槲皮素、芦丁与大豆分离蛋白非共价作用机制及其功能性和消化性研究

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摘要：黄酮具有较强的抗氧化、抑菌等作用，但其溶解性差，消化率较低，限制了其应用范围。本文分析了槲皮素-大豆分离蛋白与芦丁-大豆分离蛋白复合物功能性(溶解性、乳化性、凝胶性)和消化性的变化，并利用紫外可见光谱法、荧光光谱法研究互作机理，解析了其荧光淬灭类型、结合位点数以及热力学参数。结果发现两种黄酮均可提高 SPI 的功能性质，随着槲皮素（除添加量 8%外）和芦丁添加量的增加，分别呈现对 SPI 凝胶性的影响无显著性差异（P<0.05）及先增加后下降的趋势，槲皮素与芦丁添加量分别为 8%时，SPI 凝胶强度可分别提高 23.23%及 187.18%；随着槲皮素和芦丁添加量的增加，SPI 的 EAI 和 ESI 分别呈现先增加后趋于平缓的趋势及先增加后略有下降的趋势，槲皮素与芦丁添加量分别为 6%和 4%时，SPI 乳化活性可分别提高 20.84%及 26.17%；随着槲皮素和芦丁添加量的增加，SPI 溶解性分别呈现先增加后趋于平缓的趋势及先增加后下降的趋势，槲皮素与芦丁添加量分别为 4%和 6%时，SPI 溶解性可提高 10.06%和 19.27%。此外槲皮素、芦丁分别与 SPI 相互作用后还可提高蛋白的生物利用度，进一步研究两种黄酮多酚与 SPI 互作机制表明，两种互作复合物的荧光光谱均发生蓝移现象，槲皮素、芦丁与 SPI 自发结合，并主要通过氢键和范德华力方式作用，其中槲皮素、芦丁与 SPI 互作机制分别为动态淬灭及静态淬灭。

关键词 槲皮素；芦丁；溶解性；乳化性；凝胶性；消化特性；非共价作用

Effects of Quercetin and Rutin on the Functional and Digestive Properties of Soy Protein Isolate

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Abstract: Flavonoids has been well recognized to possess biological and pharmacological properties, including antioxidant, anti-inflammatory. However, the extremely low solubility in water and low bioavailability of curcumin greatly limit its application in food or drug formulations. The changes of function (solubility, emulsification, gelation) and digestibility of soybean protein isolate were analyzed. The interaction mechanism was studied by UV-vis spectroscopy and fluorescence spectroscopy. Then, the interaction information of fluorescence quenching type, binding site number and thermodynamic parameters were analyzed. It was found that two types of flavonoid could improve the functional properties of SPI. With the increase of quercetin (except addition of 8%), the gel properties of SPI had no significant difference (P<0.05). With the increase of rutin addition, SPI gel increased first and then decreased. When the addition of quercetin and rutin were added at 8%, the SPI gel strength could be increased by 23.23% and 187.18% respectively. With the increase of quercetin, the EAI and ESI of SPI increased first and then tended to be flat. With the increase of rutin, the EAI and ESI of SPI increased first and then decreased slightly. When quercetin was added at 6% and rutin were added at 4%, the emulsifying activity of SPI increased by 20.84% and 26.17%, respectively. With the increase of quercetin, the solubility of SPI increased first and then tended to be flat. With the increase of rutin, the solubility of SPI increased first and then decreased. When quercetin was added at 4% and rutin were added at 6%, the solubility of SPI could be increased by 10.06% and 19.27%, respectively. In addition, the interaction of quercetin and rutin interacts with SPI can also improve the bioavailability of protein. The fluorescence spectra of the two interaction complexes had a slight blue shift of the maximum wavelength. The interaction mechanism between two types of flavonoid polyphenols and SPI were studied. Quercetin and rutin spontaneously combine with SPI were mainly driven by hydrogen bond and van der Waals force. The interaction mechanisms between rutin and SPI were a dynamic quenching and a static quenching, respectively.

Keywords: quercetin; rutin; solubility; emulsification; gelation; digestibility; non-covalent interaction