Qualitative and quantitative analysis of pasteurized milk of modern manufacturers

The composition of milk

The composition of milk	Contents in %
Water	83-89
Solids	11-17
Milkfat	2.8-6.0
Casein	2.0-4.0
Lactose	4.0-5.5
Albumin	0.2-0.6
Ash	0.6-0.8

Minerals	Contents in mg per 100 g
Calcium	146
Potassium	120
Magnesium	14
Phosphorus	90
Iron	0.067
Iodine	0.009
Manganese	0.006
Copper	0.012
Fluoride	0.02
Chrome	0.002
Zinc	0.4

Vitamins	Contents in mg per 100 g
A	0.03
D	0.02
E	0.09
C	1.5
B1	0.04
B2	0.15
PP	0.1
B12	0.0004

Pasteurized milk production technology

1) Milk processing
2) Purification and cooling
3) Normalization by fat content
4) Heating and homogenization
5) Milk pasteurization
6) Cooling
7) Container packing
8) Capping and labeling of containers
9) Storage and transport of finished products

The goal and the objectives of the work.

The goal is

- to determine which of the milk samples taken for the experiments are of the highest quality.

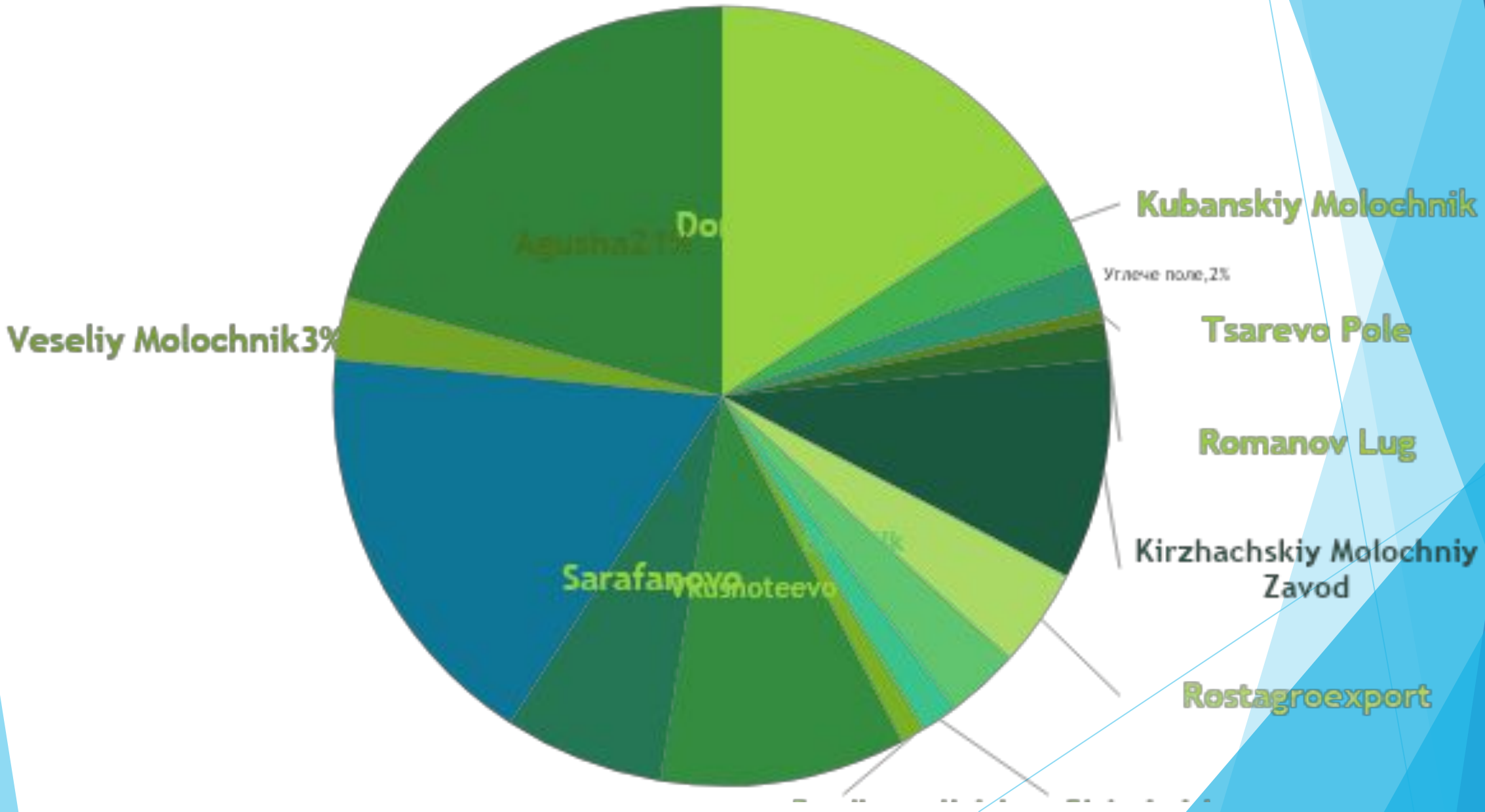
The objectives.

- 1 To conduct a sociological survey on the topic "What kind of milk do you consider of the best quality?“
- 2 To perform a series of experiments on each of 13 milk samples.
- 2.1. To check the organoleptic and physical properties of milk.
- 2.2. To conduct a qualitative analysis of milk for the presence of hydrogen peroxide, starch, ammonium cations.
- 2.3. To conduct a quantitative analysis on the amount of calcium, dry matter, acidity.
- 2.4. To compare the readings of the 12 samples of pasteurized milk with 1 sample of sterilized milk, specially taken for experiments, and draw conclusions about the difference between these readings.
- 2.5. To compare the readings of the samples of farm and factory milk.
- 3. Based on the data obtained, make recommendations to consumers.

Milk samples taken for the experiments

Fat content is 2,5%	Fat content is 3,2-3,6%	Fat content is more than 3,6%
Domik v Derevne (Moscow)	Ecomilk (Moscow)	Pravilnoye Moloko (Moscow region)
Kubanskiy Molochnik (Krasnodar region)	Brest-Litovsk (Brest, Republic of Belarus)	Veseliy Molochnik (Moscow)
Sarafanovo (Nesvizh, Republic of Belarus)	Rostagroexport (Moscow region)	**Ot Andreicha (Moscow region) (farm)**
AGUSHA (STERILIZED) (Moscow)	Vkusnoteevo (Voronezh)	Kirzhachskiy Molochniy Zavod (Vladimir region)
		Tsarevo Pole (Yaroslavl region) (farm)

The results of a sociological survey.

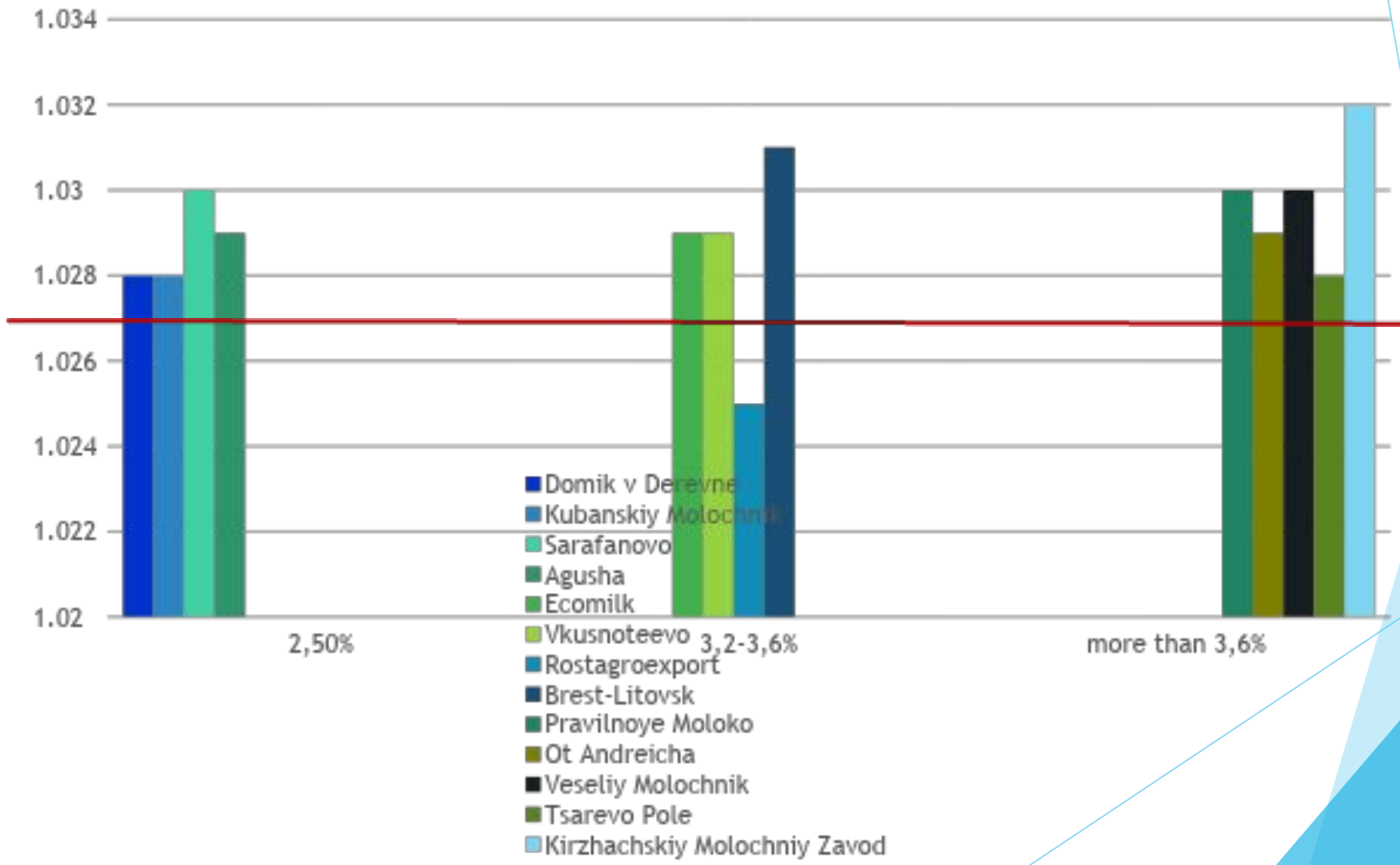


Organoleptic properties

PARAMETER	STATE STANDARDS REQUIREMENTS FOR OBTAINING THE HIGHEST ASSESSMENT (5)	RESULTS OF THE STUDY
COLOUR	White or yellowish	"Tsarevo Pole" has a too expressed yellow colour, grade "4"
SMELL	Clean, pleasant, sweetish	Samples "Sarafanovo" and "Kuban milkman" do not have a smell (both have grade "4") The sample "Ot Andreicha" has a foreign smell, reminiscent of the smell of a barn (grade "3") Of all the samples, “Ecomilk” and “Brest-Litovsk” stand out, having the sweetest smell
TASTE	Clean, pleasant, sweetish	All samples comply with state standards

Diagram of the dependence of the density of milk on its fat content

p, grammes per cubic centimeter



State standard norm is not less than 1,027 grammes per cubic centimeter

Density is measured with a hydrometer at 20 degrees

Determination of calcium content in the product

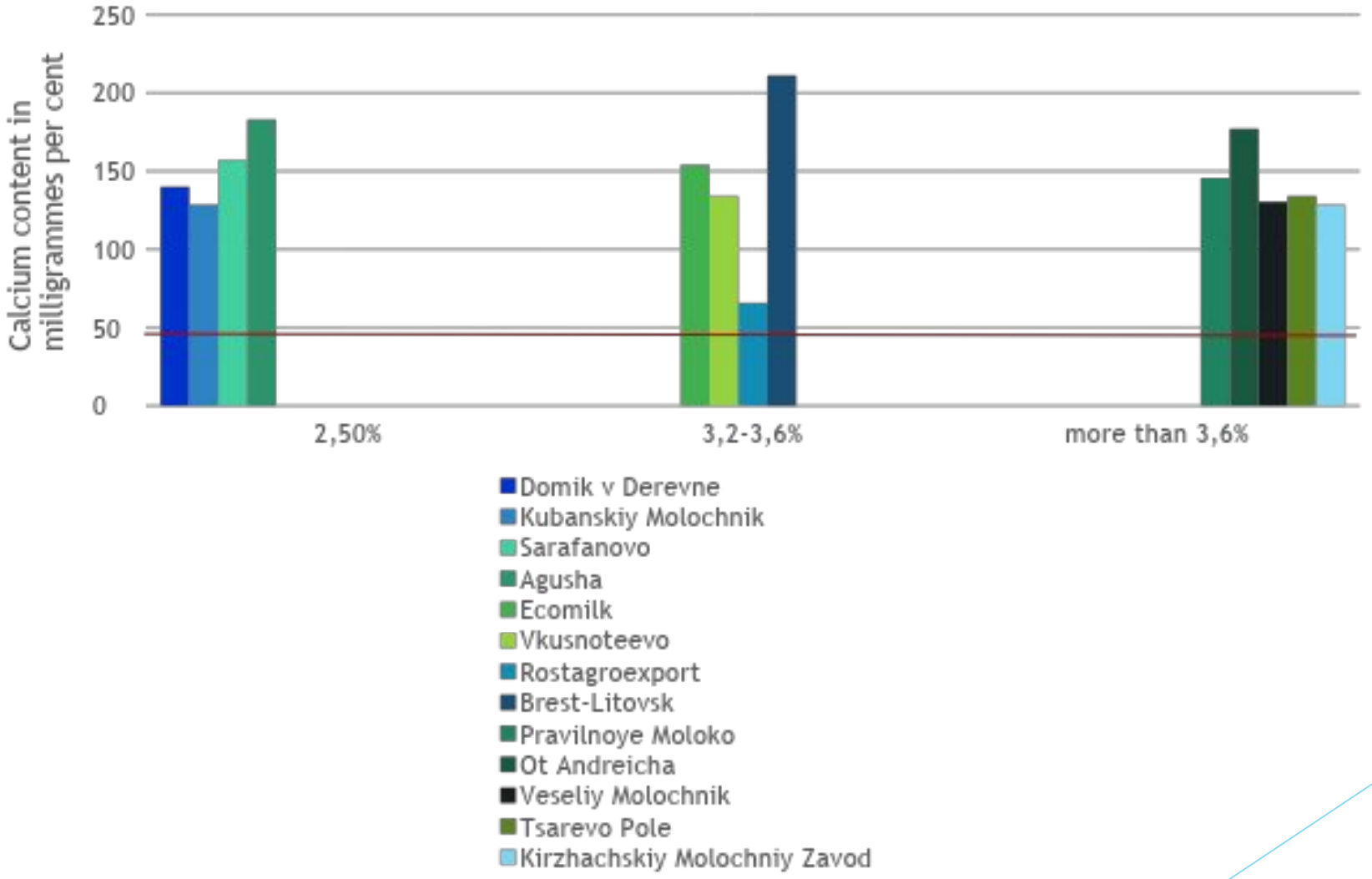
The formula for calculating the mass fraction of calcium:

$$\omega(Ca^{2+})=(0,001*m(Ca^{2+})*C_{\text{of trilone}}*V_{\text{of trilone}}*V_{\text{of flask}}/V_a)*2*5/7$$

[mg per 100 mls.],

- where **0,001** is conversion factor 1 gramme in 1 ml. of solution
- $m(Ca^{2+})$= 40,08 g;
- $C_{\text{of trilone}}$ = 0,05 M
- $V_{\text{of trilone}}$ is volume of trilone B used for titration (ml)
- $V_{\text{of flask}}$ = 100 mls.;
- V_a is aliquot volume (10 mls);
- **2** is the concentration coefficient of water in solution;
- **5/7** is the concentration factor of ammonia buffer.

The dependence of the calcium content in milk on its fat content



State standard norm is not less than 120 milligrammes per cent

Determination of the amount of dry matter.

The temperature is 105^0C
Drying time is 2 hours + 80 mins

Farrington's formula for calculating dry matter:
C=(4,9F+F)/4+0,5, где:

4,9 is the constant coefficient;
C is milk solids content (including fat),%;
F is fat content in milk, %;
A is density of milk in degrees of hydrometer;
0,5 is the density correction.

Results of determination of dry matter

The name of the sample	Dry matter, %	Dry matter according to Farrington's formula,%	Dry non-fat milk residue,%
Pravilnoye Moloko	11,93	11,93	8,3
Brest-Litovsk	12,479	12,48	8,9
Veseliy Molochnik	*12,102*	*12,9*	8,1
Domik v Derevne	*12,238*	*10,81*	9,7
Agusha	11,167	10,81	8,7
Kirzhachskiy Molochniy Zavod	12,3	12,66	7,6
Ot Andreicha	*14,7*	*12,91*	10,8
Vkusnoteevo	12,2	11,67	9
Tsarevo Pole	*12,88*	*11,91*	8,8
Rostagroexport	10,797	10,67	7,6
Ecomilk	11,83	11,67	8,6
Sarafanovo	11,258	11,06	8,8
Kubanskiy Molochnik	10,669	10,56	8,2

The content of dry milk residue is 11-13%

The content of dry non-fat milk residue - not less than 8.2%

Determination of milk acidity.

The equipment:

1. NaOH (sodium hydroxide with a concentration of 0.1 mol per dm3);
2. phenolphthalein (ethanol 1% solution)
3. A burette
4. Pipettes with volumes of 10 and 20 cm3.
5. A titration flask with a volume of 100 cm3.

The formula:

$$К = \frac{C(NaOH) \times V(NaOH) \times 100}{10 \times 0{,}1}$$

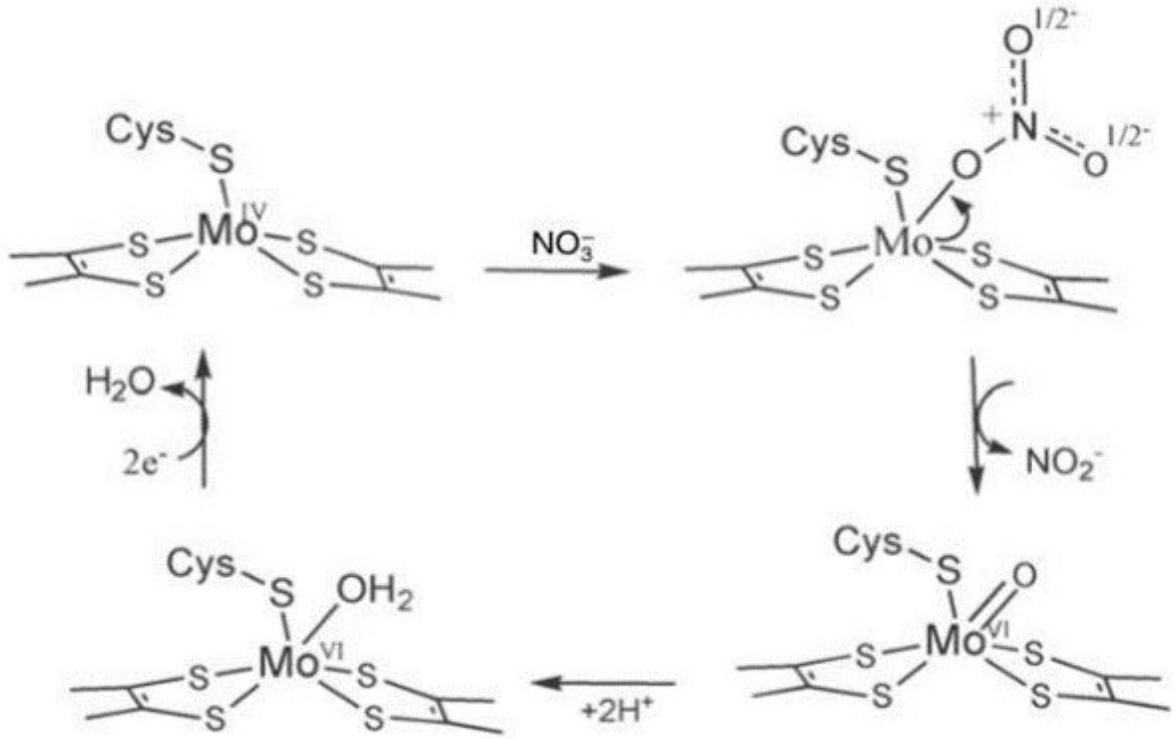
where: **V(NaOH)** is volume of sodium hydroxide solution consumed for titration of 10 cm3 of milk, cm3
C(NaOH) is concentration of sodium hydroxide solution, mol per dm3;
10 is the volume of milk taken for titration, cm3;
0,1 is the conversion factor of milk acidity per volume of 0.1 mol per dm3 sodium hydroxide solution
К is the acidity of milk in Turner degrees.

Results of determining the acidity of milk.

The name of the sample	Acidity, Turner degrees
Pravilnoye Moloko	16
Brest-Litovsk	17,6
Veseliy Molochnik	14
Domik v Derevne	17
Agusha	16
Kirzhachskiy Molochniy Zavod	19,67
Kubanskiy Molochnik	17,83
Ot Andreicha	17
Vkusnoteevo	16,5
Tsarevo Pole	21
Rostagroexport	14,5
Sarafanovo	18,17
Ecomilk	16,33

Acidity norm is 15-20 Turner degrees

Reductase test



Milk quality by reductase test

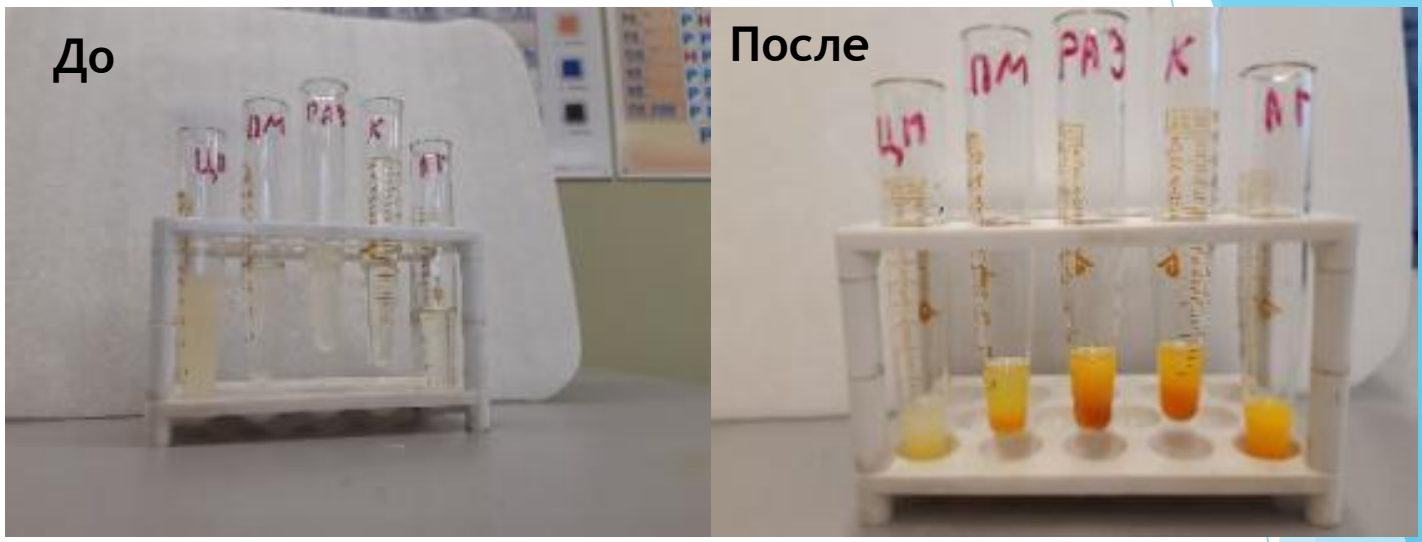
Duration of dye decoloration	The number of bacteria in 1 ml of milk	Milk quality assessment	Milk class
More than 5 hours 30 minutes	Less than 500 thousand	Good	I
2 h to 5 h 30 min	From 500 thousand to 4 million	Satisfactory	II
20 minutes to 2 hours	4 million to 20 million	Bad	III
Less than 20 min	More than 20 million	Very bad	IV

Results of reductase tests.

The name of the sample	Time for which milk became white (hours)	Quality and class of milk (according to the table)
Pravilnoye Moloko	10	Good
Brest-Litovsk	8	Good
Veseliy Molochnik	24	Good
Domik v Derevne	12	Good
Agusha	8	Good
Kirzhachskiy Molochniy Zavod	24	Good
Kubanskiy Molochnik	9	Good
Ot Andreicha	5	Satisfactory
Vkusnoteevo	5	Satisfactory
Tsarevo Pole	8	Good
Rostagroexport	8	Good
Ecomilk	8	Good
Sarafanovo	8	Good

Milk is considered to be of good quality if the sample and methylene blue turned white in more than 5.5 hours.

Determination of ammonium cations in milk



Analysis progress. 2 cm3 of serum are taken with a pipette into a test tube, 1 cm3 of Nessler's reagent is added and mixed. The colour of the solution is fixed for not more than 1 minute. **Lemon yellow coloration is permissible, the appearance of a more intense yellow or orange color indicates the content of ammonium cations in milk above the natural level.**

Results of determining the content of ammonium cations in products

The name of the sample	The presence of ammonium salts
Pravilnoye Moloko	-
Brest-Litovsk	+
Veseliy Molochnik	+
Domik v Derevne	+
Agusha	+
Kirzhachskiy Molochniy Zavod	Small amount
Kubanskiy Molochnik	+
Ot Andreicha	+
Vkusnoteevo	+
Tsarevo Pole	-
Rostagroexport	+
Sarafanovo	+
Ecomilk	-

Container, its processing; qualitative analysis for starch content

- **Type of plastic:** the samples "Pravilnoye moloko" and "Vkusnoteevo" had the second type of plastic, all the others had the first.
- **The reaction of potassium iodide and hydrogen peroxide:**
- H_2O_2+KI ▫ $KOH+I_2+H_2O+O_2$

- **Starch iodine reaction:**
- $(C_6H_{10}O_5)n+mI_2$ <-> $(C_6H_{10}O_5)n*mI_2$

The results.

- 1. The consumers who participated in the poll named “Agusha”as the milk of the highest quality.
- 2. An excess of ammonium ions was found in most samples. This helps to increase the shelf life of milk, but at the same time sharply reduces its quality.
- 3. The acidity of “Tsarevo Pole” milk turned out to be relatively high, while the acidity of “Rostagroexport” and “Veseliy Molochnik”, on the contrary, was low, therefore it can adversely affect the clotting time.
- 4. Starchy substances and hydrogen peroxide were not detected in any of the samples.
- 5. The calcium content corresponds to the norm in all samples, except for "Rostagroexport". The same brand of milk was distinguished by its extremely low density.
- 6. Milk “Tsarevo Pole” had a too strongly pronounced yellow colour, the products “Sarafanovo” and “Kubanskiy Molochnik” did not show a pronounced smell, and the samples “Ot Andreicha” and “Vkusnoteevo” had a foreign smell.
- 7. The following samples fully complied with the standards for dry matter content: "Pravilnoye Moloko", "Brest-Litovsk", "Agusha", "Vkusnoteevo", "Ecomilk", "Sarafanovo".
- 8. Deviations from the norm in the amount of the reductase enzyme were found in the “Ot Andreicha” and “Vkusnoteevo” products.
- 9. The samples "Pravilnoye moloko" and "Vkusnoteevo" had the second type of plastic, all the others had the first. The first type of plastic is cheaper to manufacture, however, unlike the second type, it can only be used once. The second type of plastic is safer, although it can release formaldehyde with repeated use.

The conclusion.

- 1. An algorithm was developed to control the quality of dairy products subjected to the pasteurization process in laboratory conditions. It was also established which products of well-known manufacturers best meet the existing state standards and, as a result, are most suitable for food.
- 2. Milk of the following companies met the state standards for all checked parameters: "Pravilnoye Moloko" and "Ecomilk".
- 3. Indicators of characteristics of pasteurized milk do not differ from indicators of characteristics of sterilized milk.
- 4. The samples of farm milk "Ot Andreicha" and "Tsarevo Pole" deviated from the established state standards: the product "Ot Andreicha" - in terms of organoleptic properties and reductase content, and "Tsarevo pole" - in acidity. This means that farm milk has a greater risk of being of poor quality than factory milk.

Thanks for your attention!