As a method of preparing ligand-selective cavities in a synthetic polymer matrix, the molecular imprinting technique has been attracting significant interest from a large number of areas in chemistry and analytical sciences. In this study, molecularly imprinted polymers (MIPs) were prepared with methyl methacrylate (MMA) as a third monomer, acrylic acid (AA), methacrylic acid (MAA), and 4-vinylpyridine (4-VP) as functional monomers, templates (acetaminophen (AAP) and aspirin (AS)), and ethylene glycol dimethacrylate (EGDMA) as a cross-linker by using supercritical fluid polymerization. The binding characteristics of MIPs and templates (AS, SA, and THN) were evaluated using equilibrium binding experiments. Scatchard plot analysis revealed that two classes of binding sites were formed with the equilibrium dissociation constants. Also, the adsorption ability of the MIPs was investigated by high performance liquid chromatography (HPLC) analysis, measuring the adsorbed amounts for a similar imprinted template structure, the selectivity factor (α), and the imprinting-induced promotion of binding (IPB). It was found the results from the analysis of these evaluations for the prepared MIPs that the adsorption properties were superior to that of the parent and other materials.