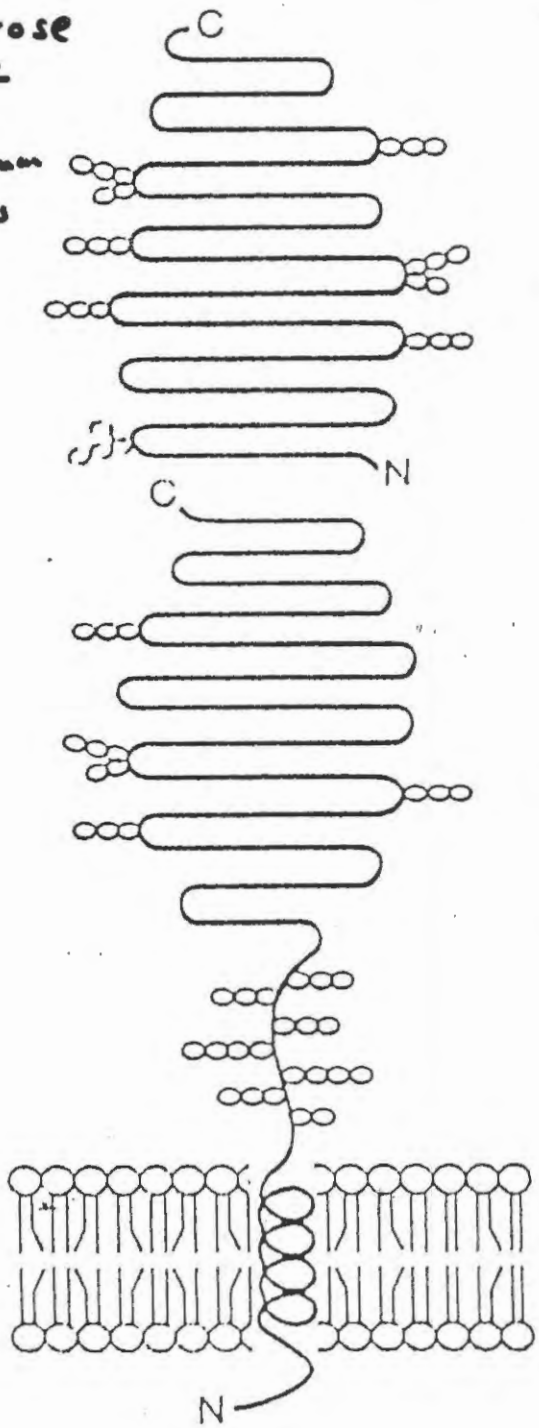


Fig. 25.12. Action of salivary and pancreatic α-amylase, on STARCH

Sucrase-Isomaltase Complex

Specificity:-
maltose, sucrose and Isomaltose

Location:-
rich in jejunum and lower below



sucrase-isomaltase

sucrase (only sucrase activity) + high maltose and maltotriase activity

} → they account for more than 80% of maltase activity

isomaltase (performs most of α-1,6 hydrolysis) + high maltose and maltotriose activity

Connecting segment (stalk) → lumen of the intestine

Transmembrane segment of absorptive cell

Cytoplasmic domain

Dietary Carbohydrates :-

→ 40 – 50% of Caloric intake

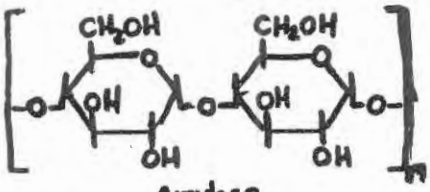
60% of Carbohydrate → STARCH

Sucrose, small amount of Fru, Glu — fruit, honey, veg.

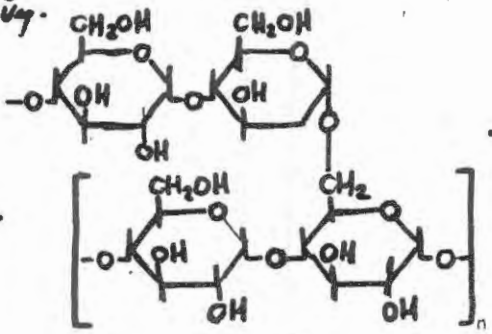
Lactose (animal)

No sp. sugar required

Glu ⟷ all other sugars

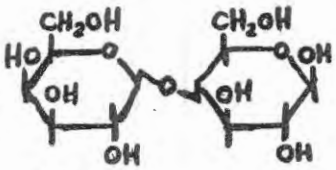


Amylose



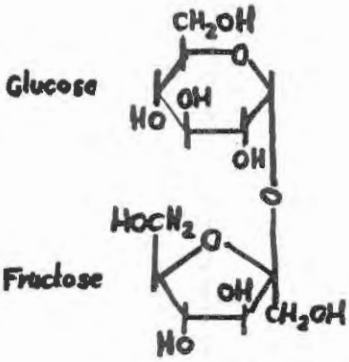
Amylopectin

STARCH

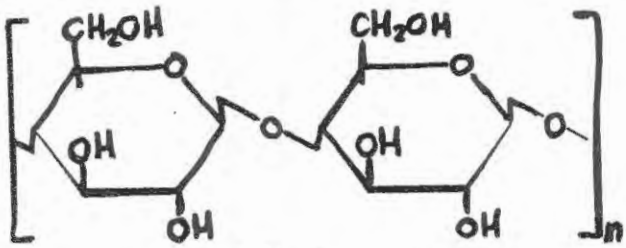


Galactose Glucose

Lactose



Sucrose



β-1,4-glycosidic bond in cellulose

CARBOHYDRATE METABOLISM

- OBJECTIVE :-
  - Utilization of Glu → Energy
  - Non-Carbohydrate → Glu
  - Storage of Glu → Glycogen
  - Release of Glu from Glycogen
  - HMS → NADPH → GSH
  - Glucuronic acid → Drug metabolism.
  - Interconversion of Sugar

- Over-all Picture :-