**RESULTS (Cont.)**

**Vitamin C**
- Hepasil DTX significantly increased plasma vitamin C as soon as 2 hours following the first treatment and was maintained during the entire acute phase (p < 0.05; Figure 3A).
- A chronic increase in vitamin C was seen, but did not reach statistical significance (Figure 3B).
- Hepasil DTX significantly increased plasma vitamin C concentrations during the acute-chronic phase of the study (p < 0.05; Figure 3C).

**CONCLUSIONS/DISCUSSION**

The purpose of this study was to assess the effectiveness of Hepasil DTX in increasing both antioxidant and detoxification capacity as measured by plasma glutathione and vitamin C levels. This study design was organized into three phases: Acute, Chronic, and Acute-on-Chronic (Figure 1). During the acute phase, the effects of Hepasil DTX were monitored during the first eight hours following the initial treatment (Day 1, hour 0). The chronic phase measured the effect of Hepasil DTX on maintaining glutathione and vitamin C levels over 28 days of supplementation. The Acute-on-Chronic phase was designed to monitor any acute effect that occurred in addition to the 28-day chronic phase. Our results show that both glutathione and vitamin C levels increased following treatments with Hepasil DTX and, to our knowledge, is the first time a combination of essential nutrients and phytochemicals has been shown to increase both antioxidant and detoxification capacity. Glutathione plays a major role in the overall antioxidant network and acts as an important intermediate in the detoxification process. Interestingly, we found a biphasic response in both the Acute and Acute-on-Chronic phases (Figure 1). This can explained by two distinct mechanisms. This first mechanism is likely due to the N-acetyl-L-cysteine provided by Hepasil DTX. Cysteine is the rate limiting substrate in glutathione synthesis and has been shown to provide systemic actions and increase glutathione levels. As such, we found a consistent significant increase in plasma systems levels following treatment with Hepasil DTX (data not shown). The second mechanism is likely due to an increase in Phase II glutathione synthesizing enzymes over time. Alpha lipoic acid, milk thistle, and broccoli extract have been shown to up regulate Phase II enzymes, and likely account for the steady increase in glutathione observed during this study. The large Acute-on-Chronic increase in glutathione, relative to the Acute phase, is likely due to this steady increase in glutathione over the course of the study in addition to the effects seen during the Acute phase (p < 0.01; Figure 2). Vitamin C is a well known antioxidant but has also been recently shown to act as an important substrate for detoxification reactions. Recently several studies have shown that vitamin C plays a critical role in the removal of toxins. The increase found in vitamin C levels is intriguing because the current Hepasil DTX formula does not contain vitamin C. Moreover, study subjects were neither taking any nutritional supplements prior to enrollment in the study nor was there vitamin C in the provided meal (nutritional data not shown). While both dietary vitamin C and glutathione supplementation have been shown to increase both antioxidant and detoxification capacity, the current Hepasil DTX formula is unique in that it contains both vitamin C and glutathione. These statements have not been evaluated by the Food and Drug Administration.