



## MONITORING MILK ANALOGUES FOR USE IN DIETARY NUTRITION МОНІТОРИНГ АНАЛОГІВ МОЛОКА ДЛЯ ВИКОРИСТАННЯ У ДІЄТИЧНОМУ ХАРЧУВАННІ

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**Abstract.** Analyzing people's diets in various parts of our planet has shown that drinking milk is a top-rated and beneficial product. Cow's milk is an excellent source of protein, calcium, and essential nutritional elements such as vitamin B12 and iodine. It also contains magnesium, which is necessary for bone development and muscle function. However, refined human diets have led to allergic reactions to milk and its processed products. This study analyzes the feasibility of using different types of milk, proposes substituting the main recipe component with powdered and lactose-free milk, and investigates their physicochemical properties. This substitution considers several aspects: obtaining a final product with high organoleptic characteristics (color, taste, aroma), ensuring a certain structure (consistency), and maximizing the concentration of vitamins and other beneficial components in the product.

**Keywords:** milk, properties, research, use, monitoring

Alternative plant-based products of animal origin are getting widely promoted to achieve popular diets. Some milk analogs, such as powdered and lactose-free milk, are becoming popular in cold dessert recipes due to their better digestibility by the human body. Also, lactose-free milk makes this type of dessert available for people with lactose intolerance [14 -16].

Desserts that combine two global culinary trends — gaining new taste experiences and matching ingredients to dietary and health characteristics — are in high demand among consumers of different ages. The group of most popular desserts that combine these two essential trends are cold desserts with a delicate consistency made from raw dairy-protein ingredients. These desserts are not just a trend but a culinary delight accessible to all, from children to older people, especially those who prioritize dietary nutrition [2, 3, 5, 7].

Due to human evolution, humans from different parts of the world have learned to digest lactose. Approximately 30% of the world's population continues to produce lactase, the enzyme necessary for digesting lactose, even into adulthood. The rest of the population has reduced lactase production after breastfeeding weaning in childhood [1, 3, 15, 19].

The rest of the people become lactose intolerant and consume milk as the exception rather than the rule. About 9% of people of European descent in the USA suffer from lactose intolerance [1]. Even those who can digest it may wish to reduce milk consumption due to other concerns, such as health issues and the environmental costs of livestock farming, which drive the growth of cow's milk alternatives.



Cow's milk is an excellent source of protein, calcium, and essential nutrients, such as vitamin B<sub>12</sub> and iodine. It also contains magnesium, which is necessary for bone development and muscle function, whey, and casein (phosphoprotein). All these elements reduce blood pressure.

The National Health Service (NHS) of the United Kingdom recommends that children aged one to three consume 350 mg of calcium per day for normal bone development. This dose contains approximately 300 ml of milk (a little more than half a pint). However, research results on whether milk benefits bone health in adults are conflicting.

One more concern in recent decades is consuming hormones while consuming milk. Farmers milk cows even when they are pregnant, causing the level of estrogen (sex hormones) in their bodies to increase 20-fold.

Although one study linked such high levels of estrogen to the development of breast, uterine, and ovarian cancer in humans, Laura Hernandez, who studies lactation biology at the University of Wisconsin (USA), says that consuming hormones along with milk is not a problem. "After all, human milk also contains hormones — we are mammals," she notes [1, 7].

Research has also found a link between milk consumption and heart disease due to the saturated fats in milk. However, the fat content of whole milk is only about 3,5%, while skim milk ranges from 0,3 to 1,5%. In contrast, unsweetened milk alternatives from soy, almond, coconut, oat, and rice have lower fat content than whole milk.

The proposal was to replace the main ingredient with powdered and lactose-free milk to improve the technology for making milk-based mousse. This substitution takes into account several aspects: obtaining a final product with high organoleptic characteristics (color, taste, aroma), ensuring a certain structure (consistency), maximizing the concentration of vitamins and other beneficial components in the product, achieving optimal concentrations from the perspective of therapeutic and preventive effects on the human body, and justifying economic feasibility.

*Powdered milk* is a fine white powder with a homogeneous structure. The process uses regular pasteurized milk, removes moisture through condensation and drying, and leaves only the milk components. This concentrated substance completely dissolves in water, regaining the properties of regular drinking milk.

The production of powdered milk involves unique technological methods such as filtration, pasteurization, and drying.

The most common type is whole powdered milk. Still, there is also a skimmed version explicitly created for those who have individual intolerance to the product and are prone to allergic reactions. The main difference between the two varieties lies in their fat content. For example, whole milk contains 25% fat, while skimmed milk contains 1%, which means the latter has 25 times less fat. Conversely, the protein content in the first case reaches 25.5%, while in the second, it is 36%.

#### *Advantages of powdered milk:*

- High nutritional value: The production process preserves the powder's proteins, fats, and other beneficial milk components. It contains a complex of B vitamins and minerals, such as calcium and magnesium. These components are essential for healthy growth and development, robust immune systems, and bone health.



- Convenient storage and transportation: Powdered milk has a long shelf life (up to 3 years) and does not require refrigeration, making it convenient for storage and subsequent use.
- Wide use in cooking: Powdered milk is helpful in cooking various dishes and baked goods, including sauces, creams, ice cream, smoothies, and porridge.

*Lactose-free milk* is a product in which lactose, the natural sugar in milk, is broken down into glucose and galactose by the enzyme lactase. Lactose is a very beneficial component of milk. Thanks to this carbohydrate ( $C_{12}H_{22}O_{11}$ ), the intestines absorb minerals and promote the reproduction of beneficial lactic acid bacteria for the body.

However, a certain percentage of people lack the enzyme lactase or have it in tiny amounts. In African, American, and some Asian countries, this genetic trait is observed in 80-100% of the population, while in Ukraine, the percentage of people with lactose intolerance is 20%. Lactose-free milk is produced for the proper nutrition of this group, making it entirely safe for them.

To obtain lactose-free milk, treat fresh milk with the enzyme lactase or add lactase to it. This milk tastes and textures like regular milk but does not contain lactose.

Using lactose-free milk allows people with lactose intolerance to consume dairy products without discomfort and health issues.

In addition to being easily absorbed by the body, lactose-free milk contains a large amount of protein, vitamins, and microelements.

### **The choice of milk substitutes**

Powdered milk is a product with removed water, leaving only the milk components. It has several advantages and beneficial properties:

- ✓ *High nutritional value:* Powdered milk contains many proteins, vitamins (especially B vitamins), and minerals such as calcium and magnesium. These components are essential for healthy growth and development, robust immune systems, and bone health.
- ✓ *Storage convenience:* Powdered milk has a long shelf life and does not require refrigeration, making it a convenient product for storage and use.
- ✓ *Culinary use:* Many people widely use powdered milk to prepare various dishes and baked goods. It is helpful in making sauces, creams, ice cream, smoothies, porridge, and many other dishes.

The situation with lactose-free milk is a bit different:

- ✓ *Ease of digestion:* Lactose-free milk has broken-down lactose, which is the sugar usually present in regular milk. This type of milk makes it easier to digest for people with lactose intolerance;
- ✓ *Alternative for people with lactose intolerance:* Lactose-free milk is an option for those with lactose intolerance. It allows such people to enjoy dairy products without the discomfort associated with lactose intolerance;
- ✓ *Nutrient content:* Lactose-free milk contains many beneficial components, such as proteins, calcium, and vitamins, which are necessary for healthy growth and development.

It is important to note that the benefits of powdered milk and lactose-free milk may vary depending on the individual's needs and characteristics. It is always better to consult a doctor or nutritionist to determine which products best meet your needs.



## Analysis of modern technologies for preparing dairy desserts

There are various methods of preparing dairy desserts: custard, jelly, and mousse. One of the most delicate and delicious is cheesecake mousse. It has a pleasant creamy taste and an incredibly airy and light consistency.

The calorie content in mousse is relatively low, and it's a dish that produces beneficial protein content for our bodies. Surprisingly, even the seemingly harmful sugar in the dessert activates blood circulation in the brain and reduces the risk of arthritis! If you reduce the fat content of the ingredients, you'll get a no less tasty but more dietary cheesecake mousse.

Mousses that have good consumer properties and are helpful for health-conscious diets are particularly interesting to consumers. They are good to sell in retail chains as well as in restaurants. Mousse is famous among various demographic groups, including children, teenagers, health-conscious individuals, and older people.

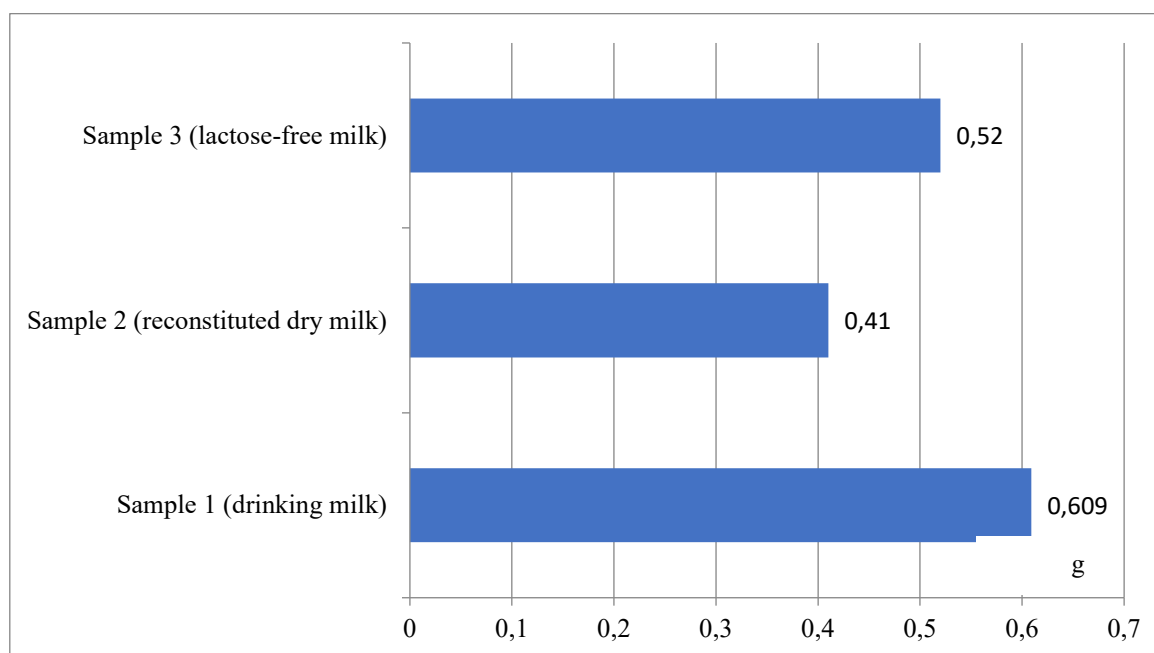
### Determination of Physical and Chemical Indicators of Raw Materials

We conducted experimental studies using established research methods to assess the impact of substituting powdered and lactose-free milk on mousse's quality and nutritional value.

The researchers conducted the study in the Department of Restaurant and Ayurvedic Product Technology research laboratories at the National University of Food Technologies.

### Determination of Milk Sample Density

Measuring the density of milk helps ensure product standardization and achieve uniform dessert consistency. Determining the density also allows for controlling the thinning or thickening of the dessert, as thicker desserts have a more intense flavor due to a higher concentration of taste components. The obtained density results for the studied milk samples are shown in Figure 2.



\* - powdered milk was reconstituted at a temperature of 21<sup>0</sup>C.

**Figure 1 - Density indicators in experimental samples of milk (g/cm<sup>3</sup>)**

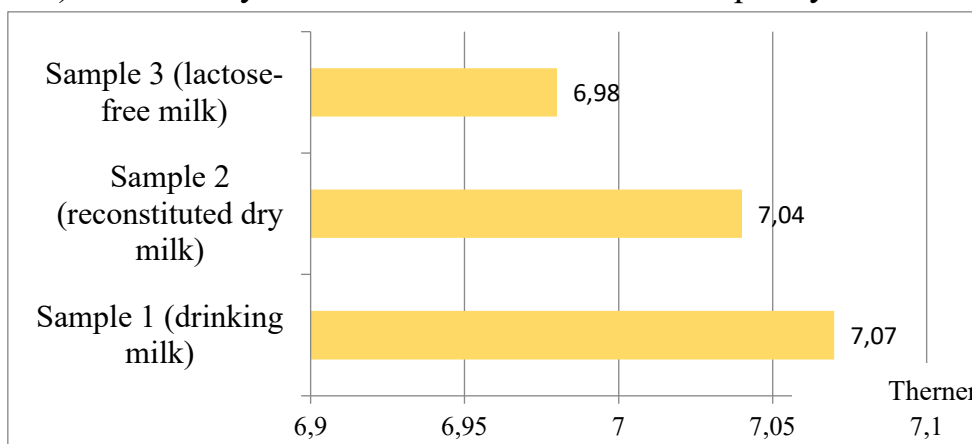
Source: developed by the author



The highest density appears in the drinking milk sample, at 0,609 g/cm<sup>3</sup>, due to its higher fat content and soluble properties.

**Determination of Raw Material Acidity**

Determining acidity is used to assess the amount of acid or the concentration of hydrogen ions (pH) in various substances or environments. This parameter is important because it helps control the quality and stability of food products. Acidity can affect the taste, safety, and shelf life of products. Acidity refers to the number of acid molecules in a sample. It is a significant indicator for dairy products that can characterize the extent of lactic acid fermentation or the state of the dairy products (fresh/spoiled). The acidity index is used to determine the quality of milk.

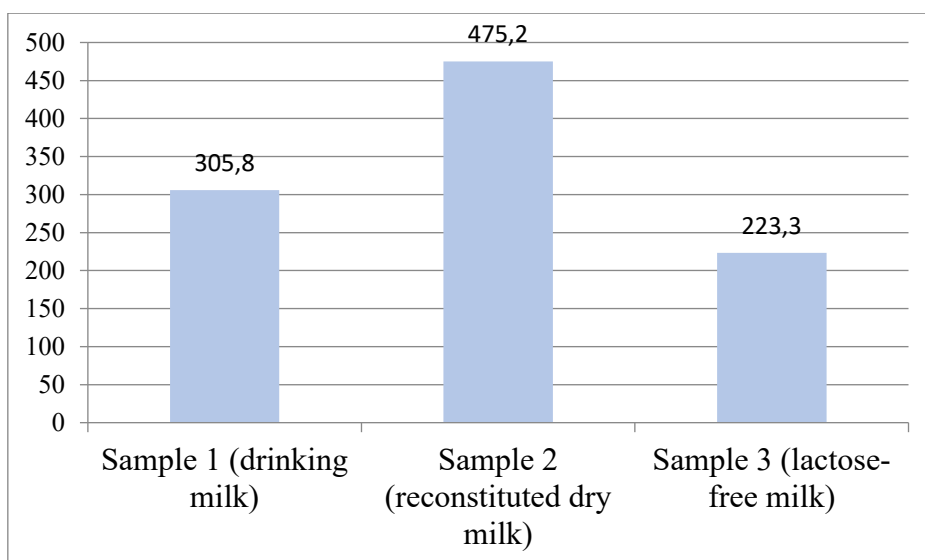


**Figure 2 - Acidity indicators of milk samples**

Source: developed by the author

**Determination of Oxidation-Reduction Potential and Reduction Energy of Model Milk Samples**

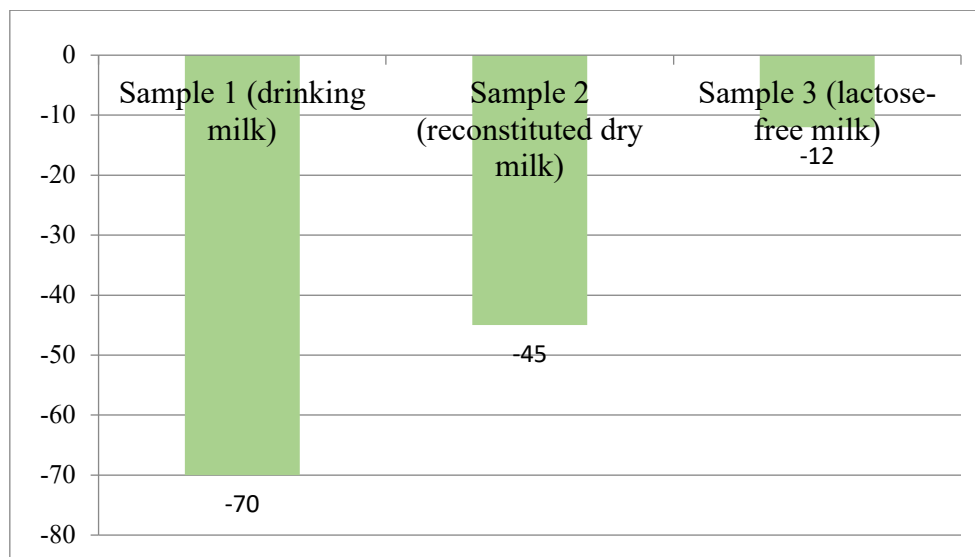
Oxidation-reduction potential (ORP) is an essential parameter for determining the degree of oxidation or reduction of a substance, solution, or environment. This parameter indicates the system's or substance's ability to undergo oxidation or reduction. Determining the oxidation-reduction potential (pH) of products and ingredients can be helpful for the quality control and stability of food products.



**Figure 3 - Oxidation-reduction potential of model milk samples**

Source: developed by the author





**Figure 4 - Determination of reduction potential of model milk samples**

Source: developed by the author

Determination of the reduction potential for milk samples involves assessing the amount of energy released upon their complete oxidation (utilization by the human body). This parameter is crucial for determining the nutritional value of products. The analysis allows for the quantification of energy in different types of milk, which is essential for quality control and compliance with nutritional standards.

### Conclusion

We have identified the technological and specific physicochemical parameters of experimental milk samples. It is important to note that the benefits of powdered milk and lactose-free milk may vary depending on individual needs and characteristics. It is recommended that you consult with a doctor or dietitian to determine which products best suit your needs.

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