

Investigating the efficacy of natural blood glucose lowering compounds in the prevention of congenital heart defects during maternal diabetes using the chick embryo

Batoul Haddad¹ Zainab El-hashmi¹

Supervised by: Dr. Huseyin C. Yalcin², Dr. Fatiha M. Benslimane², Hana A. Hussain²

¹Biomedical Science Department, College of Health Sciences, Qatar University, Doha, Qatar

²Biomedical Research Center, Qatar University, PO Box 2713, Doha, Qatar

Abstract

Diabetes is a metabolic disorder that is characterized by hyperglycemia. Although there are several drugs available for diabetes, patients tend to follow natural remedies. However, the use of these natural remedies lacks scientific evidence of its effect. Therefore the aim of this project was to first identify the histological changes of the developing heart in a hyperglycemic environments. Secondly, test the efficacy of selected natural compounds in lowering blood glucose levels and to assess its gene expression changes.

Introduction

Diabetes is a metabolic disorder characterized by hyperglycemia. Chick embryo was used as a model because it is costly effective, has simple culture requirements, and fully developed in shorter period of time. Several compounds are widely used by the population for the treatment of diabetes. Four plants (Figure 1) were used to reduce the blood glucose concentration for embryonic chick.



Figure 1: Natural compounds used in this study. A. Teucrium polium. B. mixed herbs. C. Senegalia Senegal. D. Compound X

Objectives

-To generate a hyperglycemic model using chick embryo as an animal model and assess its histological changes.

-Asses the efficacy of selected natural compounds in lowering blood glucose level and their effects on gene expression of specific cardiac markers.

Methodology

Pre-injection blood Glucose measurements:

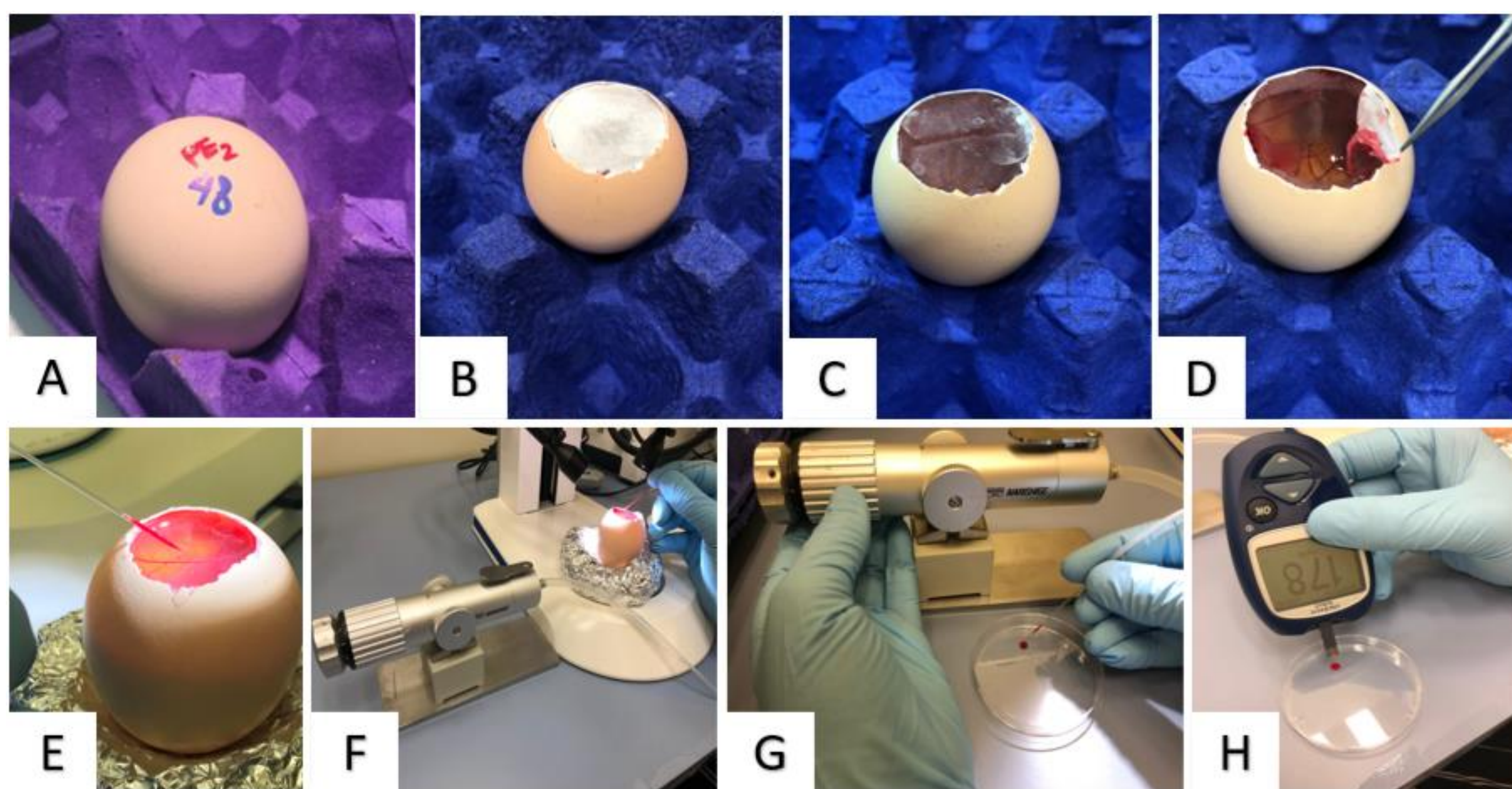


Figure 2: Process of pre-injection blood glucose level measurement. A. Closed egg. B. Opening and shell removal. C. Adding of PBS. D. Chorioallantoic membrane removal. E & F. Blood collection using micro-needle and pump. G. Releasing of blood. H. Glucose measurement.

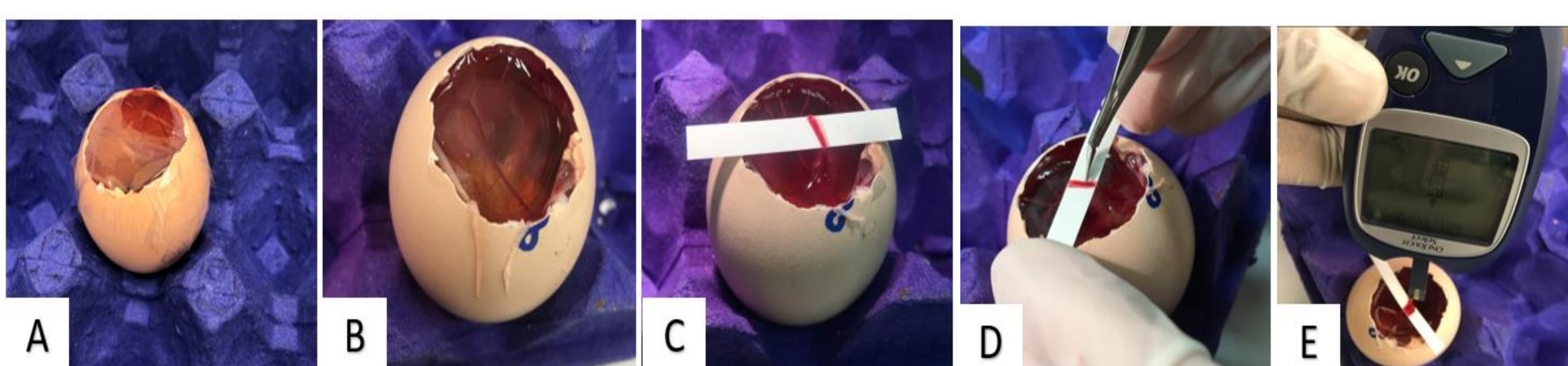


Figure 3: Post-injection blood glucose measurement. A. Covered egg. B. Tape removal. C. Blood vessel selection. D. Blood vessel opening. E. Blood glucose measurement.

Results

Figure 4: Histology of the chick embryo heart at day 10. A. Control. B. Injected with D-glucose. RV: right vertical, LV: left vertical, RA: right atrium, LA: left atrium, IV septum: inter ventricular septum. Histological slide of heart injected with glucose and saline as a control, figure represent an over all reduction in the heart size.

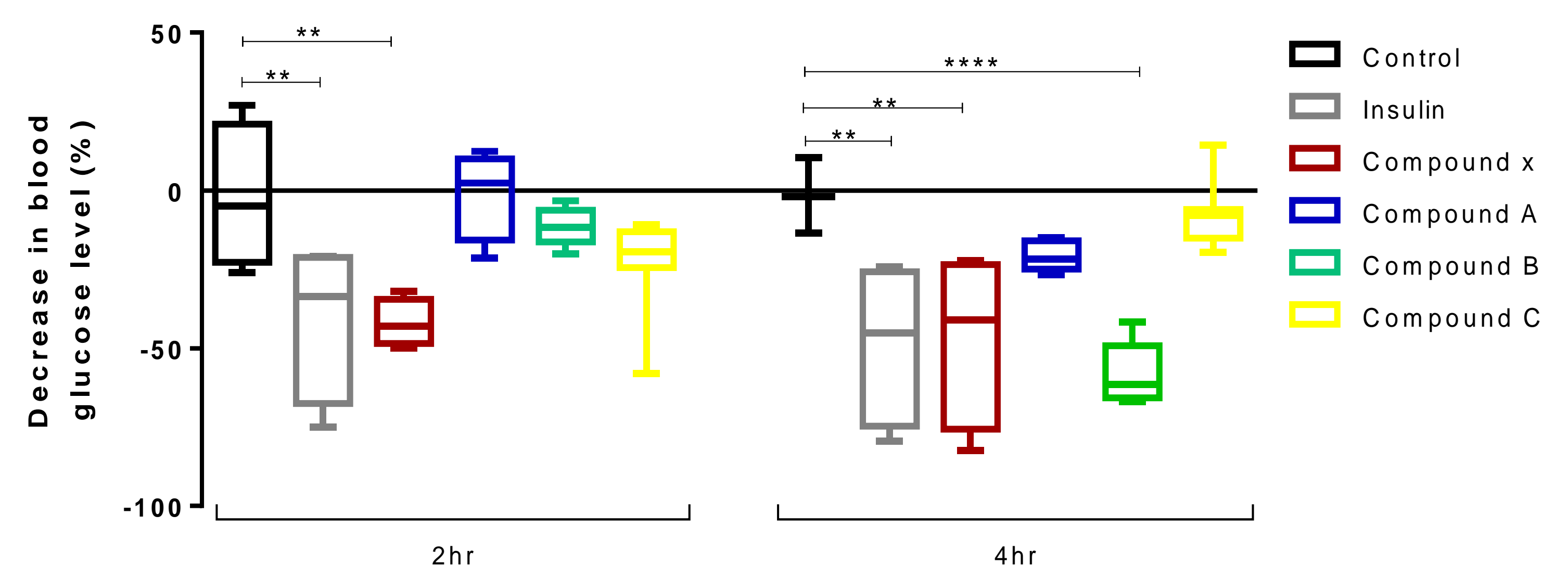
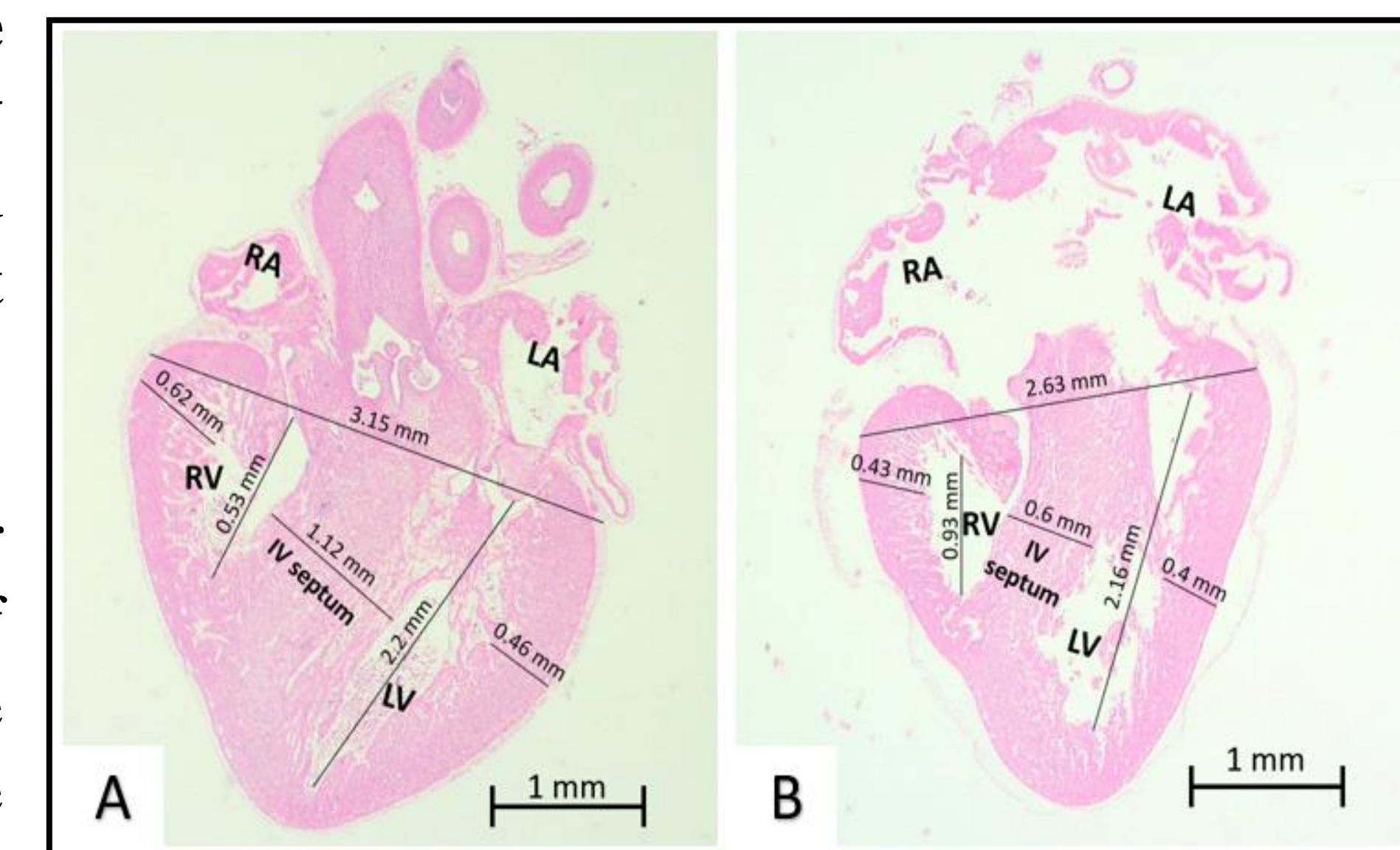


Figure 5: Percentage of decrease in blood glucose level in all groups. Compound X acted as insulin in lowering blood glucose level at 2 and 4 hours.. Compound C decreased blood glucose level after 2 hours only.

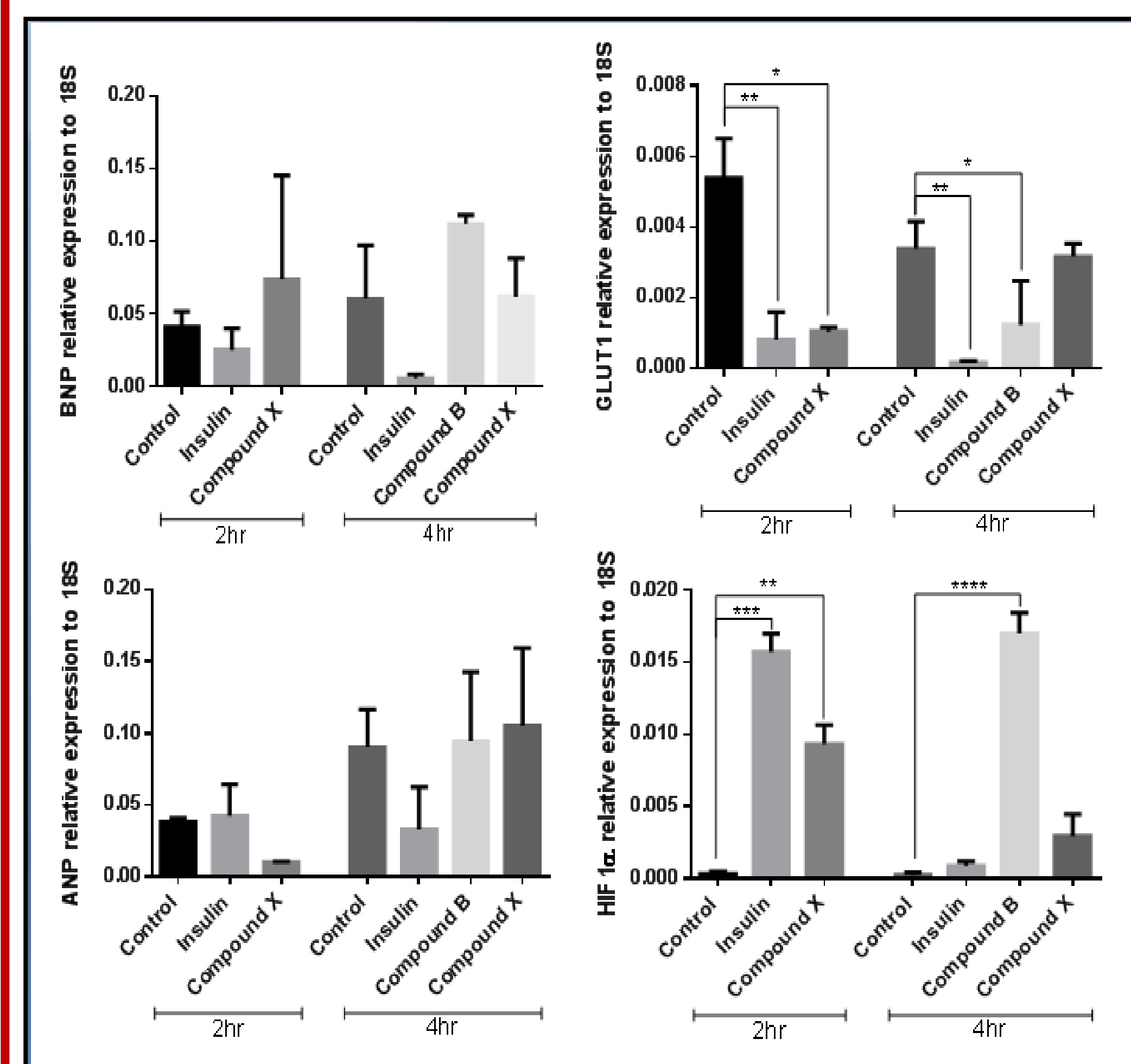


Figure 6: Gene expression studies. Compound X (P=0.0222) and compound B (P=0.0284) affected the relative gene expression of GLUT-1 and HIF1 by (P=0.0044) and (P<0.0001). However, other compounds did not cause any significant change in the other genes of interest.

Conclusion

Hyperglycemia leads to the decrease in cardiac function due to its effect on the cardiac structure. A compound obtained from the desert of Algeria and another mixture prepared in Qatar could be used to lower blood glucose levels in adults. However, they might not be suitable for the developing fetus.

Acknowledgment

We would like to express our sincere gratitude to God for protection and ability to do work. We give deep thanks to our supervisors Assist. Prof. Dr. Huseyin Yalcin and Dr. Fatiha Benslimane for their support. Also, we would like to thank our mentor Ms. Hana Abdelrahman for her help. Last but not least, a grateful thanks goes to our families and friends for their all kinds of support and motivation.

References

- Hornberger, L. K. (2006). Maternal diabetes and the fetal heart. *Heart (British Cardiac Society)*, 92(8), 1019-1021. doi:10.1136/hrt.2005.083840
- Harris, P. E., Cooper, K. L., Relton, C., & Thomas, K. J. (2012). Prevalence of complementary and alternative medicine (CAM) use by the general population: a systematic review and update. *Int J Clin Pract*, 66(10), 924-939. doi:10.1111/j.1742-1241.2012.02945.x