

# Mobilization of bone marrow adult stem cells with StemEnhance® improves muscle regeneration in cardio toxin-induced muscle injury

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## Introduction

It was shown that adult stem cells released from the bone marrow can migrate into injured tissues, supporting the process of tissue repair; in this process, the number of circulating stem cells was shown to be a critical factor. In a number of studies addressing various health conditions, higher numbers of circulating adult stem cells have been associated with greater health.

Based on this information, it was claimed that the natural adult stem cell mobilizer StemEnhance® had the ability to support optimal health by increasing the number of circulating adult stem cells. StemEnhance® is an extract from the aquatic botanical *Aphanizomenon flos-aquae* that was shown in a double-blind crossover study to increase the number of circulating stem cells.

This study was aimed at confirming the effect of StemEnhance® on tissue repair.

## Methods

In brief, 30 8-10 week old female mice were lethally irradiated before receiving a bone marrow transplant with stem cells marked with green-fluorescent protein (GFP). After transplantation, subjects were randomly separated into two groups of 15; one received a placebo, while the other received 300mg/kg/day of StemEnhance®. At day 16 and 30 after transplantation, mice from each group were randomly selected for hematological testing to see the effect of StemEnhance on hematopoiesis. The remaining mice in each group (n=6) were injured by injection of 10µm Cardiotoxin in 100 µl PBS directly into the anterior tibia muscles of their right leg. Five weeks after the injury, the mice were evaluated (using open imaging with Olympus OV 100 Small Animal Imaging System) for incorporation of GFP cells into tissues – including heart muscle, liver, kidneys, intestinal wall, brain, skin and lung. The incorporation of GFP-positive muscle fibers was quantified with Photoshop 7.0.

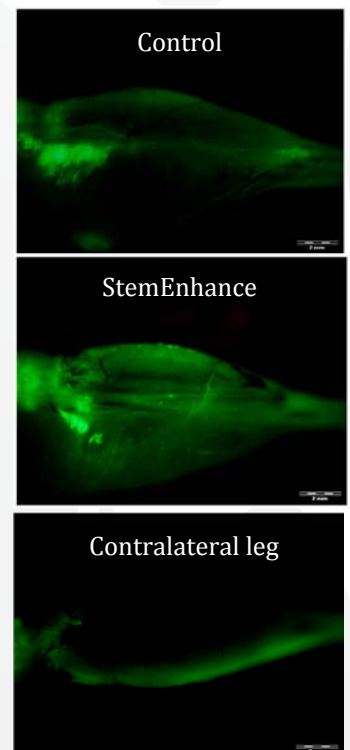
## Results

No significant difference was observed between the treated StemEnhance® and untreated (PBS) group regarding average hemoglobin content, as well as WBC, RBC platelet and reticulocytes counts. Therefore, StemEnhance® did not appear to have an effect on hematopoietic recovery.

In the injury part of the study, the extent of the recovery was evaluated by measuring the area covered by fluorescence in the injured muscles. The group receiving StemEnhance® showed greater regeneration of the tibialis muscle ( $p < 0.05$ ), though both PBS and StemEnhance® groups showed very significant recovery. The difference between the two was also noted behaviorally by a greater strength in the leg of the StemEnhance® group while being handled, though this was not quantified.

Less fluorescence was seen in the contralateral left tibialis muscle of both groups, indicating that migration of bone marrow stem cells was more significantly directed toward the injury.

Some fluorescence was also seen in most of the main organs, such as the heart, brain, kidney, liver and lung, though no difference was seen between the two groups.



## Discussion

StemEnhance<sup>®</sup> did not seem to have an effect on hematopoietic recovery, as it did not increase the number of red blood cells, white blood cells and platelets soon after irradiation. However, StemEnhance<sup>®</sup> did enhance recovery from the cardio toxin-induced muscle injury. Reliable measurements of fluorescence were not made during the healing process, therefore, it is not possible to discriminate whether StemEnhance<sup>®</sup> accelerated the repair process or enhanced the overall repair process. Studies have reported that bone marrow stem cell mobilization accelerates the healing of skin burns and bone fractures. On the other hand, it was reported that scar formation appears to take place when not enough stem cells are available to support full repair process. So it is likely that the effect of StemEnhance<sup>®</sup> was an acceleration of the repair process, which in some conditions could also lead to a greater overall repair by reducing scar formation.

While StemEnhance<sup>®</sup> enhanced recovery, significant recovery was nonetheless seen in the control group indicating stem cells derived from the bone marrow - naturally contributing to the repair of the injury. Furthermore, in both StemEnhance<sup>®</sup> and the control group, incorporation of GFP-muscle cell was much less in the contralateral left tibialis muscle; indicating that stem cells migrate predominantly towards sites of injury. Therefore, this study confirms three key aspects of stem cell physiology:

1. Stem cell migration in an injured tissue is a natural process that takes place without any stimulation
2. Increasing the number of circulating stem cells accelerates the repair process
3. Stem cells primarily migrate to sites of injuries.

In conclusion, this study confirmed the hypothesis that StemEnhance<sup>®</sup> supports the natural process of tissue repair by supporting the release of adult stem cells from the bone marrow.

## References

Drapeau, C., Antarr, D., Ma, H., Yang, Z., Tang, L., Hoffman, R., & Schaeffer, D. (2010).

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