CHOSEN ASPECTS OF THERMOGRAPHIC STUDIES ON DETECTION OF PHYSIOLOGICAL DISORDERS AND MECHANICAL DEFECTS IN APPLES

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Abstract

Recent years have brought new ideas of application of thermography in agrophysical studies. It is connected with new possibilities given by active thermography which enables not only to study the surface changes of object thermodynamical processes but also to have an insight into deeper layers of specimens to give information about the sizes, properties and the depth of the defects. It occurred that thermography is especially useful in agrophysical studies. Many processes of mass and energy exchange in agrophysical systems are have their reflection in the change of the surface temperature of the studied bodies. This concerns the soil-plant-atmosphere system where the transport of water and gas from the soil through the plant membranes into the atmosphere and the turbulent transport of air in the atmosphere create specific actual distribution of temperature on the surface of plant and soil. Measuring this parameter considerably improves evaluation the rate of evaporation from soil and transpiration from plants. Similarly, in various stages of fruit production the dynamics of the fruit surface temperature distribution gives important information about the quality of the product. During growth, harvesting, storage and distribution fruits are the subject of constant changes of their temperature as a result of interaction with external factors such as solar radiation, frost, shading by leaves, cooling in storage houses what has an impact on their quality. An important problem in postharvest technology of fruit is nondestructive detection of defects coming from diseases, mechanical damages and physiological disorders. These defects manifest themselves with changes of thermodynamical properties of the infected tissue. In agrophysical studies of fruit quality various nondestructive testing and evaluation methods are being incorporated, including visible and near infrared imaging, spectrophotometry, colorimetry, X-ray imaging, magnetic resonance, acoustic resonance etc.. Thermography can be a promising alternative to these methods. It proved to be useful not only for the measurement of temperature changes on the surface of the investigated objects but also for detection of internal heat intrusions and heterogeneity of the thermal properties within bodies.

This paper presents the results of the studies on detection of fruit bruises and watercore in their tissues. Both passive and active pulse phase thermography was applied to early detect tissue defect.

Watercore is a physiological internal disorder in which the intercellular air spaces around the core line become filled with fluid and a characteristic translucent tissue creates. As a result thermal properties of the affected tissues change. Three varieties of apples were studied: ‘Jonagold’, ‘Ligol’ and ‘Gloster’.The absence of external symptoms of watercore, made us use dynamical thermography to distinguish affected and unaffected apples. The derivative of apple temperature in time per apple mass is a good parameter to evaluate the differences in thermal properties between apples with sound and watercore affected tissues. For apples with watercore the rates of temperature increase per mass in particular initial stages of heating were considerably smaller than for apples with sound tissue irrespective of the part of the fruit surface considered.

The obtained courses of temperature changes on fruit surface during the heating process showed for all the studied varieties the occurrence of temperature differences between bruised and sound parts in the range 0,5-1,5°C. The highest differences of radiation temperature were noticed for ‘Jonagold’ variety and the lowest for ‘Gloster’ variety, what is determined by highest differences of firmness between these two varieties.

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