Specific lectin biomarkers for isolation of human pluripotent stem cells identified through array-based glycomic analysis.

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Public Summary:
Rapid and dependable methods for isolating human pluripotent stem cell (hPSC) populations are urgently needed for quality control in basic research and in cell-based therapy applications. Using lectin arrays, we analyzed glycoproteins extracted from 26 hPSC samples and 22 differentiated cell samples, and identified a small group of lectins with distinctive binding signatures that were sufficient to distinguish hPSCs from a variety of non-pluripotent cell types. These specific biomarkers were shared by all the 12 human embryonic stem cell and the 14 human induced pluripotent stem cell samples examined, regardless of the laboratory of origin, the culture conditions, the somatic cell type reprogrammed, or the reprogramming method used. We demonstrated a practical application of specific lectin binding by detecting hPSCs within a differentiated cell population with lectin-mediated staining followed by fluorescence microscopy and flow cytometry, and by enriching and purging viable hPSCs from mixed cell populations using lectin-mediated cell separation. Global gene expression analysis showed pluripotency-associated differential expression of specific fucosyltransferases and sialyltransferases, which may underlie these differences in protein glycosylation and lectin binding. Taken together, our results show that protein glycosylation differs considerably between pluripotent and non-pluripotent cells, and demonstrate that lectins may be used as biomarkers to monitor pluripotency in stem cell populations and for removal of viable hPSCs from mixed cell populations.

Scientific Abstract:
Rapid and dependable methods for isolating human pluripotent stem cell (hPSC) populations are urgently needed for quality control in basic research and in cell-based therapy applications. Using lectin arrays, we analyzed glycoproteins extracted from 26 hPSC samples and 22 differentiated cell samples, and identified a small group of lectins with distinctive binding signatures that were sufficient to distinguish hPSCs from a variety of non-pluripotent cell types. These specific biomarkers were shared by all the 12 human embryonic stem cell and the 14 human induced pluripotent stem cell samples examined, regardless of the laboratory of origin, the culture conditions, the somatic cell type reprogrammed, or the reprogramming method used. We demonstrated a practical application of specific lectin binding by detecting hPSCs within a differentiated cell population with lectin-mediated staining followed by fluorescence microscopy and flow cytometry, and by enriching and purging viable hPSCs from mixed cell populations using lectin-mediated cell separation. Global gene expression analysis showed pluripotency-associated differential expression of specific fucosyltransferases and sialyltransferases, which may underlie these differences in protein glycosylation and lectin binding. Taken together, our results show that protein glycosylation differs considerably between pluripotent and non-pluripotent cells, and demonstrate that lectins may be used as biomarkers to monitor pluripotency in stem cell populations and for removal of viable hPSCs from mixed cell populations.Cell Research advance online publication 6 September 2011; doi: 10.1038/cr.2011.148.