Research on the development of liposomal biologics

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Liposomes are small, self-enclosed spherical structures with a concentric lipid bilayer that encapsulate an aqueous phase in the center. They were discovered in 1965 and have been widely used since then due to their unique ability to encapsulate hydrophilic agents (hydrophilic drugs, DNA, RNA, etc.) in the inner aqueous core and hydrophobic drugs inside the lipid part of the bilayer, making them versatile therapeutic carriers. They are non-toxic, protecting the substance they contain from contact with the biological environment. In addition, they can deliver the contents of liposomes into the cell when their membrane fuses with the cell membrane. Liposomes also gradually release the drug substance, which increases its duration of action. The advantages of these vesicles as drug carriers are obvious: liposomes derived from natural phospholipids, unlike polymeric delivery systems, are completely biocompatible and capable of complete biodegradation, suitable for incorporating many biomolecules, including enzymes, hormones, vitamins, antibiotics, immunomodulators, cytostatics, which are active pharmaceutical ingredients. Drug substances incorporated into liposomes become more stable in the body, as they are isolated by the lipid membrane from the harmful effects of external conditions, in particular, from destruction in the gastrointestinal tract, and in turn have a lesser degree of general toxic effect on the body. A unique feature of liposomes is the ability to deliver drugs to the cells with which they interact by fusion or endocytosis. By modifying the liposome membrane with molecules that provide "recognition" of the target cell or organ, it is possible to carry out targeted drug transport. Therefore, research aimed at the development of liposomal drugs is relevant. The purpose of the research is to analyze current trends in the use of liposomes in medicine, ways to manipulate the physicochemical characteristics of liposomes to create flexible drug delivery systems that can affect various diseases,

and to study the peculiarities of the formation of stable liposomal systems. The analysis of current trends in the production and stabilization of liposomes, their loading with drugs, can be used in the development of industrial technological schemes of production at domestic enterprises for the production of liposomal and liposome-like drugs of the latest generation.

Microflora of kefirs available on the Polish market

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Kefir is classified as a fermented dairy beverage; it has a creamy color, a characteristic smell, and a refreshing taste. It is obtained through fermentation. In this study, an analysis of the compositions of kefirs available on the Polish market was conducted. The research material consisted of 6 products available in Polish stores, produced by 6 different manufacturers whose headquarters and production facilities are located in Poland. Table 1 presents a statistical analysis of the comparison of the microflora of the examined kefirs.

Table 1. Analysis of the microflora composition of the examined kefirs

Kefir	**Lactic acid bacteria**	**Milk streptococci (mainly *Streptococcus thermophilus*)**	***Bifidobacterium* spp.**	**Yeasts**
Kefir 1	$6{,}37 \pm 0{,}33^{D}$	$0{,}00 \pm 0{,}00^{A}$	$2{,}55 \pm 0{,}65^{B}$	$4{,}15 \pm 0{,}36^{C}$
Kefir 2	$7{,}47 \pm 0{,}19^{B}$	$7{,}94 \pm 0{,}71^{B}$	$0{,}00 \pm 0{,}00^{A}$	$0{,}00 \pm 0{,}00^{A}$
Kefir 3	$5{,}24 \pm 0{,}45^{B}$	$4{,}95 \pm 0{,}27^{B}$	$6{,}64 \pm 0{,}36^{C}$	$0{,}00 \pm 0{,}00^{A}$
Kefir 4	$2{,}15 \pm 0{,}13^{B}$	$0{,}00 \pm 0{,}00^{A}$	$3{,}22 \pm 0{,}73^{B}$	$0{,}00 \pm 0{,}00^{A}$
Kefir 5	$4{,}53 \pm 0{,}23^{B}$	$6{,}36 \pm 0{,}04^{D}$	$5{,}48 \pm 0{,}02^{C}$	$3{,}77 \pm 0{,}16^{A}$
Kefir 6	$7{,}79 \pm 0{,}15^{C}$	$0{,}00 \pm 0{,}00^{A}$	$2{,}01 \pm 0{,}10^{B}$	$2{,}07 \pm 0{,}16^{B}$

A, B, C, D - statistically significant differences in the quantity of microorganisms between kefirs of the same company (ANOVA, Tukey's *post-hoc* test ($p \leq 0.05$); Statistica12 software (StatSoft, USA)).