The Role of the Human Kidneys in Glucose Homeostasis: A Phenomenological Based Semiphysical Model

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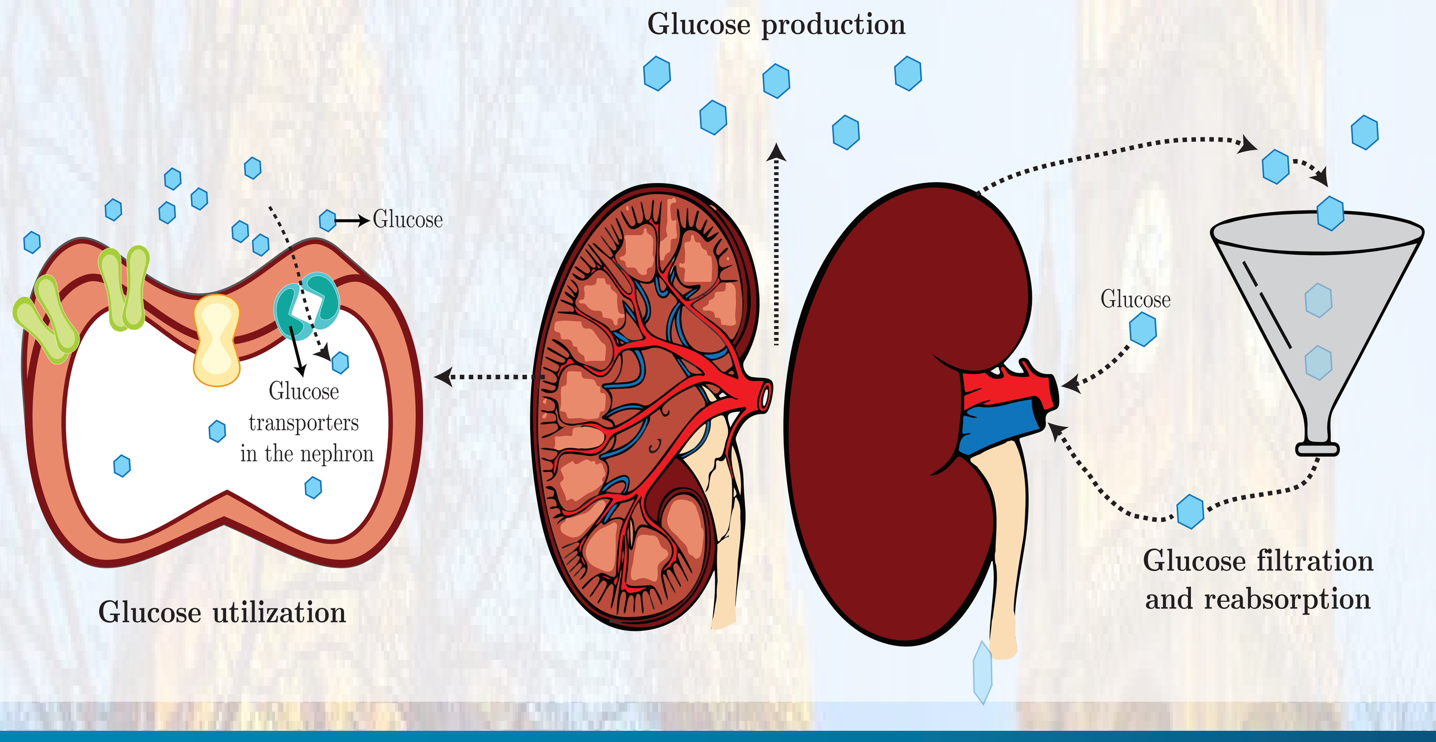
INTRODUCTION

Kidneys play an important role in glucose homeostasis in three ways:

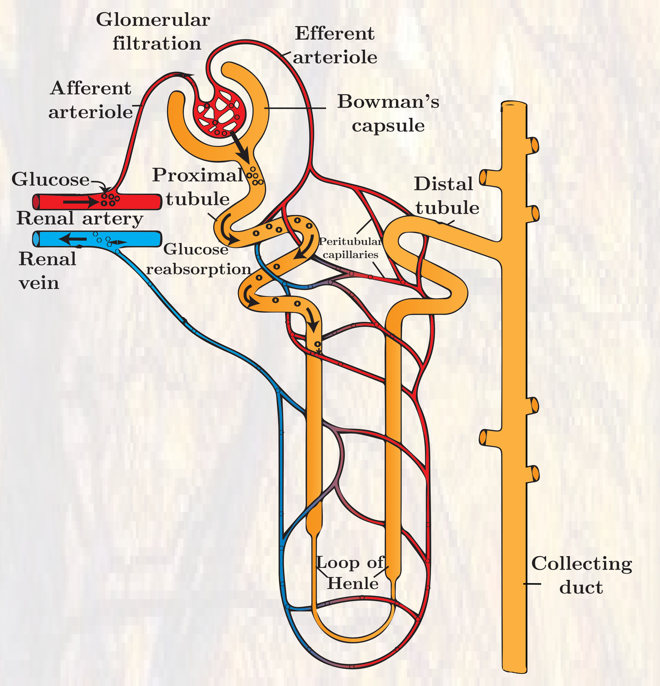


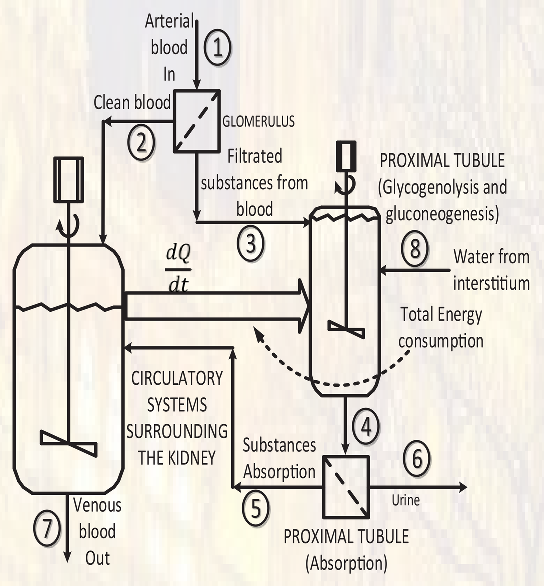
GENERAL OBJECTIVE

Propose a Phenomenological Based Semiphysical Model, with parameters interpretability from current physiological knowledge to describe the role of the kidneys in the glucose homeostasis in humans.

METHODOLOGY

- Verbal description of the real object and modeled hypothesis





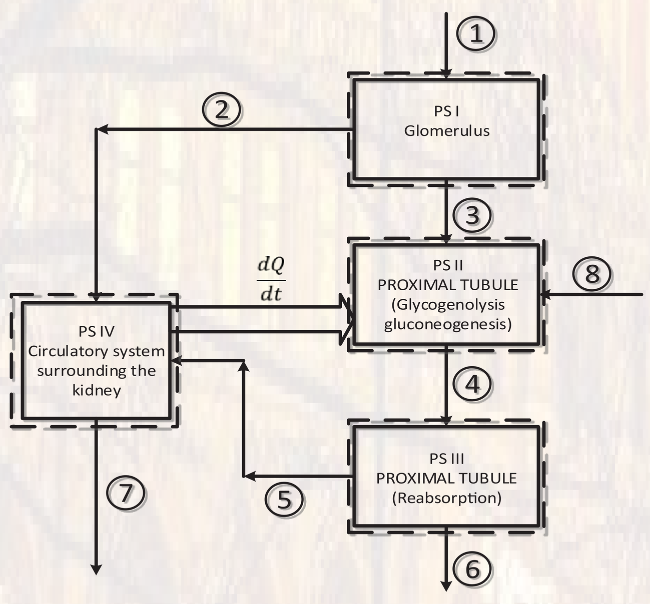
- Applicate the conservation principles and physical laws

$$\frac{dN_{PS_i}}{dt} = \dot{n}_{in} - \dot{n}_{out} + \dot{n}_P - \dot{n}_C$$

- Make explicit the specification levels from constitutive equations and evaluate of the meaning of the parameters

Arrhenius Law - - - - - - - - → $r_j = K_0 * C_j * e^{\frac{-Ea}{RT}}$

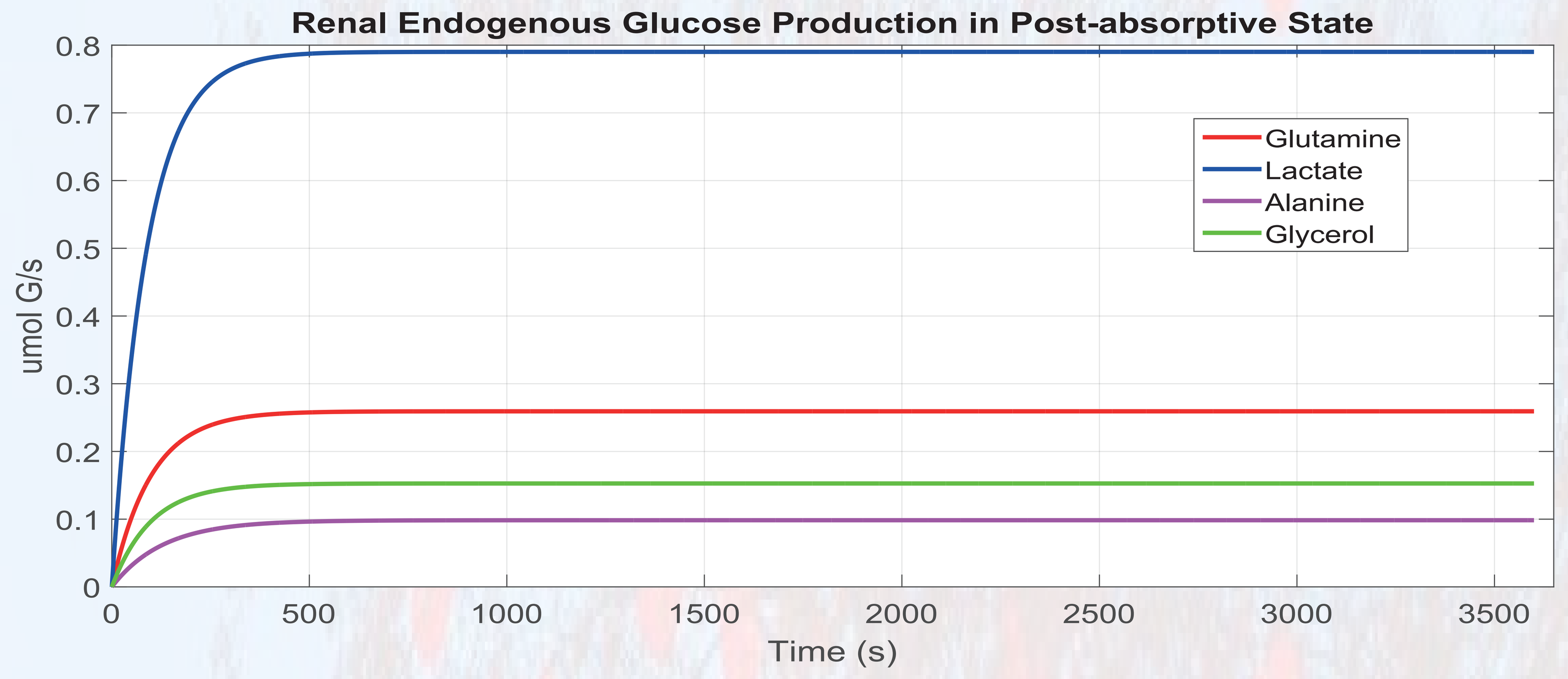
- Representation like a set of process systems

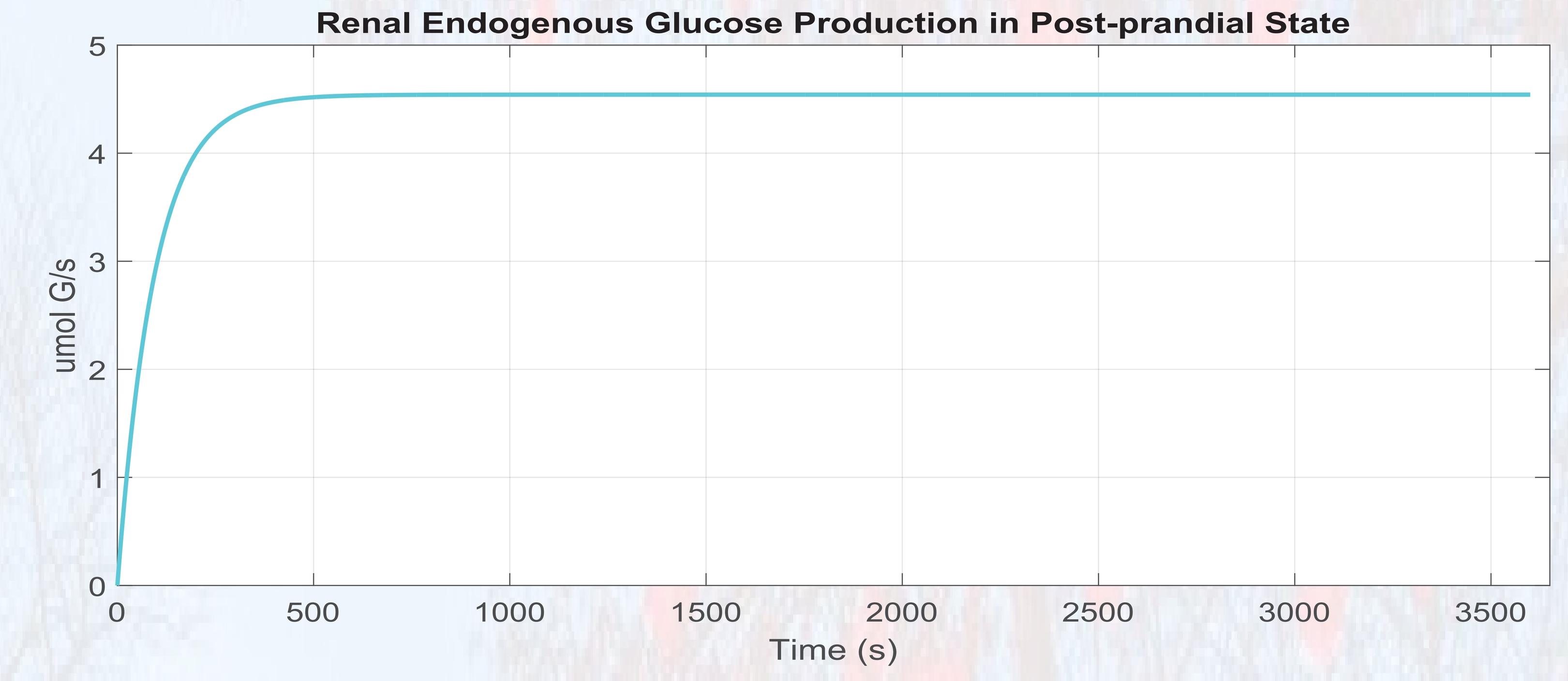


- Degree of freedom analysis
- Computation solution of the model
- Model validation

Non Carbohydrate Precursor	Average Utilization Rate (μ m ol	Reference
Glutamine	0.539074	[2], [4], [5], [6], [7]
Renal Glucose production from Glutamine	0.269537	Stoichiometry
Lactate	1.637857	[2], [4], [5], [6], [7]
Renal Glucose production from Lactate	0.818928	Stoichiometry
Alanine	0.207083	[2], [4], [5], [6], [7]
Renal Glucose production from Alanine	0.103541	Stoichiometry
Glycerol	0.318095	[2], [4], [5], [6], [7]
Renal Glucose production from Glycerol	0.159047	Stoichiometry

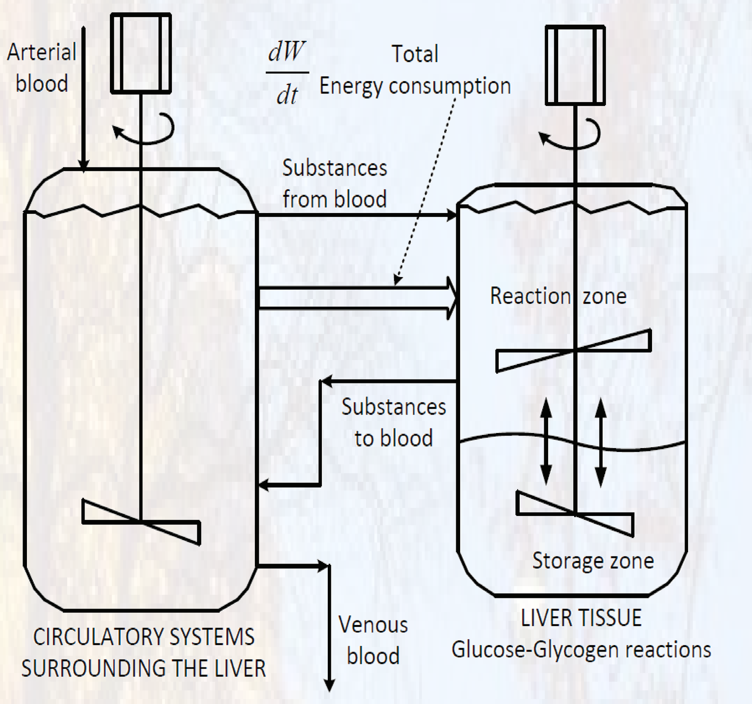
RESULTS



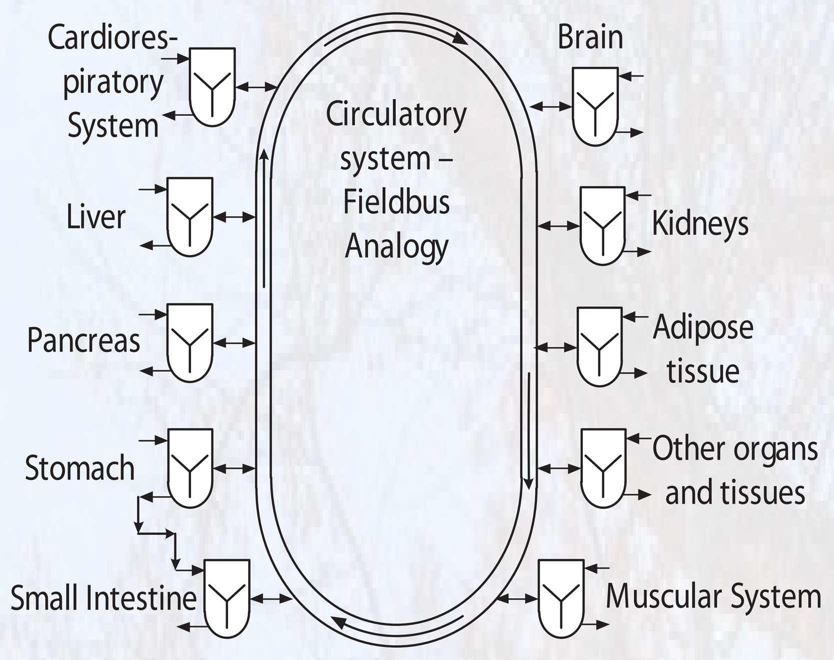


The results were adapted to the data reported in the **literature**. In the **post-absorptive state**, renal glucose production is approximately **20-25%** of total body glucose, while in the **postprandial state** renal glucose production is **three times higher** than production in the post-absorptive state, reaching **60%.** The **literature reports precise data** on the use of non-carbohydrate precursors for the renal endogenous glucose production in the post-absorptive state, therefore the **mathematical model** for each precursor could be solved. However, for the postprandial state there are no specific data on the use of each non carbohydrate precursor. Our results shows how the non-carbohydrate **precursors filtered** through the glomerulus are **utilized**, remaining just a **few amount unutilized.**

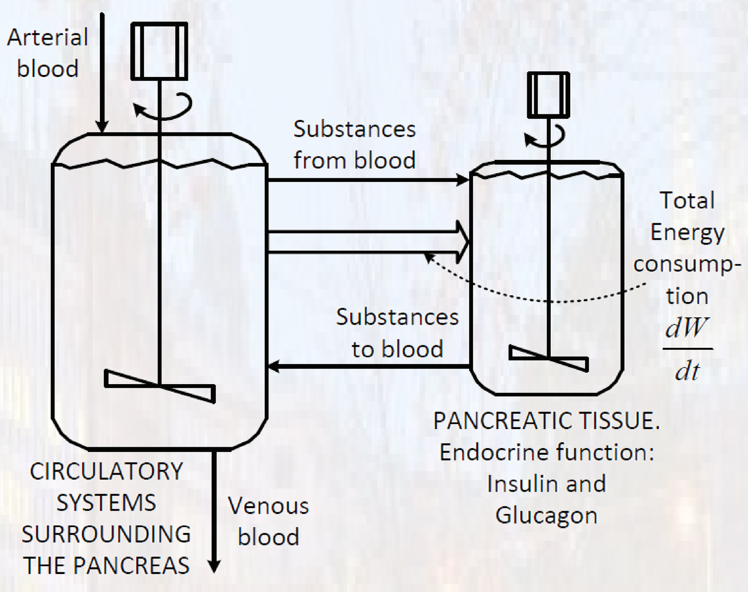
FUTURE WORK



Hepatic model



Blood circulating model



Pancreatic model

Construction of a whole mathematical model with parameters interpretability describing the dynamic of blood glucose in the human body

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