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# ANTHOCYANIN RESEARCH

## PRECLINICAL STUDY ON THE EFFECTS OF ANTHOCYANINS ON METABOLISM AND LIVER

The peer-reviewed study results summarized below were published in the journal *Redox Biology* in 2018.

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### BACKGROUND

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Typical Western diets consist of eating foods high in fat and sugar and overeating, which contributes to what has been an increasing percentage of the population becoming overweight or obese. Other side effects of this diet include the promotion of inflammation in various body tissues, increased oxidative stress, and dysregulation of various metabolic markers such as glucose and insulin control and fat metabolism. Our previous research discovered that specific anthocyanins were more effective than others at attenuating the negative effects of increased permeability caused by inflammation in intestinal cells.

Anthocyanins are ingredients found in many of the dark blue to purple vegetables, fruits, and berries like bilberry and black currant. These are powerful antioxidants with unique biological activities based on the type of anthocyanin. Based on our unique discovery, we formulated a blend of ingredients rich in specific anthocyanins (cyanidin and delphinidin) and tested their effects on mitigating some of the negative effects of a high fat diet in mice on metabolic parameters, liver health, and other markers of health, which are discussed in the full paper by clicking on the link at the bottom of this summary.

### METHODS

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All procedures complied with standards for care of laboratory animals as outlined in the NIH Guide for the Care and Use of Laboratory Animals. Healthy mice were divided into groups for the length of the 14-week study. The control group (C) was fed a standard diet. A second group was fed a standard diet plus anthocyanins (CA). Another group was fed a high fat diet; this was the High Fat (HF) group. The last group was fed a high fat diet plus anthocyanins (HFA). Different amounts of anthocyanins were tested; the dose of 40 mg/kg was shown to be the most effective, so those results are shown below. This dose is similar to the human equivalent of just over 200 mg of anthocyanins per day, which is an effective level for health benefits as has been demonstrated.

### RESULTS

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The high fat diet caused many negative metabolic effects in mice, such as poor glucose and insulin responses and fatty liver. However, supplementation with anthocyanins had protective and beneficial effects on metabolic wellness (or biochemistry) and liver health.

#### *Glucose regulation*

The high fat diet caused significant dysregulation of glucose control and insulin sensitivity. The HF group showed increases in fasting plasma glucose (40%) and insulin (130%) when compared with the control group. However, the high fat group with anthocyanins had a very similar glucose and insulin response to the control group, which demonstrates the positive effect of anthocyanins to attenuate the negative glucose and insulin response of a high fat diet. To gather additional evidence of the glucose response and how sensitive insulin is to the effect of glucose, a glucose tolerance test (GTT) and an insulin tolerance test (ITT) were performed. Glucose and insulin were given in the GTT and ITT tests, and then glucose was measured to see the response to the treatment. Consumption of the high fat diet altered the response of mice to both types of tolerance tests. Remarkably, supplementation with anthocyanins caused a significant reduction of the increase in GTT area under the curve (Figure A) and completely prevented the increase of glucose in the ITT area under the curve (Figure B). This data suggests that anthocyanins can help to improve glucose control and lower the resistance of insulin, important aspects of a healthier metabolic response.

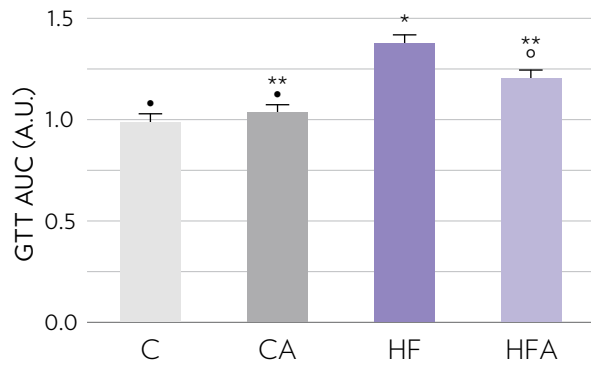


Figure A

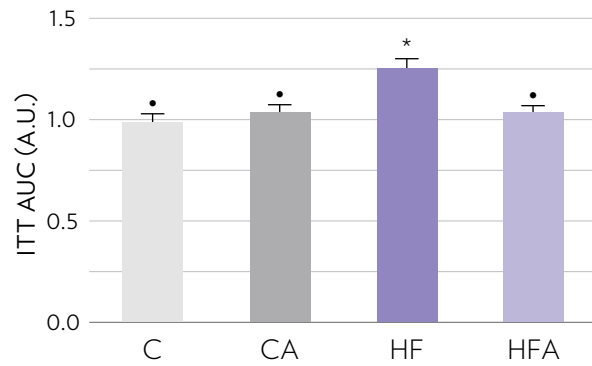


Figure B

### Vital Organ Support—Liver

The liver is a vital organ in the body with many roles in filtration, detoxification and more, and it also plays a crucial role in glucose and fat homeostasis (which has to do with the regulation/metabolism and control of glucose and fat). A high fat diet or the overconsumption of energy can lead to problems in liver health, including the build up of fat in the liver over time and increased markers of inflammation. To test the effectiveness of anthocyanins in the liver to help offset the negative effects of a high fat diet, we compared triglyceride levels in the livers of each group and performed a histological analysis. Triglycerides are fats in the blood that can be deposited in tissues like the liver and can be a marker of excess fat and energy intake, and histological analysis provides clear images to detect the change in fat deposition in the liver (Figure C). The high fat diet specifically caused a 76% higher liver triglyceride level compared to the control diet. However, anthocyanins with the high fat diet had a remarkable ability to attenuate the increase in fat deposition in the liver; in fact, the HFA group was very similar to the control group in the measurement of triglycerides and the visual histological analysis.

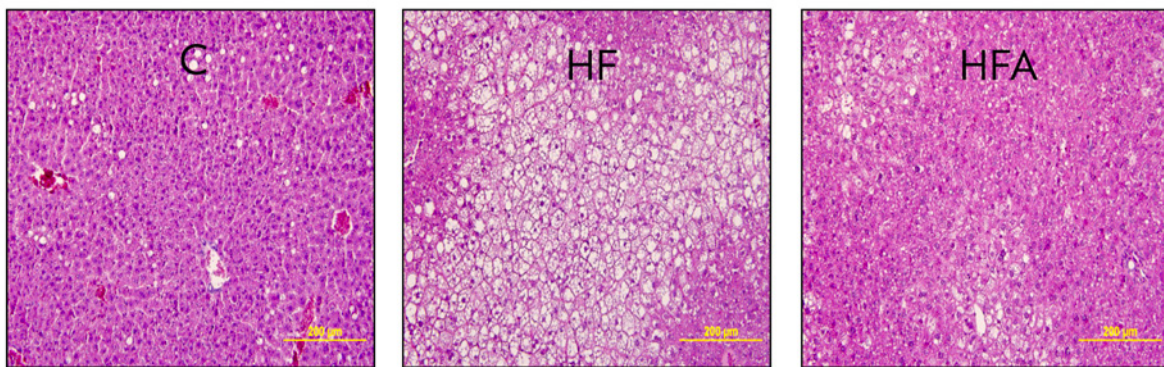


Figure C

## DISCUSSION

The consumption of a high fat diet can lead to damaging effects on metabolic health and liver health, along with increased inflammation and oxidative stress. A high fat diet along with excessive consumption of carbohydrates is typical of an unhealthy lifestyle that leads to obesity and other underlying health issues. This study shows that the high fat diet specifically caused increases in fasting glucose and insulin, along with poor responses to the glucose and insulin tolerance tests, demonstrating the negative effects of a high fat diet on metabolic health and biochemistry. This study also shows a dramatic increase in fat in the liver for the group fed a high fat diet, which can lead to liver problems in the future. However, the exciting aspect of the results shows that anthocyanins mitigate many of the negative effects of a high fat diet. The improvements in glucose and insulin responses, along with less fat buildup in the liver (among other benefits noted in the full paper), demonstrate the importance of these anthocyanins to support health and wellness. Supplementation or improvements in diet to increase the intake of anthocyanins, especially cyanidin and delphinidin, warrant further investigation for their potential to support metabolic health and other health parameters.

(Feb 2021)

## REFERENCE

Daveri E, Cremonini E, Mastaloudis A, et al. Cyanidin and delphinidin modulate inflammation and altered redox signaling improving insulin resistance in high fat-fed mice. *Redox Biol.* 2018;18:16-24. doi:10.1016/j.redox.2018.05.012.

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