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GLUT CLASSIFICATION (SLC2A, SLC5A)

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RESUME

Because SLC2A (Soluto Carrier 2 A) and SLC5A (SolutoCarrier 5 A) transporters are being studied without a normalized criteria before, this work make a grouping of all them and their nomenclatures used. They are known as SGLT (Sodium/Glucose Transporter) and GLUT (Glucose Transporter). We want to help in the knowledge about their properties in the different papers made about them. Old GLUT name was referring only on Glucose transporter, but all this related transporters not only carried Glucose, but also other sugars like Galactose, Fructose, Mannose, and inclusiveMyo-inositol andUric acid.

In Spanish language exist the word "glúcido" ("glucid" translated in English) whose reference all carbohydrates, and for that is possible continuous use the word GLUT referencing all the "Glucid" transporters. To avoid misidentifications we must use the official symbols (by genetic origin)of solute transporters which are SLC2A and SLC5A.

KEY WORDS: GLUT, SGLT, SLC5A, SLC2A

GLUCID TRANSPORTERS

Glucose is a monosaccharide of large size which cannot diffuse well through the channels of the plasma membrane, and it is insoluble in lipids, and so it cannot diffuses through the layer of phospholipids. Therefore facilitated diffusion is necessary.

It has high solubility in polar solvents such as water because the hydroxyl groups (OH) make partial loads capable of establishing hydrogen bonds. It is mainly dissolved in blood and stored as glycogen in the liver and skeletal muscle.

To traverse the plasma membrane of every cell requires the intervention of carrier proteins. These are known by the acronym SGLT (Sodium / Glucose Transporter) and GLUT (Glucose Transporter). All cells have specific transporters of glucose and other carbohydrates to speed their transit through their membranes. These conveyors may be dependent upon insulin or not. The transporters activity dependent by insulin are GLUT 4, also are being studied GLUT 6, GLUT 8, GLUT 10 and GLUT 12. GLUT 6 has great similarity with GLUT 8 (44.8 % homology).

The GLUT 9 was studied in principle with this name, which has now been renamed GLUT 6, thus identifying errors in relatively recent works in which it is not clear which of the GLUT are referring . We should note that the official nomenclature used abbreviations SLC2A (Solute Carrier 2 A) that take into account the genetic origin of each GLUT avoiding misidentification. In this case it is SLC2A6.

GLUT 13 transports myo-inositol, not glucose, so some papers doesn'tdesignit with the name GLUT, but with this other, HMIT (H + / inositol transporter). It is SLC2A13.

Others carriers not only transport glucose, they may also carry others carbohydrates with varying affinity, as galactose, fructose and mannose. Even others transport uric acid.

Acronyms GLU initially made only glucose reference, but because in Spanish language we use the word “glúcidos” (carbohydrates or glucids) referring to all kind of sugar (i.e. carbohydrates) we can continue use the acronym GLUT, in my opinion, as "Carbohydrate transporter" or “Glucid transporter”.

There are twotypes of families of Glucose transporters of membrane proteins, the sodium-coupled glucose transporters (SGLT) and the facilitative glucose transport proteins (GLUT).

SGLT (SGLTs) are responsible of the absorption and reabsorption of sugars at the intestinal epithelium and glomerulus on their way into the bloodstream. They belong to the family of solute carrier 5 A (SLC5A1), and they are sodium / glucose carriers.

GLUT (GLUTs) are responsible of the entry of sugars into the different cell tissues through the plasma membrane. They belong to the family of solute carrier 2 A (SLC2A), making the facilitated transport of glucose and other carbohydrates.

The entry of glucose across the cell membrane may be insulin dependent, as the case of the membrane translocate of GLUT4 by Akt activation (PKB) in the signaling pathway of the insulin receptor, making the uptake of the glucose from the bloodstream into the cell; or may not be insulin dependent.

GLUT 4 is in cells of striated and cardiac muscle, in adipocyte, and in granulocyte in patients with DM. It is widespread in human body.

GLUT 1 was studied initially in cells of brain and erythrocyte, not request insulin for the entry of glucose. But we found in fetus, endothelium, neuron, placenta, leukocyte, retinal, kidney and adipocyte. This GLUT has high affinity of Glucose carrying inside the cell. It is the basic entry of glucose.

GLUT 12 was found in breast cancer cells, apart the other physiological places.

(1-5)

In Table 1, "Insulin depend" indicates access of carbohydrate to the cell interior, depending of cell activation by insulin. (1-5)

ABBREVIATIONS:

SGLTs: Sodium/Glucose Transporters
GLUTs: Glucose Transporters
SLC5As: Solute Carrier 5 A (Solute Carrier Family 5, sodium/glucose transporter)
SLC2As: Solute Carrier 2 A (Solute Carrier Family 2, facilitated glucose/ transporter)
Akt: PKB: Protein Kinase B

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TABLE 1 (1-5) GLUT CLASSIFICATION

Transporter	solute	Official Symbol	Also known as	Genomic Location	In cells of	Affinity	Insulin depend
SGLT-1	Glucose Galactose	SLC5A1	NAGT;SGLT1; D225675	Crom. 22 (22q12.3)	Small Intestine - Proximal nephron (S3)	High	no
SGLT-2	Glucose	SLC5A2	SGLT2	Crom. 16 (16p11.2)	Kidney (S1 y S2)	Low	no
SGLT-3	Glucose	SLC5A4	SAAT1;SGLT3; DJ90G24.4	Crom. 22 (22q12.3)	BowelNeurons Neuromuscularjunction	Low	no
SGLT-5	Mannose Fructose Glucose Galactose	SLC5A10	SGLT5	Crom. 17 (17p11.2)	Kidney Intestine		
GLUT-1	Glucose Galactose	SLC2A1	PED;DYT9;GLUT; DYT17;EIG12; GLUT1; HTLVR; GLUT1DS	Crom. 1 (1p34.2)	**Erythrocyte-brain**-fetus-endothelium-neuron-placenta-leukocyte-retinal-kidney-adipocyte	High	No GLUT1 synthesis Ins dep
GLUT-2	Glucose	SLC2A2	GLUT2	Crom. 3 (3q26.1-q26.2)	**Liver- beta cells- pancreas-** bowel- kidney	Low	No synthesis of insulin
GLUT-3	Glucose Galactose	SLC2A3	GLUT3	Crom. 12 (12p13.3)	**Brain-placenta**-spermatozoa-leukocyte - skeletal muscle-myocardium- liver	High	No GLUT3 synthesis Ins dep
GLUT-4	Glucose	SLC2A4	GLUT4	Crom. 17 (17p13)	**Striated and cardiac muscle-adipocyte-** Granulocyte in DM	High	**YES**
GLUT-5	Fructose	SLC2A5	GLUT5	Crom. 1 (1p36.2)	**Small intestine**-kidney-erythrocyte-adipocyte-sperm-skeletal muscle	Normal	No
GLUT-6	Glucose	SLC2A6	GLUT6; GLUT9; HSA011372	Crom. 9 (9q34)	**Brain-spleen-lymphocyte-peripheral leukocyte**	Low	?
GLUT-7	Glucose Fructose	SLC2A7	GLUT7	Crom. 1 (1p36.2)	**Small intestine-colon-testis-prostate**	High	No
GLUT-8	Glucose	SLC2A8	GLUT8;GLUTX1	Crom. 9 (9q33.3)	**Testicle-neuron-adipocyte-**placenta- insulindependent tissue	High	?
GLUT-9	Glucose Fructose Uric acid	SLC2A9	GLUT9;GLUTX; UAQTL2;URATv1	Crom. 4 (4p16.1)	**kidney-liver**-intestine-leukocyte-placenta-lung		
GLUT-10	Glucose	SLC2A10	ATS; GLUT10	Crom. 20 (20q13.1)	**Liver-pancreas**		synthesis of Insulin
GLUT-11	Fructose Glucose	SLC2A11	GLUT10;GLUT11; SLC2A11-a; SLC2A11-c	Crom. 22 (22q11.23)	Heart-**pancreas- kidney-skeletal muscle**- adipocyte-**placenta**	Low G High F	No
GLUT-12	Glucose	SLC2A12	GLUT8; GLUT12	Crom. 6 (6q23.2)	**Skeletal muscle-heart-prostate-**adipocyte-small intestine-**breast cancer cell**	High	YES
GLUT-13	Myo-inositol	SLC2A13	HMIT; GLUT13	Crom. 12 (12q12)	**Brain**		No
GLUT-14	Glucose	SLC2A14	GLUT14; SLC2A3P3	Crom. 12 (12p13.31)	**Testicle**		

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