Novel h9e Peptide Sequence for Medical Uses

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Statement of Purpose: One of the leading causes of death following a traumatic injury is exsanguination [1-2]. Among U.S. military personnel, hemorrhage is one of the greatest threats to survival [3-4]. Among American civilians, bleeding is the leading cause of death in operating rooms [5]. Extensive blood loss due to hemorrhage is not only a concern in the United States but also around the world.

In order to prevent or significantly reduce the number of deaths associated with exsanguination, research has been conducted over the past 40 years. The body naturally addresses the issue of bleeding by the process of hemostasis (coagulation cascade) [6]. However, during a traumatic injury, the body may be unable to stop or slow the amount of bleeding caused by the injury. To address these issues, several hemostatic agents have been developed.

The Bio-Materials and Technology Lab, in the Department of Grain Science and Industry, at Kansas State University has developed a new peptide sequence called the h9e peptide [7]. While exploring the possible applications of this innovative peptide, it was discovered that if mixed with serum albumin, a hydrogel would form. Because of its elastic and high tensile strength properties, the h9e peptide hydrogel has the potential for use in biomaterials for medical uses and possibly the formation of a hemostatic agent.

Methods:

We demonstrated the ability of the novel h9e peptide to form a stable hydrogel with commercial mouse blood at the following wt % concentrations of h9e peptide solution: 1%, 2%, 3%, 4%, and 5%. Visual observation of hydrogel formation was recorded via a Nikon Coolpix L22 camera.

Both storage and loss moduli, G' and G" respectively, of the h9e/blood hydrogel was determined using a C-VOR 150 rheometer (Malvern Instruments, Malvern, Worcestershire, United Kingdom). A plate 20mm in diameter was used with 1 % strain and frequency of 1 Hz at a 37°C temperature for 30 minutes.

Results:

At all concentrations tested the h9e peptide, when added to the blood sample, forms a hydrogel within a few seconds to minutes depending upon the concentration. All gels are strong and self-supporting (Fig. 1). The viscosity, strength, and stability of the h9e/blood hydrogel increased as both time and concentration of the h9e peptide increased. For example, at 5% wt concentration, a hydrogel was formed instantaneously once the h9e solution came in contact with the blood sample. In addition, h9e/blood hydrogel appears to form a visible fibrous network.

Currently the ability of the h9e peptide to form a stable hydrogel, with a blood sample, in the presence of antibiotics commonly used for antimicrobial prophylaxis is being investigated. The results of this study, as well gelation video, micro-imaging of the hydrogel, and the storage modulus of h9e/blood hydrogel 24 hours post gelation will be presented at the meeting.

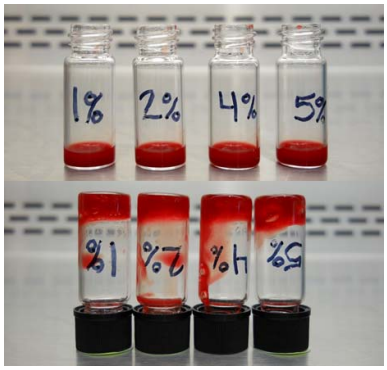

Figure 1. Visual comparison of blood before (top) and after (bottom) gelation.

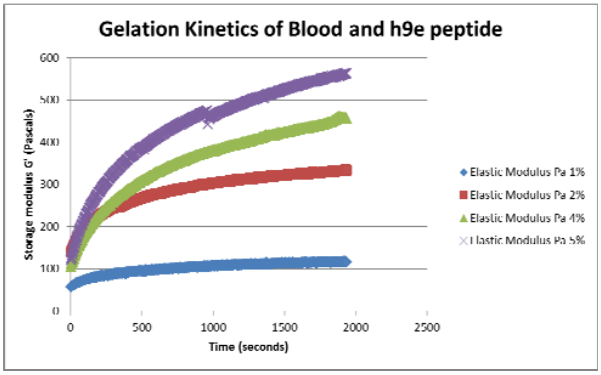

Figure 2. Time Sweep test: Storage modulus vs time of blood samples with various h9e peptide concentrations

Conclusions: From the in vitro assays, we confirmed that the novel h9e peptide sequence formed a stable hydrogel when added to commercial mouse blood. Based on these findings, we consider the h9e peptide to be a potentially useful component of a hemostatic biomaterial that may demonstrate hemostatic efficiency when used to treat hemorrhaging in vivo.

References:

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