CHOICE OF FINITE ELEMENT ADEQUATE TYPE FOR MODELING THE STRUCTURE OF THE MULBERRY FRUIT

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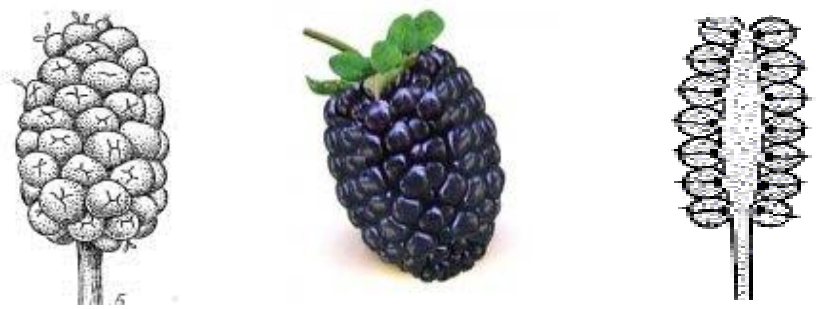
Abstract: In drawing up the finite element mathematical model of an investigated object important issues are the choice of the form of finite element and finite element sampling (mash) of the object. The basis for proper and adequate choice of the form of a finite element is the structure of the object itself, in our case it is the composed structure of mulberry fruit. In this paper the rationale for the selected finite element model of the mulberry fruit has been presented, which can adequately simulate the complex structure and parameters either the individual fruitlet with bone, from set of which is formed a mulberry fruit, and the mulberry fruit as a whole.

Key words: mulberry fruit, fruit structure, finite element selection, finite element modeling.

The mulberry fruit structure

In [1] characteristic of mulberry fruit (Morus L.) and review of data on their structure, mechanical and geometrical parameters has been presented.

Mulberry is a stem of succulent head-seeded fruitlets with the skin, flesh and small seed (seed-bone), fused with the central fruit axis (inflorescence) (Fig. 1).



a b c

Fig. 1. Mulberry fruit: a) botanical illustration of fruit [2]; b) photo of fruit [3]; c) longitudinal section of fruit [4]

During the experimental analysis authors obtained and studied components of the black mulberry: fruitlets with bone (usually in an amount of 20-40 pcs.), each having 4 mini drupelets and the central axis of the stem (Fig. 2).

Fig. 2. Components of black mulberry fruit (authors' photo)

Choosing a finite element and finite element mathematical model of the mulberry fruit structure

In accordance with the complex composite structure of mulberry fruit, in [5] was proposed finite element mathematical model of the composed fruit structure on the example of the mulberry fruit. In drawing up the finite element mathematical model of an investigated object important issues are the choice of the form of finite element and finite element sampling (mash) of the object. The basis for proper and adequate choice of the form of a finite element is the structure of the object itself, in our case it is the composed structure of mulberry fruit shown and described above. What is why ***as the finite element of the model was selected the volume (three-dimensional) five-node finite element in the form of a pyramid with a square base,*** which can adequately simulate the complex structure and parameters either the individual fruitlet with bone (each having 4 mini drupelets), from set of which (usually 20-40 pieces) is formed a mulberry fruit, and the mulberry fruit as a whole.

And the set of nodes represented by tops of the pyramids, adequately models the central axis of the whole mulberry fruit. The dimensions and number of finite elements (fruitlets) are determined based on statistical analysis of experimental measurements.

Conclusion

The finite element method is widely and successfully used for computer modeling and simulation of complex objects and processes [6]. Based on the finite element mathematical model on an example of mulberry fruit selected, proposed and developed by the authors, it is possible to perform adequately and effectively computer simulations of the complex structure of composite fruits as well as of the complex processes for different methods of drying fruits.

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