The in vivo estrogenic potential of the flavonoids apigenin, kaempferol, genistein and equol was investigated in immature female mice. Genistein and equol, administered by gavage for 4 consecutive days [post-natal day (PND) 17-20, 100 mg/kg body weight], was found to significantly increase uterine weights and the overall uterine concentration of estrogen receptor alpha (ER alpha). In kaempferol- and equol-exposed mice the cytosolic ER alpha concentration was significantly increased as compared to the solvent control, which is speculated to result in an increased sensitivity of the uterus to subsequently encountered estrogens. Oral administration of equol, genistein, biochanin A and daidzein to 6-week-old female mice revealed a great variation in their systemic bioavailability. The urinary recovery of equol was thus over 90% of a single gavage administered dose, whereas the urinary recoveries of biochanin A, genistein and daidzein were 16, 11 and 3%, respectively. Most of the metabolites were either hydroxylated or dehydrogenated forms of the parent compounds. The in vitro estrogenic potency of some of the metabolites was greater than that of the parent compounds, whereas others were of similar or lower potency. Bioavailability, metabolism, the ability to alter ER alpha distribution in the uterus and the estrogenic potential of parent compound and metabolites may thus contribute to the differences in in vivo estrogenicity of dietary flavonoids.