Development of a classification scheme for main food processing processes

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Abstract. In this work, the results of the development of a general classification scheme, the main food processing processes are presented; It is well known that expanding the size of the working components of machines and installations and decreasing downtime are two ways to attain high productivity of these equipment and installations in food production. More efficient intensive techniques by speeding up procedures and so cutting down on their duration using methods of semantic-system analysis of food processing processes, such as fruits and vegetables, and a general classification scheme for the main food processing processes is obtained. Also, unified classification scheme for the main food processing processes used in the development of machines and devices for creating conditions that ensure the effective implementation of food processing processes has been obtained.

1 Introduction

In the process of reforming the agricultural industry of Uzbekistan, special emphasis is placed on equipping it with modern, highly productive specialized machinery and technological equipment of domestic production that meets international requirements and standards.

A program of measures to expand and develop the food industry for 2020-2025 serves as the foundation for strengthening the activities of food industry enterprises in the near future, as does a program of additional measures to increase production quantity, enlarge the processing and preserving the agro raw materials, and expand range of food products.

The food industry transforms basic raw materials into consumable items by implementing multiple production techniques which achieve safety enhancement while improving both product flavor and nutritional quality together with extended storing capabilities.

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Food processing implements physical along with chemical alterations that transform food substance properties regarding characteristics such as texture but also affects chemical agents including preservation additives.

In-depth processing of fruits and vegetables utilizing modern technology would allow for a 5.7-fold rise in the amount of production quantity of environmentally sustainable finished products, such as fruits and vegetables, in demand on foreign and local markets by 2030.

The execution of profound structural changes in the economy, the modernization and diversification of industry, the ongoing technical and technological renewal of the production quantity and the ongoing search for internal reserves should be our primary guidelines in light of this.

Food processing entails developing items that provide security, healthful content, and practicality while being reasonably priced. Sustainable environmental processing techniques are gaining popularity since they aim to reduce waste output and energy requirements.Food processing methods must be classified so that people can understand all of the production procedures utilized in the food manufacturing industry. Several groupings exist to classify food processing activities based on their intended functions, operational frameworks, and expected outcomes. Every categorization group contains specialized processing processes that work together to achieve the necessary features in the finished food.

To put the long-term ambitions stated above into action, highly skilled industry personnel must be trained, which necessitates a thorough understanding of modern literature.

Currently, in all existing textbooks here and abroad, on processes and apparatuses, the classification of existing processes is presented verbally, they are not brought to a single classification scheme, which cannot simultaneously present information about all processes and apparatuses, as well as their prospects. Therefore, the development of a classification scheme for the main food processing processes is relevant.

2 Materials and methods

Based on the strategy of system analysis based on semantic system analysis, the study of food processing processes (which are fruits and vegetables), consideration of a preliminary analysis of a priori information about the physical and chemical laws of heat and mass transfer processes in food processing, allows us to draw up a classification of all processes where, for any type of processing In these products, two phenomena occur simultaneously: evaporation of moisture and transfer of mass (PM) and energy (PE) - heat transfer. This classification scheme allows us to deeply understand the meaning of food processing, shows that the process is a set of phenomena and, based on the driving forces, the main food processing processes are determined.

There are considerable reserves in raising the kinetic coefficients, which indicates that there are technological limits to increasing the driving forces, according to a systematic review of scientific research focused on food processing technology and engineering.

It is well known that expanding the size of the working components of machines and installations and decreasing downtime are two ways to attain high productivity of these equipment and installations in food production. More efficient intensive techniques-by speeding up procedures and so cutting down on their duration.

The study of scientific data on the mechanisms of food processing processes shows that, according to the nature of their passage (implementation), processes are divided into reversible and irreversible. To analyze typical irreversible processes, which include

numerous processes such as drying, frying, frying, etc., it is advisable to apply the basic principles of the thermodynamics of irreversible processes.

3 Results and Discussion

Based on the results of the analysis of modern ideas about food technology processes, we have developed a classification scheme for the main processes, the diagram of which is presented in the figure. As can be seen, from the classification of food processing processes there are a set of phenomena, i.e heat transfer, mass balance and the momentum.

Moreover, the mass of wet materials (products, particularly fruits and vegetables) is primarily composed of two phases: the first (1) indicates that the material contains moisture, and the second (2) is the material's dry skeleton, or dry matter. In the middle of these phases, two phenomena happen simultaneously during any product processing: moisture evaporation and mass transfer (PM) and energy transfer (ET) - heat transfer and (PI) - momentum transfer.

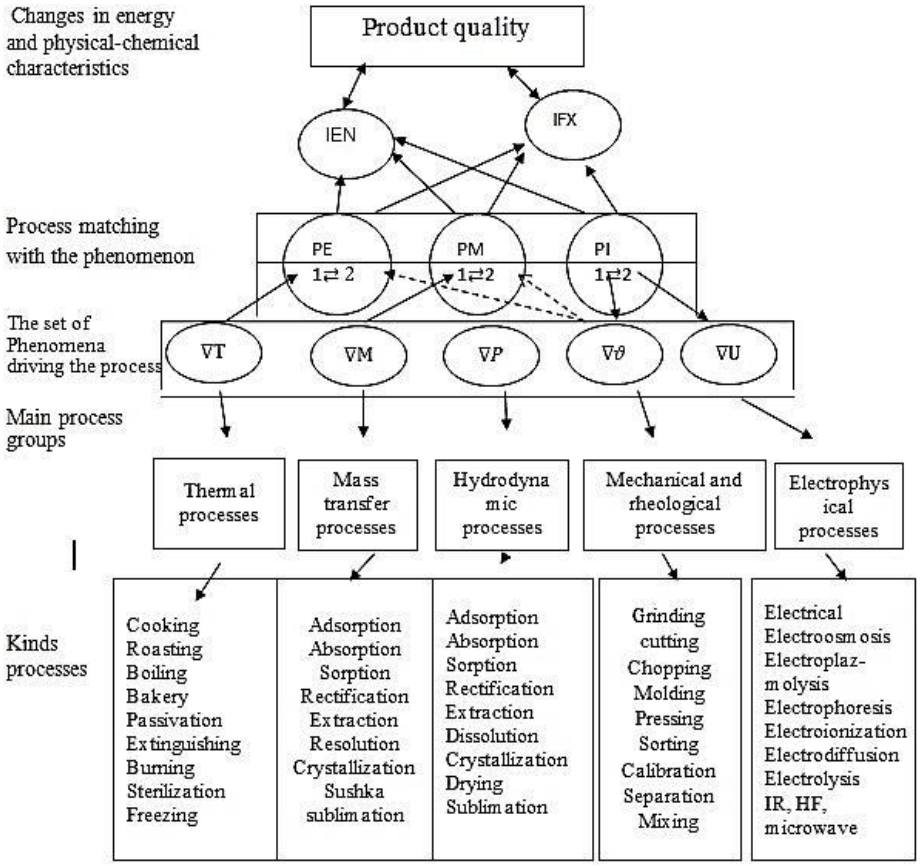

Fig. 1. Classification of basic food processing processes.

In wet materials, gradients of temperature (∇T), mass (∇M), and pressure (∇P) are the primary drivers of heat and moisture transport. In rheological systems, the action of normal and tangential forces results in a gradient of surface forces (surface tension) (∇σ). Additionally, the voltage potential (gradient) (∇U) is the driving force behind electrophysical events.

Food processing processes promote the passage of mass and energy across phases. This graphic illustrates the selection of driving forces, the kind of material transfer that occurs during the process, and the steps involved in creating their mathematical models. It is known that the productivity of machines and installations in food production can be achieved using both extensive methods, i.e. by more efficient intensive ways, such as raising the pace of operations and so decreasing their duration, and by enlarging the working sections of machines and installations and decreasing downtime.

The analysis of transfer processes in food products was based on phenomenological concepts until recently, when heat and mass transfer were primarily studied as macro processes and objects were viewed as continuous models in which individual phases are represented as a continuous medium uniformly distributed throughout the body's volume. This is in contrast to the current state of molecular physics, which has made significant strides, and the widespread use of new physical effects under the influence of external fields.

A deeper understanding of the fundamentals of macroprocesses is recommended, and processing objects should be viewed as corpuscular models, whose physical characteristics are dictated by the molecular structure of bodies and the forces of interaction between the constituent wet materials by molecules, atoms, and ions.

According to the fundamental principles that define the processes' progression, the driving factors mentioned above give rise to the primary categories of processes, which are further subdivided into the following main groups: mass transfer, hydrodynamic, mechanical, rheological, electrophysical, thermal, and hydrodynamic processes.

Hydrodynamic processes are based on hydrostatic processes. Thermal processes, which are based on changes in the thermal state of interacting media, include heating in the form of cooking, frying, boiling, baking, sautéing, etc. The driving force of these processes is the temperature difference between interacting media.

Mass transfer diffusion processes, in which, along with heat transfer, the transition of a substance from one phase to another due to diffusion plays an important role, include adsorption, absorption, drying, extraction, etc. Disparities in the concentrations of the transmitted substance interacting or hydromechanical actions on materials, such as mixing, settling, filtration, centrifugation, etc., are the driving force behind these operations, as the classification scheme makes clear. Centrifugal force, hydrostatic pressure, and hydrodynamic pressure are the forces that propel processes.

Grinding, sorting, pressing, and other mechanical and rheological operations are based on the mechanical impacts on materials. Centrifugal or mechanical pressure forces are what propel these processes.

To electrophysical processes characterized by the impact on the object of processing of electric, magnetic, electromagnetic fields, as well as electrically charged particles. These factors can act both individually and in combination. The processes include electrical electroosmosis, electroplasmolysis, electromagnetic infrared (IR), high frequency (HF), microwave frequency range.

The properties of food as well as its components are important criteria to consider when designing a method to manufacture a food product. Although property magnitudes can be calculated using published values for similar materials, changes in process efficiency and the design of the equipment used to perform the process require more precise property magnitudes. In addition to that the classfification of food processing models and the processing steps such as unit operation are vital for the understanding the specific parameters which should be measured during the processing steps. It will reduce the overcooking or over processing of foods. This measurments should be in proper international parameters.

4 Conclusion

More efficient intensive techniques by speeding up procedures and so cutting down on their duration using methods of semantic-system analysis of food processing processes, such as fruits and vegetables, and a general classification scheme for the main food processing processes is obtained. Also, unified classification scheme for the main food processing processes used in the development of machines and devices for creating conditions that ensure the effective implementation of food processing processes has been obtained. .

References

1. M. Salima, B. Kalykova, G. Ordabayeva, I. Mizanbekov, Entrepreneurship and Sustainability Issues, **11**, 4 (2024)
2. H.Ch. Buriev, V.I. Zuev, S.M. Medzhitov, Vegetable Production in Central Asia, **117** (2005)
3. V.A. Voytyuk, T.E. Marinchenko, Modeling of export development of agricultural enterprises of the Kaluga region, In IOP Conference Series: Earth and Environmental Science, **659**, 1(2021)
4. D. Yurii, V. Halanets, T. Kulakovska, M. Pugachov, V. Pugachov, Economic Affairs, **67,** 4 (2022)
5. C.G. Kuo, S.R Ramasamy, M. Nair, C.S. Marco, Agricultural policy and program framework: Priority areas for research & development in South Asia, 288 (2019)
6. P.R Ghosh, D. Fawcett, B.S. Shashi, G.E. J Poinern, International journal of food science, **2016**, 1 (2016)
7. R.B. Singh, R.S. Paroda, M. Dadlani, Indian agriculture towards 2030, World, **821**, 51(2020).
8. S.J. Freeman, Ultrasonics sonochemistry, **18**, 4 (2011)
9. B.R Bhandari, K.C. Patel, X.D. Chen, Drying technologies in food processing, **4**, 4 (2008).