Supplementation with Undenatured Whey Protein During Diabetes Mellitus Improves the Healing and Closure of Diabetic Wounds through the Rescue of Functional Long-lived Wound Macrophages

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Abstract:

Long and persistent uncontrolled diabetes tends to degenerate the immune system and increase the incidence of infections in diabetic patients. A serious complication of diabetes is impaired healing, which diminishes physical activity and, in some cases, leads to chronic wounds and limb amputation. Whey proteins (WPs) enhance immunity during early development and have a protective role in some immune disorders. The effect of camel WPs on wound healing in a streptozotocin-induced type 1 diabetic mice model was investigated. Sixty male mice were equally distributed into 3 experimental groups: group 1, non-diabetic control mice; group 2, diabetic mice; and group 3, diabetic mice that were orally supplemented with undenatured WP (100 mg/kg body weight/day for 1 month through oral gavage). We observed that the diabetic mice exhibited delayed wound closure characterized by a significant reduction in collagen deposition, prolonged elevation in inflammatory cytokines, aberrant activation of STAT3 and reduction in the activation of Akt and NF-□B when compared with the control mice. Moreover, in the diabetic mice, the wound-resident macrophages were dysfunctional and demonstrated increased apoptosis, a significant reduction in their phagocytotic ability, aberrant activation of STAT3 and a marked reduction in the activation of Akt. Interestingly, the supplementation of diabetic mice with WP significantly enhanced the collagen deposition, limited the inflammatory stimuli, restored the activation of STAT3, Akt and NF- □B and greatly improved the closure of diabetic wounds compared with the control mice. Most important, the supplementation of diabetic mice with WP rescued functional, long-lived wound-resident macrophages. Our data reveal the benefits of WP supplementation in improving the healing and closure of diabetic wounds.

Keywords:

Cytokines □ Diabetes Mellitus □ Macrophages □ Phagocytosis □ Wound healing □ Whey protein

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