

# **A LabVIEW Program For Computing pH Dependent H<sup>+</sup> Coefficients for the Metabolites and Reactions of the Phosphagen and Glycolytic Energy Systems**

**Robert A. Robergs, Ph.D., FASEP, EPC**

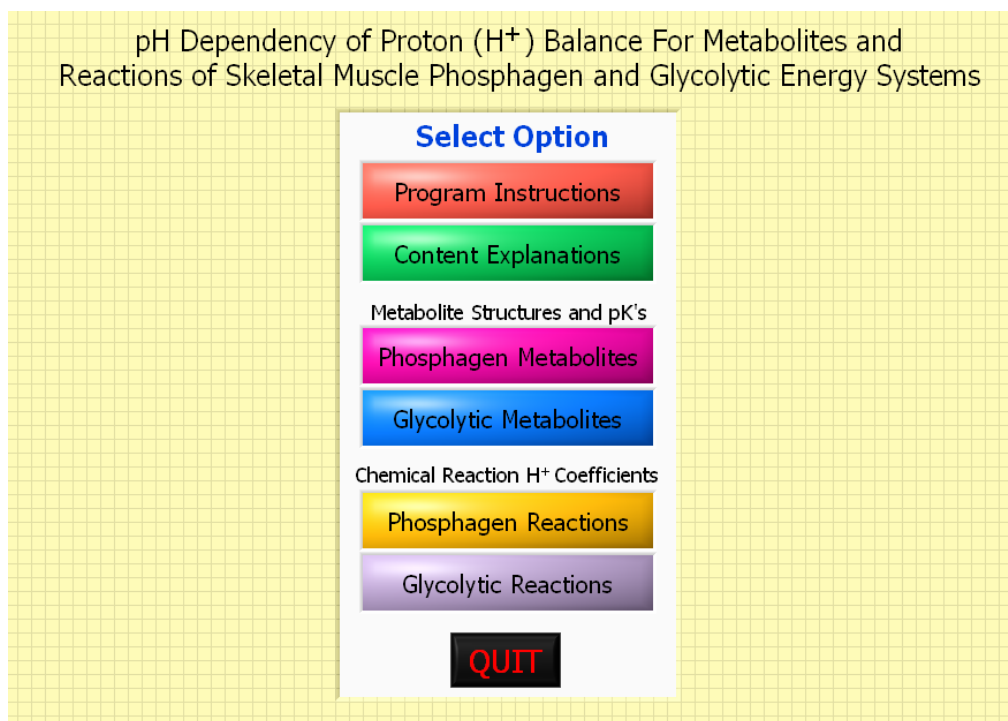
Director: Exercise Physiology Laboratories, Exercise Science Program, Department of Health, Exercise and Sports Science, The University of New Mexico, Albuquerque, NM, USA. Phone: (505) 277-2658; FAX: (505) 277-9742; Email: [rrobergs@unm.edu](mailto:rrobergs@unm.edu)

Nutrition, Exercise and Sports Information Services (NEXSIS); [www.NEXSIS.org](http://www.NEXSIS.org)

## Overview

The program you purchased and are about to use is a LabVIEW program, or as referred to by LabVIEW gurus, a virtual instrument (VI). With this program you will be presented with  $H^+$  coefficients for metabolites and reactions of the phosphagen and glycolytic energy systems of skeletal muscle across the cellular pH range (pH=6.0 to 7.0).

LabVIEW programming is based on what are called the Front Panel and the Block Diagram. The Block Diagram is for the programmer for developing the program. The Front Panel is essentially the user interface. Figure 1 provides an image of the Front Panel for this program.

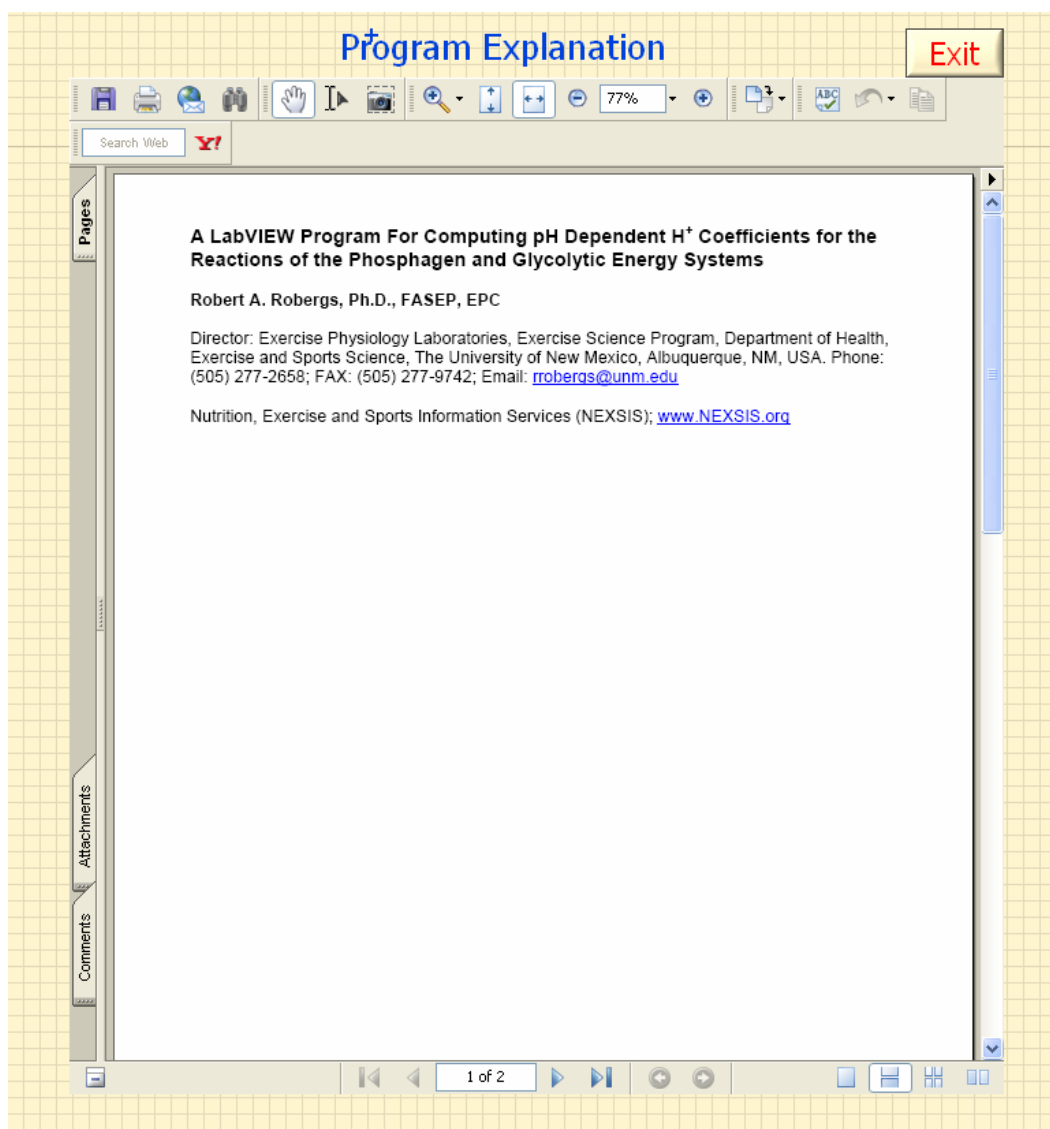


**Figure 1.** An image of the Front Panel window of the program, which reveals all components of the program control features.

Note that there are 6 options, and since you are reading this, you have managed to successfully migrate to this Program Instructions window. Nevertheless, when you click on an option, you will start a sub-program with a specific and different Front Panel to this “Home” window.

## Program Instructions

As you now know, the Program Instructions selection takes you to a window that displays an Acrobat Reader display (Figure 2) containing a pdf file of this instruction document. Scroll down and up through the pdf document with this Acrobat Reader display and learn how to use and get the most from this program.

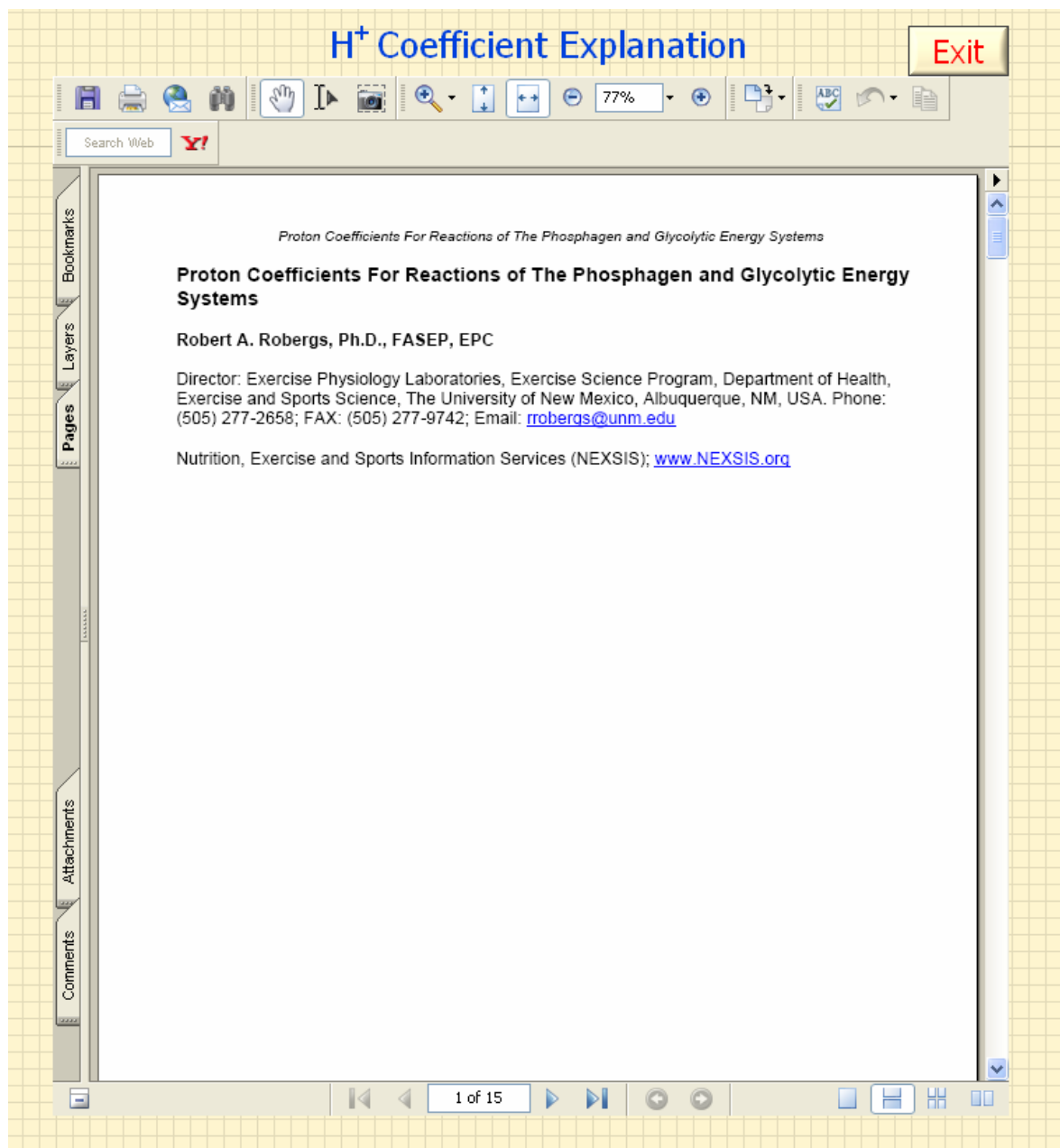


**Figure 2.** An image of the Front Panel window of the Program Instructions sub-program, which reveals all components of the program control features.

When finished with this or any sub-program, simply click on the “Exit” icon to return to the “Home” Front Panel window.

### **Content Explanations**

The Content Explanations sub-program is like the Program Instructions sub-program in that it provides an Acrobat Reader display of a pdf document (Figure 3). This document explains why I have developed this program, as well as presenting a brief summary of the analytical chemistry involved in computing cation-competitive and pH specific  $H^+$  coefficients for metabolites and chemical reactions of the phosphagen and glycolytic energy systems in skeletal muscle.



**Figure 3. An image of the Front Panel window of the Content Explanations sub-program, which explains the rationale for the program and the chemistry and computations procedures involved in quantifying  $H^+$  exchange for metabolites and chemical reactions.**

### **Chemical Structures and Metabolite-Cation Complex pK data for the Metabolites of the Phosphagen Energy System**

Figure 4 presents the Front Panel as it first appears for the phosphagen system metabolites. The two left icons provide links to present data to an image (chemical structure) display box, a figure and an array table. The chemical structure box, figure and table appear after selections have been made.

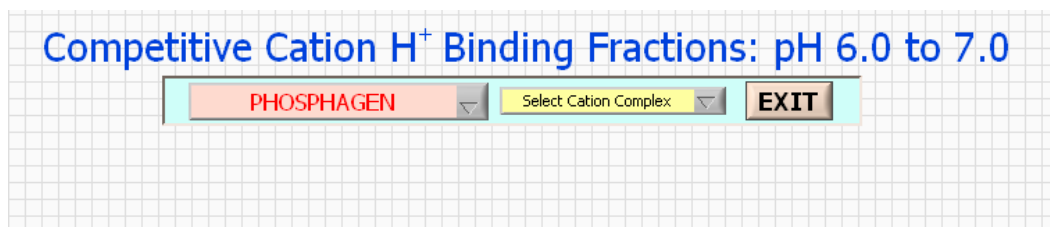


Figure 4. An image of the initial Front Panel window of the Metabolite Structure and pK sub-program for the Phosphagen System.

Figure 5 presents the Front Panel content after selections have been made, which in this case are for the chemical structure of hydrogen phosphate and the pH dependent  $H^+$  coefficients for hydrogen phosphate. The array table presents the pK values for each metabolite-cation complex for which there are reference data for.

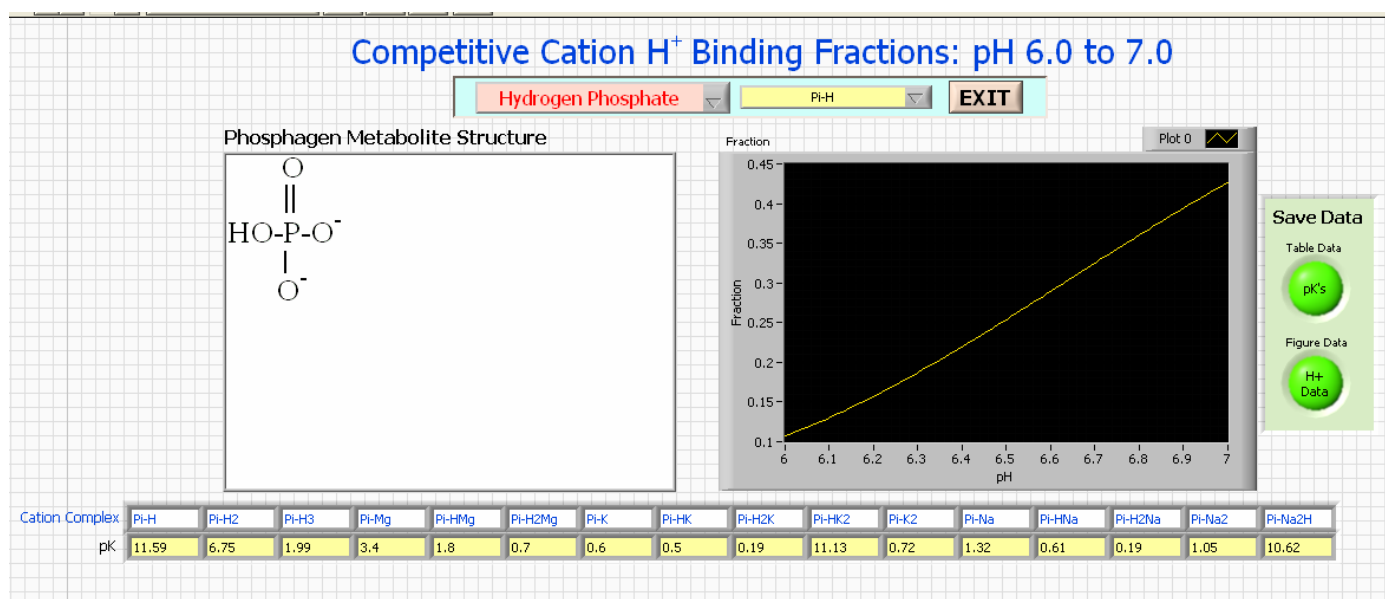


Figure 5. An image of the Front Panel window of the Metabolite Structure and pK sub-program for the Phosphagen System after selection of a metabolite and metabolite-cation complex.

Once data has been retrieved, you can save numeric data of either the figure or array table to a text file. You can then use this data as you wish in computations or your own custom tables or figures. The same procedures are involved in retrieving data for metabolites of the glycolytic energy system (Figures 6 and 7).

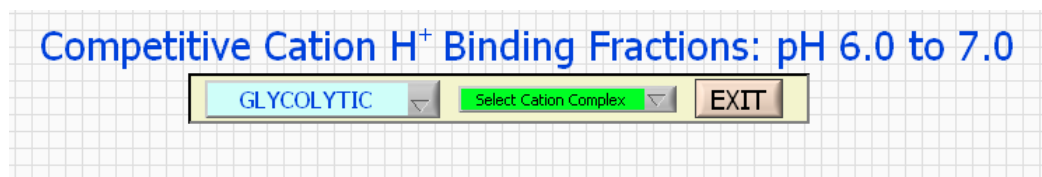
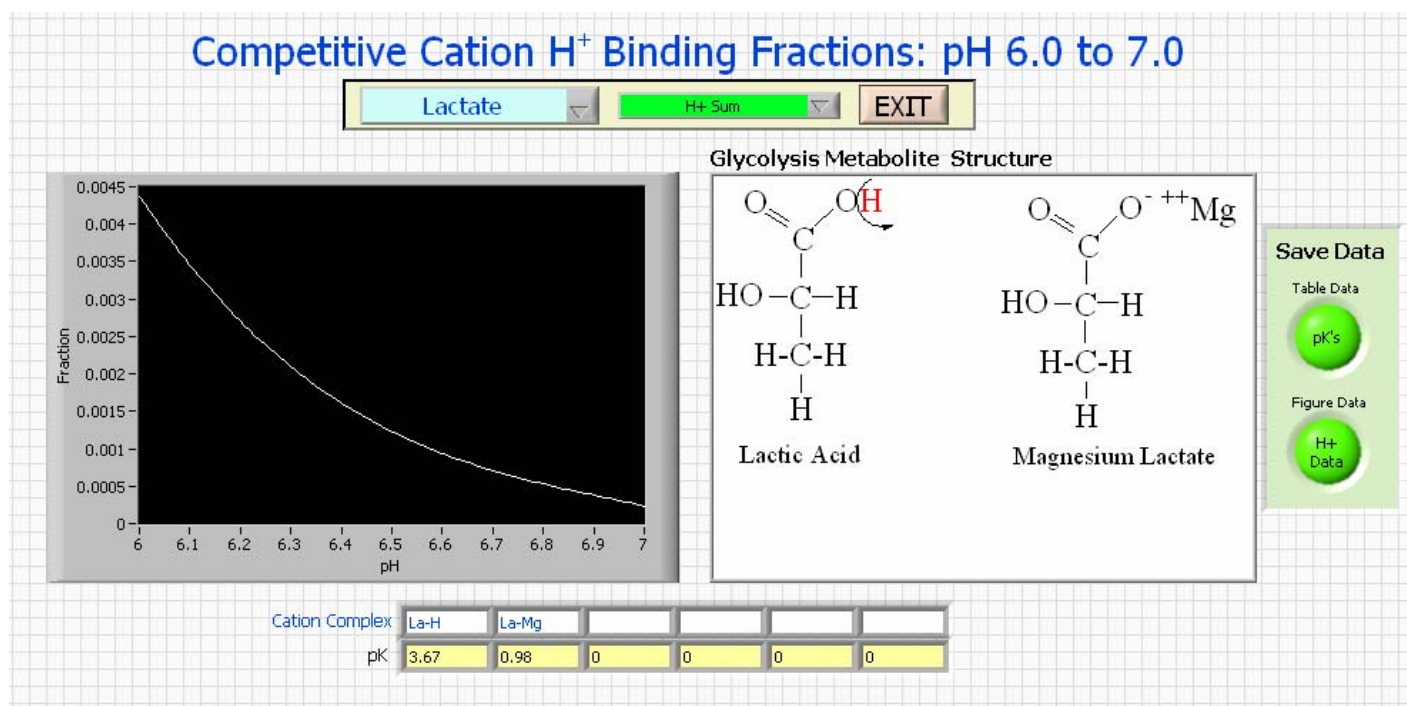


Figure 6. An image of the initial Front Panel window of the Metabolite Structure and pK sub-program for the Glycolytic System.



**Figure 7.** An image of the Front Panel window of the Metabolite Structure and pK sub-program for the Glycolytic System after selection of a metabolite and metabolite-cation complex.

## H<sup>+</sup> Coefficients for the Chemical Reactions of the Phosphagen Energy System

Figure 8 presents the Front Panel as it first appears for the chemical reactions of the phosphagen system. After selecting a reaction, data appear in the figure. Once data has been retrieved in the figure, you can select to save numeric polynomial equations for all the reactions, just the reaction for which the figure data is presented, the pH specific H<sup>+</sup> coefficients for all reactions, or just the H<sup>+</sup> coefficient data for the selected reaction depicted in the figure. The same procedures are involved in retrieving data for chemical reactions of the glycolytic energy system (Figure 10).

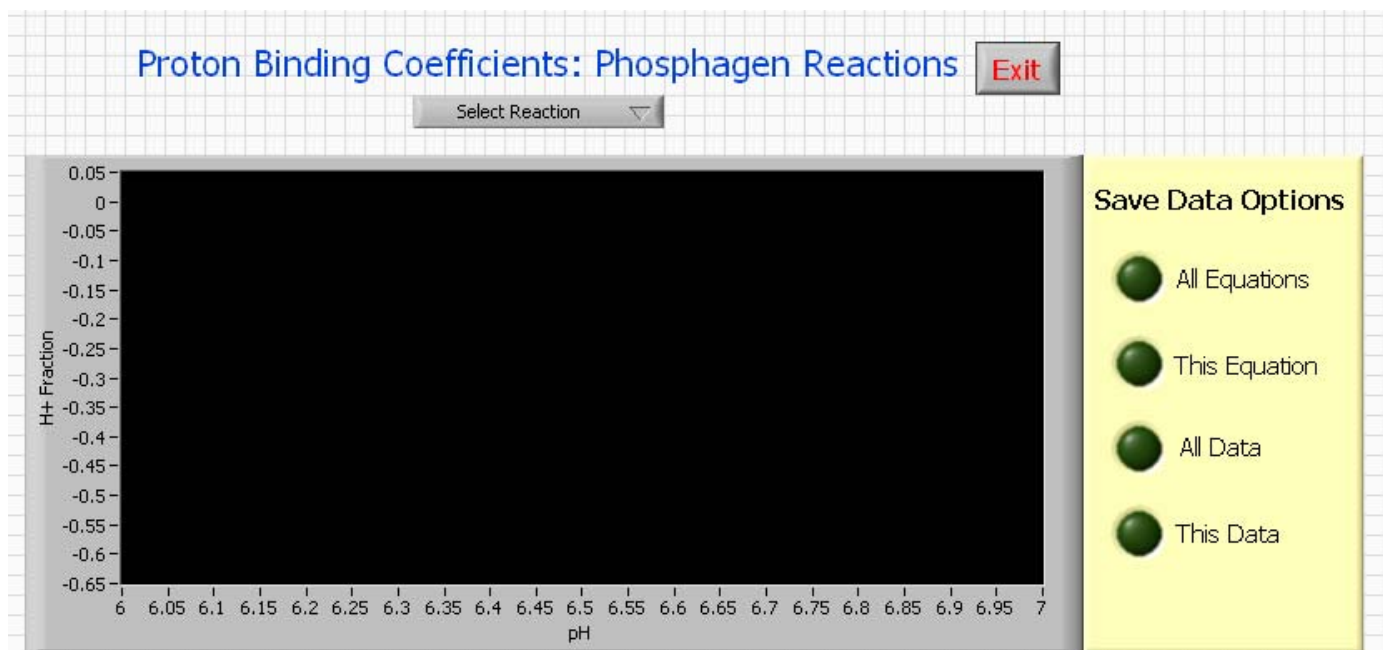


Figure 8. An image of the Front Panel window of the Chemical Reaction and H<sup>+</sup> Coefficients sub-program for the Phosphagen System prior to selection of a specific chemical reaction.

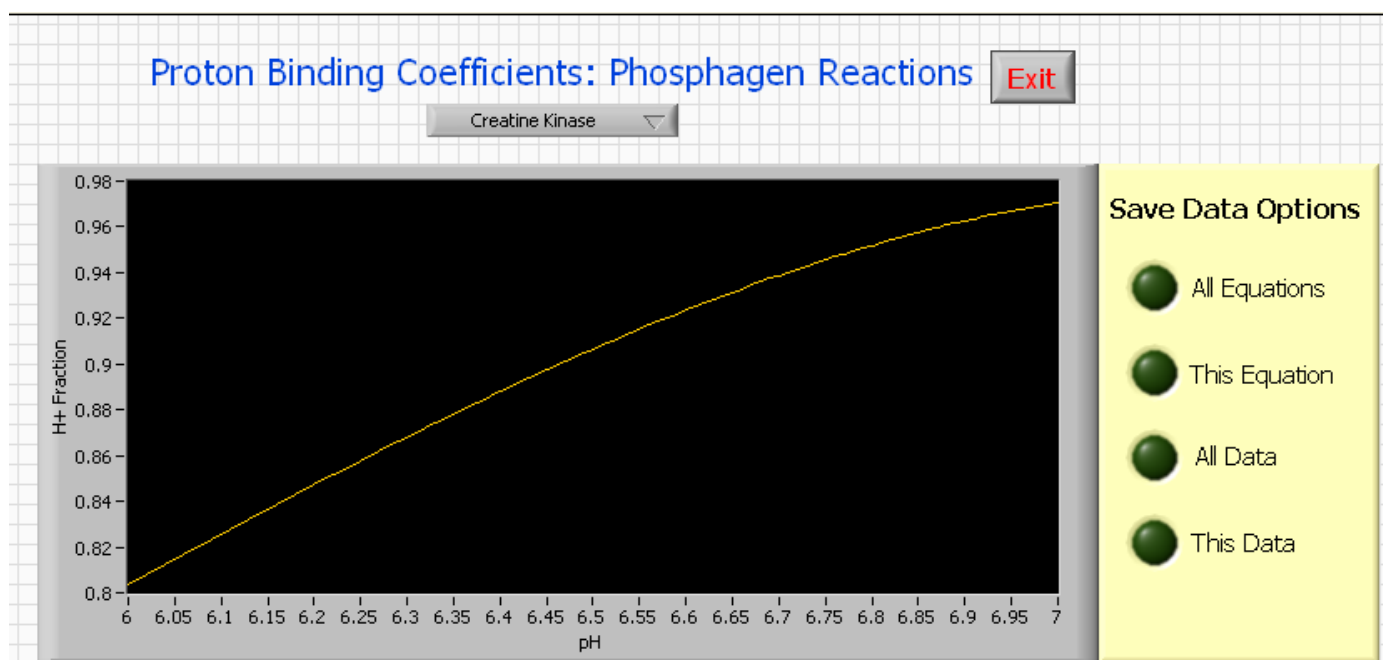
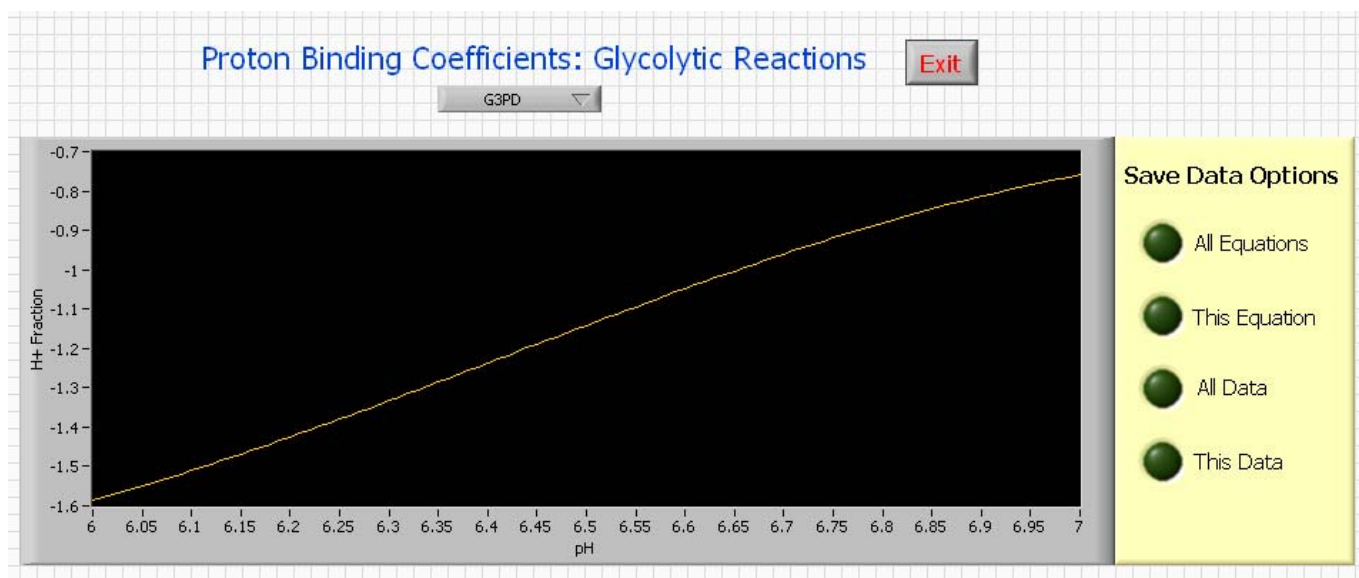


Figure 9. An image of the Front Panel window of the Chemical Reaction and H<sup>+</sup> Coefficients sub-program for the Phosphagen System after to selection of the Creatine Kinase reaction.

## H<sup>+</sup> Coefficients for the Chemical Reactions of the Glycolytic Energy System

Follow the same procedures as for the Phosphagen system. Figure 10 presents the data for the glyceraldehydes-3-phosphate dehydrogenase reaction. As explained in the Contents Explanation sub-program, this reaction is far more H<sup>+</sup> releasing that previously recognized.



**Figure 10.** An image of the Front Panel window of the Chemical Reaction and H<sup>+</sup> Coefficients sub-program for the Glycolytic System after to selection of the glyceraldehydes-3-phosphate dehydrogenase reaction.