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Liposome-Encapsulated Flavonoids as a Novel Approach to Target Hepatic Insulin Resistance and Inflammation in Type 2 Diabetes

Abstract:
Hepatic insulin resistance is a key feature of type 2 diabetes mellitus, closely associated with oxidative stress and inflammation. Despite its significance, there is a lack of therapies specifically targeting hepatic dysfunction. Flavonoids have shown promise for their antidiabetic properties; however, their clinical application is limited due to challenges related to bioavailability and metabolism. This study investigated the effects of four flavonoids (kaempferol, quercetin, kaempferol-7-O-glucoside, and quercetin-7-O-glucoside) in a HepG2 cell model of hepatic insulin resistance. Among them, quercetin was identified as the most promising compound and was subsequently encapsulated in liposomes (mean size 0.12 μm, encapsulation efficiency 93%) to enhance its therapeutic potential. Quercetin liposomes showed superior efficacy in improving insulin resistance by modulating Akt expression, reducing inflammation via NF-κB, and regulating PGE2 and COX-2 expression. Furthermore, they outperformed free quercetin in decreasing the production of reactive pro-oxidant species. These findings suggest that quercetin liposomes could serve as a novel therapeutic strategy for diabetes, effectively addressing both hepatic insulin resistance and inflammation.

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