

Title Comparison of three nondestructive methods for determination of vegetable surface area.  
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### **Abstract**

Surface areas of differently shaped vegetables, namely beet (*Beta vulgaris*), cucumber (*Cucumis sativus*), carrot (*Daucus carota*) and parsnip (*Pastinaca sativa*) were determined by a linear method (Baugerod's method), a shrink-wrap replica method and image analysis. Values obtained using these methods did not differ significantly for carrots and beets. Surface area values obtained using image analysis were higher than those obtained by Baugerod's method for parsnips (by 23.5%), and higher than Baugerod's and shrink-wrap replica methods for cucumbers (by 11.3 and 12.6%, respectively). A method was considered reproducible if surface area values from five measurements on the same product did not differ significantly (P less than or equal to 0.05). Surface area values for an individual product varied in the range of 4.7% for Baugerod's method for parsnips, and 6.6% for the shrink-wrap replica method for carrots. No significant variation was observed for any of the vegetables when repeated measurements were made using the image analysis method. Image analysis offers rapidity, lack of adverse effect on produce, and the ability to collect and analyse data simultaneously. However, in the absence of the necessary equipment for image analysis, Baugerod's method may be used for a product symmetrical around its central axis, after comparing it with a more direct procedure (e.g. shrink-wrap replica method).