PARTICULARITIES OF THE NUTRITIONAL METABOLISM OF THE CARNIVOROUS

Claudia Ariemma, June 2017 Universidad Autónoma de Barcelona (UAB), Faculty of Veterinary Medcine

INTRODUCTION

The typical high protein and low carbohydrate diet of carnivores has foced their metabolism to develop adaptations in order to maintain glucose homeostasis and control levels of ammonia from protein oxidation. Domestic cats, however, consume high-carbohydrate dry food and are prone to obesity. On the other hand, carnivores living in captivity have been shown to be more susceptible to developing chronic diseases and reproductive failures associated with the type of meal and absence of some essential nutrients in their diets.

OBJECTIVES

-To identify the adaptations in carbohydrates and protein metabolism in carnivores, and understand how they achieve glucose homeostasis.
-To review the importance of the urea cycle in the removal of ammonia and the role of Arginine as essential aminoacid (aa) as well as other disposable metabolites such as taurine.
-To identify particularities in fatty acid metabolism and the enzymes involved.

CARBOHYDRATE METABOLISM

Glycolysis: Glucokinase and Hexokinase activities, causes the liver to have little capacity to remove high blood glucose after feeding

Gluconeogenesis: the high rate of this path causes the liver to constantly release glucose to blood from glycogenic aminoacids (aa)

PROTEIN OXIDATION

- Protein catabolism is not subject to regulation
- Activity of aminotransferases is high in liver
- Carbon skeleton is oxidated or incorporated to gluconeogenesis
- Oxidation rate of aa increases with higher protein content in diet. Below the protein requirement, catabolism of aa can not be inhibited.

UREA CYCLE

- Nitrogen detoxification pathway to ammonia from active aa catabolism in carnivores.
- There is no evidence of changes in enzyme activity by varying the levels of protein in the diet.
- The relative control of the cycle is through the concentration of its intermediates

ESSENTIAL AMINOACID ARGININE

- In cats the synthesis of ornithine is deficient, compromising the production of Citruline and Arginine.
- Deficient activity in the small intestine of:
  Pyrroline-5-Carboxylate synthase
  Ornithine Aminotransferase (OAT)
  Ornithine Transcarbamoylase (OTC)
- Whithout Arginine in the diet, the Urea Cycle can not function and ammonia from aa catabolism accumulates producing hyperammonemia.

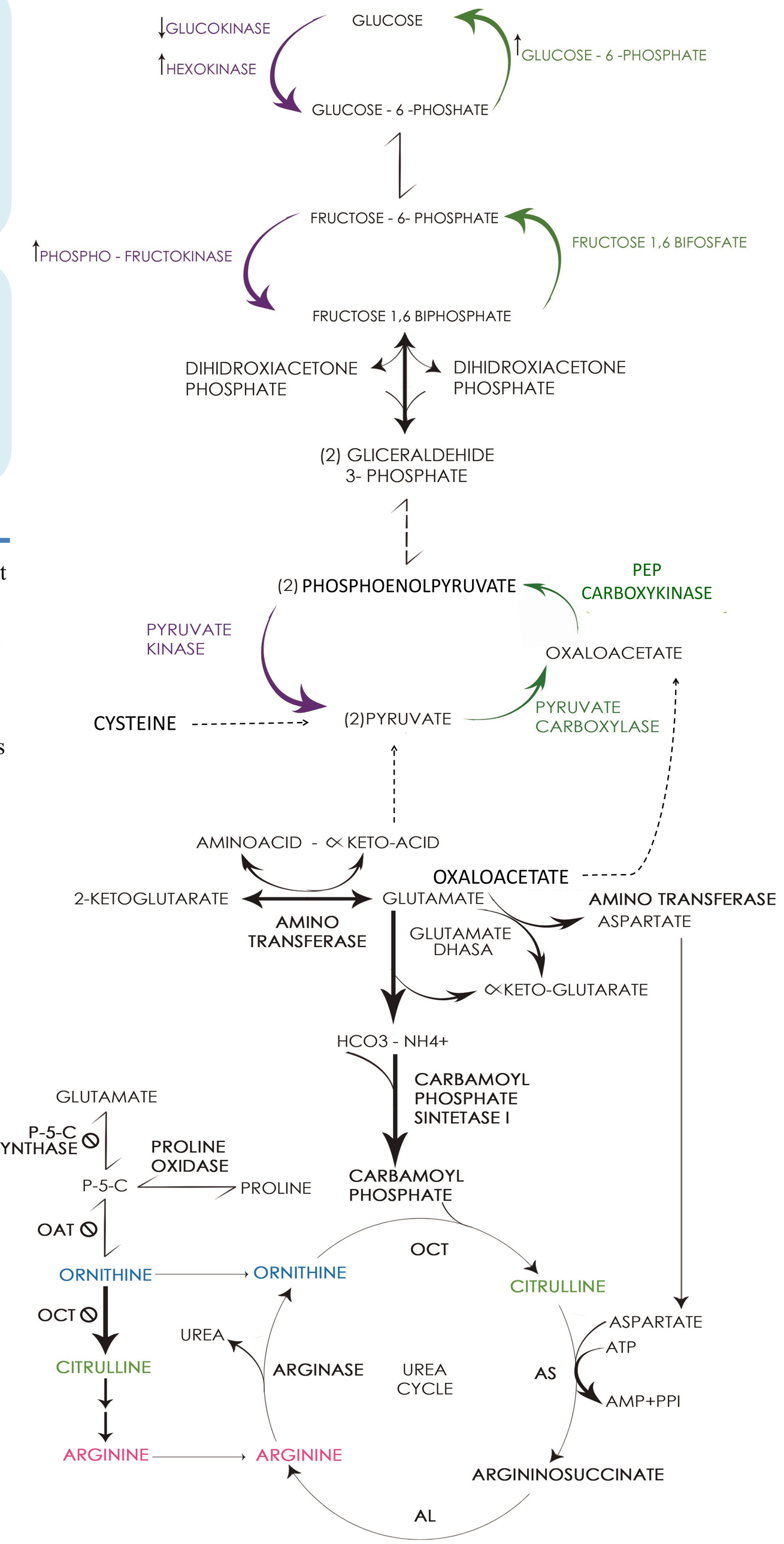

Fig. 1 Interaction of carbohydrate metabolism, amino acid oxidation and urea cycle in carnivorous

CONCLUSIONS

- Minimal Glucokinase (GK) activity allows the distribution of glucose to extrahepatic tissues. Constant Gluconeogenesis from glycogenic aa and active protein catabolism compensate for the low amount of glucose in the diet and the high activity of the urea cycle control the levels of ammonia.
- The inability to synthesize Taurine allows carnivores to use Cysteine to produce Piruvate for gluconeogenesis.
- Carnivores feed on animal tissue, have plenty of essential compounds like Arginine, ARA and Taurine and do not suffer from deficiency diseases.
- Understanding the carnivorous metabolism, allows to elaborate adequate diets and to prevent obesity and chronic diseases in domestic cats and other species in captivity.