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Oat βeta Glucan Attenuates the Development of Atherosclerosis and Improves the Intestinal Barrier Function by Reducing Bacterial Endotoxin Translocation in APOE-/- MICE

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Abstract : Oat β-glucan a water soluble non starch linear polysaccharide has been approved as a cholesterol lowering agent by various food safety administrations and is commonly used to reduce the risk of heart disease. The molecular weight of oat β-glucan can vary depending on the extraction and fractionation methods. It is not clear whether the molecular weight has a significant impact at reducing the acceleration of atherosclerosis. The aim of this study was to investigate three different oat β-glucan fractionations on the development of atherosclerosis in vivo. With special focus on plaque stability and the intestinal barrier function. To test this, ApoE-/- female mice were fed a high fat diet supplemented with oat bran, high molecular weight (HMW) oat β-glucan fractionate and low molecular weight (LMW) oat β-glucan fractionate for 16 weeks. Atherosclerosis risk markers were measured in the plasma, heart and aortic tree. Plaque size was measured in the aortic root and aortic tree. ICAM-1, VCAM-1, E-Selectin, P-Selectin, protein levels were assessed from the aortic tree to determine plaque stability at 16 weeks. The expression of p22phox at the aortic root was evaluated to study the NADPH oxidase complex involved in nitric oxide bioavailability and vascular elasticity. The tight junction proteins E-cadherin and beta-catenin from western blot analyses were analysed as an intestinal barrier function test. Plasma LPS, intestinal D-lactate levels and hepatic FMO gene expression were carried out to confirm whether the compromised intestinal barrier lead to endotoxemia. The oat bran and HMW oat β-glucan diet groups were more effective than the LMW β-glucan diet group at reducing the plaque size and showed marked improvements in plaque stability. The intestinal barrier was compromised for all the experimental groups however the endotoxemia levels were higher in the LMW β-glucan diet group. The oat bran and HMW oat β-glucan diet groups were more effective at attenuating the development of atherosclerosis. Reasons for this could be due to the LMW oat β-glucan diet group's low viscosity in the gut and the inability to block the reabsorption of cholesterol. Furthermore the low viscosity may allow more bacterial endotoxin translocation through the impaired intestinal barrier. In future food technologists should carefully consider how to incorporate LMW oat β-glucan as a health promoting food.

Keywords : Atherosclerosis, beta glucan, endotoxemia, intestinal barrier function
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