FINITE ELEMENT MATHEMATICAL MODEL FOR COMPLEX STRUCTURE FRUITS ON AN EXAMPLE OF MULBERRY FRUIT

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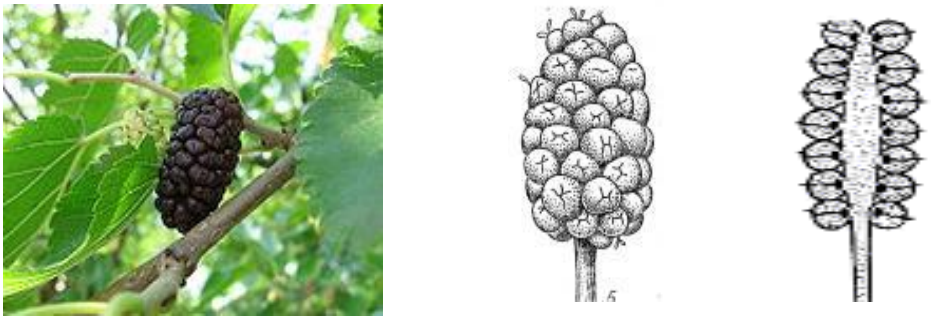
Abstract: The finite element mathematical model, developed by the authors for complex structure fruits on an example of the mulberry fruit (as a set of fruitlets), which can adequately simulate on the one hand, the complex structure of the fruit by using volume (three-dimensional) finite elements of its parts (for the fruit of the mulberry, of its many constituent fruitlets) and on the other hand, complex thermodynamic processes for different methods of drying fruits, has been presented and consided.
Key words: complex structure fruits, mulberry fruit, finite element method, modeling and simulation, fruits drying processes

The structure of the mulberry fruit

It is known that the mulberry fruit (more precisely a set of fruitlets) (Fig. 1) is formed from fused constituent florescences[1].



a **b** **c**

Fig. 1. Compound fruits of mulberry: a), b) general forms [2, 3] and c) longitudinal section [4]

Mulberry is a stem succulent hand-seeded fruitlets (drupelets) with the skin, flesh and small seed (seed-bone) [5] and fused with the fruit axis (inflorescence) (fig. 1c).

According to above presented complex composite structure of mulberry fruit authors in this work propose the finite element mathematical model for complex structure fruits on an example of the mulberry fruit (set of fruitlets).

Finite element mathematical model for complex structure fruits on an example of mulberry fruit

In the first step of developing of the finite element mathematical model, the important moments are the choice of kind of finite element and finite element sampling (mashs) of the investigated object [6]. The basis for the proper adequate selection is the structure of the object itself, in our case it is the structure of the fruit of mulberry, shown and described above. What is why ***as the finite element of the model was selected the***

volume (three-dimensional) four-node finite element in the form of a pyramid with a triangular base, using which it is possible to model and simulate adequately the structure and properties of the individual fruitlet with bone, from a variety of tham (usually 20-40 units) as it is known mulberry fruit (set of fruitlets) is formed. And the set of nodes represented the tops of the pyramids, adequately models the central axis of the whole mulberry fruit. The dimentions and number of finite elements (fruitlets) are determined based on statistical analysis of experimental measurements.

In the second step of the finite element modeling, the mathematical description of the processes occurring in the investigated object is performed. In our case one of the main goals of the finite element modeling and simulation is to investigate, analyze and determine the optimal parameters of complex thermodynamic processes for different methods of drying fruits, in particular, for drying fruits by convection in combination with the use of high frequency currents.

Conclusion

It is well known that 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 proposed and developed by the authors, it is possible, on our opinion, 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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