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MEMBRANE-LESS ORGANELLES OF THE EUCARIOTIC CELL: BASIC CONCEPTS AND PRINCIPLES OF FORMATION

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Along with “classical” organelles that have a membrane, membrane-less organelles, or biomacromolecular condensates, play an important role in the cell compartmentalization system. In this review, the biological significance of the two types of cell compartmentalization, which is expressed in the existence of membrane-bound and membrane-less compartments (organelles), and also the basic organizational principles of membrane-less organelles, the basic terms and concepts are discussed briefly. Membrane-less organelles, many of which contain not only proteins, but also specific RNAs, are formed as a result of the separation of biomacromolecules into phases under macromolecular crowding conditions and increase the efficiency of many specific cellular functions. According to modern concepts, the general principle of forming the membrane-less organelles, regardless of their molecular composition and functions, is the liquid–liquid phase transition. In the nucleus, some organelles are formed at sites of transcription of specific genes, and RNA, for example, rRNA, small nuclear and long non-coding RNA, can serve as a “seed” in the formation of such membrane-less organelles or play a structural role. Proteins containing the intrinsically disordered regions or low complexity domains predominantly contribute to the formation of membrane-less organelles. In the conclusion of the review, some examples of membrane-less organelles with a complex internal structure, which apparently arises as a result of secondary phase separation, are presented.

Keywords: membrane-less organelles, biomolecular condensates, cell compartmentalization, liquid–liquid phase separation