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ANALYSIS OF CHEMICAL COMPOSITION AND TECHNOLOGICAL SUITABILITY OF RAW MILK IN POLAND

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ABSTRACT

The following parameters of bulk raw milk, destined for processing were determined: percentage content of fat, protein, milk solids, quantity of fat and protein units and quality class of each batch of raw milk according to PN. The analysis included the results of monthly tests of raw milk for 2002. The mean values of chemical components of bulk milk and of the calculated indices of technological suitability of raw milk: for butter and cheese production, were estimated. The obtained results allowed determination of an average chemical composition of raw milk, specific of the central Poland and its technological suitability, depending on feeding season, size of deliveries and quality class of the purchased raw milk. The co-relationships between the examined properties were determined.

Key words: chemical composition of the bulk raw milk, technological suitability of raw milk, classification of raw milk.

INTRODUCTION

Accession of Poland to the European Union imposes on our country the necessity of increasing the effectiveness of dairy production and an urgent need to improve the quality of raw milk. The progressive restructuring of fairy sector consists, among other things, in processes of concentration of milk production, improvement of its technological and qualitative properties. Evaluation of milk quality according to Polish Standard PN-A-86002 “Raw milk. Requirements and tests”, being commonly obligatory since January 1, 2000 has definitely improved milk quality and forced milk producers to cool the raw milk and to observe strictly the hygienic standards [2, 3, 4, 6, 7, 8, 10, 11]. At the end of 2002, the possibilities of collecting the milk satisfying till-now the requirements of class II were eliminated. It is planned to liquidate the possibility of purchasing the raw milk classified so-far class I at the end of 2005. At the moment of the entry of Poland to the European Union, Polish act,

corresponding to the EU Directive 92/46 regulating the basic problems concerning the dairy industry shall be universally obligatory.

Actually, there is a necessity to improve further the raw milk quality, restructuring the dairy industry (including the possibility to improve milk quality in the farms, producing the raw milk of the present class II) and full unification of the raw milk standards.

MATERIALS AND METHODS

The studies covered the bulk milk, purchased by the dairy plant of the Mazovian voivodeship (central Poland) which - in respect of processing capacities and technological possibilities – is one of the most modern establishments in Poland, applying for the licence to export its products to the European Union member states. In 2002, the monitoring of chemical composition of the raw milk was carried out at the territory of the raw milk resources of the dairy plant, bearing in mind the necessity of introducing the prohibition to buy raw milk, belonging to the so-far quality class II since January 2003. The analytical tests of the bulk raw milk were conducted in Milk Testing Laboratory, using electronic milk analyser MilkoScan of Foss Electric, at the instructions of the Dairy Plant. Milk samples were at random collected from regular suppliers, from the bulk raw milk in the farm, once a month. The obtained technological documentation contained the following data:

1. quantities of the supplied milk;
2. percentage content of fat in the raw milk;
3. percentage protein content in the raw milk;
4. percentage dry matter (DM) content in the raw milk;
5. classification of the raw milk (Extra class, I and II)
6. calculated quantity of fat units of the delivered milk (u F);
7. calculated quantity of protein units of the delivered milk (u P).

At the same time, information on the number of dairy cows kept in the given farm, were obtained. The received data covered the whole year 2002. From these data, cheesemaking suitability of the raw milk was calculated according to the equations of Pijanowski, Obrusiewicz and Branch Standards and using a criterion of skimmed milk for manufacture of acid-rennet curd cheese (tvorog; quark) with 20% dry matter content. The suitability of the milk for butter manufacture was evaluated when calculating the butter yield from 100 weight units of milk [10, 11,12].

In Polish dairying system, the suppliers of the raw milk are paid for volume of the delivered raw milk as well as for the quantity of fat and protein units and for quality class. To determine the suitability of the raw milk for butter production, the index of butter manufacture possibility was used. To determine the suitability of the raw milk for cheese manufacture, the index of acid curd cheese (unripened white cheese) with 20% dry matter, produced from skimmed milk (containing casein and non-casein proteins) was applied.

The results of laboratory tests were statistically assessed, using multi-factor analysis of variance (Statistical Product and Service Solutions base version 8.0 for Windows. User's guide, 1998, by SPSS Inc., USA). According to constant linear model:

$$Y_{ijkl} = \mu + A_i + B_j + C_k + (AB)_{ij} + (AC)_{ik} + (BC)_{jk} + e_{ijkl}$$

where:
Y_{ijkl} - the level of the studied property,
μ - the total mean,
A_i - the effect of i-period of the test (2 seasons: summer V – X and winter XI – IV),
B_j – effect of j-class of the milk (3 classes: extra, I and II),
C_k – effect of k-size of milk deliveries (3 levels: up to 1000 litres of milk; 1001-2000 litres and above 2000 litres of milk),
$(AB)_{ij}$ – effect of interaction between the season of raw milk delivery and milk classes,
$(AC)_{ik}$ – effect of interaction between the season and the size of raw milk deliveries,
$(BC)_{jk}$ – effect of interaction between the class of milk and size of milk deliveries,
e_{ijkl} – random error.

When estimating the relationship between the parameters of chemical composition of milk, seasons of the year, classification of the raw milk, size of the deliveries and the properties of technological suitability of the milk, the coefficients of Pearson correlation were employed.

RESULTS AND DISCUSSION

Table 1 represents the quantity of the collected raw milk, its dry matter and parameters of chemical composition (% of fat and protein) during different seasons of the year, with different sizes of milk deliveries and in different quality class.

Table 1. The means of the smallest squares and standard errors for milk quantities, produced per month in the farm, dry solids of milk and its chemical composition in the particular seasons of the year, sizes of milk deliveries and quality classes of raw milk

Factor	N	Milk (l)		Dry solids (%)		Fat (%)		Protein (%)	
Season		LSM	SE	LSM	SE	LSM	SE	LSM	SE
Summer	6533	1527.97^{A}	5.03	12.41^{A}	0.008	3.67^{A}	0.006	3.27^{A}	0.002
Winter	6384	1368.76^{A}	6.66	12.65^{A}	0.010	3.87^{A}	0.008	3.30^{A}	0.003
Level of significance		p≤0.01		p≤0.01		p≤0.01		p≤0.01	
Size of milk deliveries									
Up to 1000 l	5032	693.81^{A}	5.80	12.54^{A}	0.009	3.80^{A}	0.007	3.28^{A}	0.002
1001 – 2000 l	6023	1419.15^{A}	5.84	12.51^{AB}	0.009	3.76^{A}	0.007	3.28^{B}	0.002
Above 2001 l	1862	2624.05^{A}	11.25	12.54^{B}	0.017	3.75^{A}	0.014	3.31^{AB}	0.013
Level of significance		p≤0.01		p≤0.01		p≤0.01		p≤0.01	
Class of milk									
Extra	6816	1622.51^{A}	3.82	12.78^{A}	0.006	4.06^{A}	0.005	3.26^{A}	0.002
Class I	5267	1558.69^{A}	7.59	12.42^{A}	0.012	3.67^{A}	0.009	3.28^{A}	0.003
Class II	834	1021.65^{A}	10.80	12.32^{A}	0.016	3.50^{A}	0.013	3.34^{A}	0.005
Σ	12917								
Level of significance		p≤0.01		p≤0.01		p≤0.01		p≤0.01	
The total mean		1448.36	4.17	12.53	0.006	3.77	0.005	3.29	0.002

The levels of factor marked with the same letter differ highly significantly (big letters).
LSM - least square mean.
SE - standard error.

During the summer period, the mean delivery per month was equal to 1527 litres whereas in winter period, it was 1368 litres (difference of 11%). The raw milk, purchased in summer, had lower dry matter content (12.41%) as compared to winter period (12.65%), lower fat (3.67 and 3.87%, respectively) and protein (3.27 and 3.30%, respectively) content. The differences are statistically highly significant for all the mentioned properties. The mean quantity of the raw milk, as calculated in the size of the deliveries, revealed a close relation to the size intervals. Thus, for the size of milk deliveries up to 1000 litres, the mean delivery was 693 litres, for the interval 1001 – 2000 l, it was equal to 1419 litres and for the deliveries of the raw milk above 2000 litres, it amounted to 2624 l. The statistical comparison of the groups in respect of this factor showed highly significant differences.

When comparing the quantities of the milk in deliveries in respect of quality classes, the highest deliveries of the raw milk included extra class (1622 l) and class I (1558 l). In class II, the mean delivery amounted to 1021 litres. A distinct relationship ($p \leq 0.01$) between the class of the delivered milk and the mean size of the delivery was observed.

The highest content of dry matter was found in extra class of the raw milk and in winter period. A similar relationship was noticed when determining the level of fat in the milk. The highest protein content was found in the winter season, in big deliveries of the raw milk and in quality class II. Gradually with the deterioration of quality class, the lowering of the percentage of fat and the increase of the percentage of protein was observed. The calculated differences are highly statistically significant.

Table 2 shows the results of statistical analysis of fat and protein units of the purchased raw milk what is, apart from milk quality and its quality classification, the basis for financial settlement of accounts of the dairy plants with the milk suppliers. During the summer period, more fat (by 5%) and protein (by 10%) units were collected than in winter season. The differences between the seasons are highly significant. When comparing the particular seasons of the year, we may state that the increase of milk production during the summer period (by 11%) compensates its lower (at that time) participation of milk components: fat and protein. These observations are consistent with the data from literature [1, 3, 6, 14].

Table 2. The means of the smallest squares and standard errors for fat and protein units of milk, produced per month in the farm, in the particular seasons of the year, sizes of milk deliveries and quality classes of raw milk

Factor	N	Fat units of milk		Protein units of milk	
Season		LSM	SE	LSM	SE
Summer	6533	5572.45^{A}	20.98	5004.66^{A}	16.63
Winter	6384	5325.72^{A}	27.77	4533.34^{A}	22.02
Level of significance		$p \leq 0.01$		$p \leq 0.01$	
Size of milk deliveries					
Up to 1000 l	5032	2628.20^{A}	24.18	2272.23^{A}	19.17
1001 - 2000 l	6023	5336.70^{A}	24.33	4662.31^{A}	19.30
Above 2001 l	1862	9849.00^{A}	46.87	8674.19^{A}	37.17
Level of significance		$p \leq 0.01$		$p \leq 0.01$	
Class of milk					
Extra	6816	6541.84^{A}	15.93	5300.70^{A}	12.63
Class I	5267	5607.74^{A}	31.61	5143.99^{A}	25.07
Class II	834	3571.97^{A}	45.00	3408.97^{A}	35.69
$\sum$	12917				
Level of significance		$p \leq 0.01$		$p \leq 0.01$	
The total mean		5449.08	17.401	4769.00	13.80

Levels of factors marked with the same letters differ highly significantly (big letters).
LSM - least square mean.
SE - standard error.

In the obtained results, we notice the relationship between the size of milk deliveries and the quantity of the purchased fat and protein units. Together with the increase of the size of deliveries, the quantity of the collected units is increasing. The most of deliveries come from the producers who deliver 1000-2000 litres of milk per month and the smallest quantities – from those ones, supplying above 2001 litres of milk; however, in this case, the mean purchased quantity of fat (9849) and protein (8674) units was the highesst one. The quantity of fat units

is closely related to classification of the raw milk. Thus, in extra class, the mean purchased quantity of fat units was the highest (6541) whereas in quality class II, it was the lowest (3571), i.e. lower by 45%. When analysing the relationship between the quantity of protein units and milk class, we may notice a similar trend of changes. Deterioration of the quality class of milk results in the decrease of the quantity of usable components of milk. The directions of these changes were supported by the statistical analysis of relationships between the property of fat and protein units of milk and a factor – quality classes of the milk.

Table 3 shows the analysis of qualitative classification of the purchased raw milk. During the whole 2002, milk purchased in extra class covered 52.5% of deliveries, in class I – 41% and in class II – it constituted 6.5% of all deliveries.

Table 3. Classification of raw milk, produced in the farms, during the particular seasons and during the whole year

Seasons	Class Extra (%)	Class I (%)	Class II (%)
Summer	50.1	42.0	7.8
Winter	55.0	39.9	5.1
Total 2002	52.5	41.0	6.5

Classification of raw milk, produced in the farms, in size of raw milk deliveries

Size of raw milk deliveries	Class Extra (%)	Class I (%)	Class II (%)
Up to 1000 litres	40.0	52.2	7.8
1001 – 2000 litres	52.2	40.3	7.5
Above 2001litres	86.9	13.1	
Total 2002	52.5	41.0	6.5

During summer season, the purchase of the milk in extra class was lower by 5%; it was higher by more than 2% in class I and higher by 2.7% in class II as compared to winter period. The raw milk quality is closely related to the quantity of the milk in delivery. Thus, the greatest deliveries of the raw milk (above 2001 litres a month) satisfied the requirements of extra class in 87% and did not include milk of class II at all. The suppliers, delivering the milk in the quantities up to 1000 litres per month, produced the raw milk of extra class in 40%, of class I in 52% and of class II – in 7.8%. It is an evidence of a close relationship between the class of raw milk delivery and its size.

Table 4 shows the quantitative characteristics of the raw milk, purchased by the dairy plant and its potential production capacities, based on the purchased raw milk.

Table 4. Summary of the quantities of the raw milk produced in farms and theoretical rocessing possibilities of dairy plant

Summer season

Raw materials and production	N	The sum of the quantity purchased by dairy plant and possibilities of processing	The mean from the quantity produced in farm and possibilities of processing
MILK (litres)	6786	10.237.860	1508.67
Fat units	6533	37.129.920	5683.44
Protein units	6549	32.178.976	4913.57
Butter (kg)	6533	445.201.13	68.1465
Acid curd cheese (quark) (kg)	6533	1.685.474.23	257.99

Winter season

Raw materials and production	N	The sum of the quantity purchased by dairy plant and possibilities of processing	The mean from the quantity produced in farm and the possibilities of processing
MILK (litres)	6410	7.310.223	1140.44
Fat units	6384	29.395.456	4604.55
Protein units	6400	23.957.591	3743.37
Butter (kg)	6384	352.463.03	55.2104
Acid curd cheese (quark) (kg)	6384	1.235.112.00	193.47

Annual summary

Raw materials and production	N	The sum of the quantity purchased by dairy plant and possibilities of processing	The mean from the quantity produced in farm and the possibilities of processing
MILK (litres)	13196	17.548.083	1329.80
Fat units	12917	66.525.376	5150.22
Protein units	12949	56.136.567	4335.20
Butter (kg)	12917	797.664.16	61.7531
Acid curd cheese (quark) (kg)	12917	2.920.586.23	226.10

In summer period, 10.24 million litres of milk were purchased while in winter season, the purchase amounted to 7.3 million litres of milk so, it is by 30% less than in the summer period. In the summer season, more fat (by 20%) and protein (by 25%) units were collected. During winter period, the number of milk suppliers was by almost 6% lower as compared to summer season. As far as the purchase of fat and protein units of milk is concerned, values obtained in the both seasons are found in the different range of size what did not allow the dairy plant to determined uniformly production during both seasons of the year. The seasonality of milk purchase was equal to 1.4 (ration of milk collection in summer and winter period) and the seasonality of the purchase of fat units was 1.25 and that of protein units amounted to 1.34.

The indices of technological suitability of the raw milk (for butter and cheese manufacture), developed by Pijanowski [11, 12] and Obrusiewicz [10] and employed in the studies allowed to illustrate completely then manufacturing capacities of the dairy plant, based on the purchased raw milk. Butter contains usually 83.5% fat so from 100 weight units with X% of fat in the cream, we may obtain X%/0.835 = Y kg of butter. Such quantities of butter we might obtain under the conditions of ideal processing of milk fat or cream during the manufacturing process – without fat losses, caused by its passage to skimmed milk and buttermilk. In practice, this yield is somewhat lower. Branch standards provide use of 83.4 fat units for manufacture of 1 kg of butter and this value was adopted as the basis for calculation of index of butter suitability of raw milk.

When calculating the cheese making value, the indices, resulting from the possibility of obtaining casein and non-casein proteins from milk, were used. The acid-rennet methods are employed in manufacture of the majority of the types of fresh white unripened cheeses (tvorog, quark). During the run of such process, acid and rennet coagulation takes place at the same time. The separation of casein together with whey proteins has place and it is determined by the previous high thermal treatment (thermal-calcium method) of milk in order to denaturate whey proteins. It is well known fact [18] that thermally denaturated whey proteins are precipitated together with casein during acid or rennet coagulation of milk, or during the high milk heating up, with a small addition of calcium chloride. To bring about the interaction of casein with whey proteins, the milk with $CaCl_2$ addition is pasteurised at temperature of 92°C with few second holding and then after cooling down, the starter consisting of dairy cultures of streptococci and the rennet, are added. We obtain coagulum (cheese mass), enriched with a part or almost all whey proteins. The output is increased by 15% and the utilisation of milk proteins rises by more than 50%. Universally known separator allows obtaining the skimmed tvorog with dry matter content of 24% from cheese curd. In our studies, the expected yield of this half-product was calculated with the assumption that dry matter of whey would be 6% and the necessary dry matter of acid curd cheese (tvorog) shall be 20% [10, 11, 12, 18].

If, theoretically, the dairy plant directs all purchased fat units for butter manufacture, according to the formulae [10, 11, 12] it could produce 797.66 tons of butter during a year and from all purchased protein units, it could produce 2920.5 tons of skimmed tvorog with 20% dry matter content. The diversity of production of the dairy plant excludes, of course, manufacture of butter and tvorogs exclusively as the internal market forces also production of liquid milk with different fat content, cream, yoghurts, kefir, many varieties of cheeses etc. According to technological standards, there is a necessity of adding a certain quantity of fat or protein units almost to every dairy product. Indices of technological suitability of the raw milk allow, therefore, illustration of final production of the dairy plant in more distinct way and apart from fat and protein units, they may serve the evaluation of suitability of the raw milk. If we want to answer the question how many protein units are necessary for manufacture of 1 kg of unripened white fresh cheese with 20% dry matter content, we have calculated that it amounts to 19.17 protein units and 5.83 litres of skimmed milk.

The results, obtained in the present work and concerning the data of 2002, are consistent with the literature [2, 4, 6, 8, 12, 14]. In our studies, we obtained the percentage of the milk classified in high quality classes, which is completely consistent with the reports of other authors. When taking the whole year into consideration, 52.5% of milk deliveries were classified as extra grade, 41% as class I and only small quantities of milk (6.5%) were classified as milk of class II. The studies of other authors [7, 8, 12] report on the values of the milk, purchased in extra class, amounting to 50-60%, with 10% participation of the milk of class II. Our studies derive from the central part of Poland and it is difficult to refer them to the region of the whole country. Milk production and purchase are not uniformly distributed all over the country. Many factors such as climate- soil conditions, size of the farms and their specialisation, industrialisation of the region, level of the possessed agricultural knowledge and furnishing of the farms with appropriate equipment affect significantly the quality of the raw milk.

Higher content of usable milk components (fat and protein) during the winter period as compared to summer season, are the evidence of stimulating production of milk with the high-energetic feeds or those ones, balancing the feeding ration. Interaction between the class of the purchased raw milk and season of its production is highly significant for the quantity of the milk (kg) and its fat and protein content. The above mentioned results are consistent with the data cited in literature [1, 2, 3, 5, 12, 15]. Feeding of animals is one of the factors, which causes relatively quick changes in composition and yield of milk. It was demonstrated that the changes in fat, protein and lactose content in the milk are in 45% determined by the quantity of the energy and protein taken up and the composition and structure of physical feeding ration. It seems that feeding is one of the significant ways of adjusting the milk composition to varying needs of the dairy industry.

The raw milk, purchased from greater suppliers was characterised by better quality and related technological suitability – the raw milk purchased in the highest quality class had the highest dry matter and fat content. We should also pay attention to the fat that the raw milk, being delivered by a small number of suppliers (834 deliveries during the years) and classified as quality class I, possessed the highest level of crude protein in the milk (3.34%). It may be supposed that it is connected with the sub-clinical mastitis (former quality class II admitted 500000-1000000 somatic cells in 1 ml of milk). The level of non-casein proteins is also increased [1, 3, 6, 8, 13].

Table 5 shows the correlation coefficients between the studied properties. As is can be seen, milk quality (KLASA=CLASS) is closely correlated to the percentage content of fat (r=0.449), dry matter of milk (r=0.352), size of deliveries of raw milk (r=0.265) and final production of the dairy plant, i.e. butter (r=0.374) and tvorog (r=0.292).

Table 5. Pearson's correlations for raw milk parameters, sizes of milk deliveries and technological indices of raw milk

Examined properties	Pearson's correlation	CLASS	PROTEIN (%)	FAT (%)	DS. (%)	Size of milk deliveries	BUTTER (kg)
CLASS							
PROTEIN (%)	Correlation	-0.074					
	Significance	p≤0.01					
	N	12949					
FAT (%)	Correlation	0.449	0.286				
	Significance	p≤0.01	p≤0.01				
	N	12917	12917				
DS (%)	Correlation	0.352	0.594	0.939			
	Significance	p≤0.01	p≤0.01	p≤0.01			
	N	12917	12917	12917			
Size of milk deliveries	Correlation	0.265	0.050	-0.035	-0.013		
	Significance	p≤0.01	p≤0.01	p≤0.01	0.143		
	N	13196	12949	12917	12917		
BUTTER (kg)	Correlation	0.374	0.088	0.154	0.160	0.876	
	Significance	p≤0.01	p≤0.01	p≤0.01	p≤0.01	p≤0.01	
	N	12917	12917	12917	12917	12917	
ACID CURD CHEESE (QUARK) (kg)	Correlation	0.292	0.028	-0.058	-0.039	0.895	0.971
	Significance	p≤ 0.01	p≤ 0.01	p≤ 0.01	p≤ 0.01	p≤ 0.01	p≤ 0.01
	N	12917	12917	12917	12917	12917	12917

Pearson's correlation: ** correlation is significant on the level of 0.01 (bilaterally).
DS - Dry solids.

As the results of the studies have univocally revealed that the producers of big milk deliveries to the dairy industry supply the raw milk with better hygienic and technological quality, the additional calculations were carried out. The results are given in Table 6.

Table 6. The size of production and deliveries of raw milk to dairy plant, depending on number of cows in the farm

Up to 1000 l of milk	N	Sum of the milk quantities delivered to the dairy plant	The mean from the farm	Standard deviation
MILK litres	5134	3.487.404	679.28	178.39
COWS (heads)	5134	13631	2.66	6.3

1001 – 2000 litres of milk	N	Sum of the milk quantities delivered to the dairy plant	The mean from the farm	Standard deviation
MILK, litres	6162	9.042.027	1467.39	305.14
COWS (heads)	6162	26859	4.36	1.18

Above 2000 litres of milk	N	Sum of the milk quantities delivered to the dairy plant	The mean from the farm	Standard deviation
MILK, litres	1900	5. 018.652	2641.40	523.54
COWS (heads)	1900	13904	7.32	2.19

The mentioned table shows the size of milk purchases by the dairy plant in different size groups of deliveries and the mean sizes of raw milk deliveries. These data have been combined with the number of the possessed dairy cows in the farm. As it results from the whole-year studies, the greatest number of milk suppliers (6162) comes from the farms, producing 1001-2000 litres of milk per month. They are the farms, which keep 4-6 dairy cows. These farms supply 9.04 million litres of milk per year and this milk is of a good hygienic and technological quality. There is a very numerous group of milk suppliers (5134) who have farms with 2-3 cows (the mean is 2.66) and deliver 3.48 million litres of milk during the year. But the least numerous group of milk suppliers (1900) possessing more than 7 dairy cows in their farms (the mean is 7.32) deliver as much as 5.02 million litres of milk to the dairy industry. The above mentioned results indicate univocally the necessity to concentrate production and its specialisation.

When analysing Polish dairying in the light of Poland's accession to the European Union, we have to bear in mind the necessity of liquidating the quality class I of raw milk at the quick time and of adapting our standards to the requirements of the UE Directive 92/46. Thus, more than 50% of raw milk deliveries in Poland needs to be quickly improved. In the EU member states, the dairy industry buys the raw milk classified in only one quality class – extra grade. On July 5, 2002, the Regulation of the Minister of Agriculture and Rural Development "in the matter of detailed veterinary conditions, required in obtaining, processing, storage and transport of milk and milk products" entered into force. It is a Polish equivalent of EU Directive 92/46, regulating the basic problems concerning health quality of dairy products. The transition rules provide for liquidation of raw milk collection in class II. The purchase of the milk in class I is admitted until the end of 2005. The regulation imposes the duty of introducing the requirements for raw milk: no more than 100000 microorganisms in 1 ml and maximum 400000 somatic cells in 1 ml. These parameters are established from the so-called geometric mean of the results of the tests: for total bacterial count from 2 months of tests, at least 2 samples during one month, and for somatic cell count – from the period of 3 months for at least one sample during one month. The purchased raw milk must be cooled down to temperature of 8°C or lower in case of everyday collection or to temperature of 6°C or lower if the milk is not collected every day.

In 2002, the dairy industry in Poland collected still the raw milk, belonging to quality class II. In the perspective of 2003, however, the dairies will be allowed to buy only the milk of extra class and class I for processing, with the complete satisfaction of the hygienic – veterinary requirements at the site of raw milk production and during its transport and processing into final products. Already now, we have to improve quickly the quality of 6.5% of total milk deliveries in Poland. Since 2006, Poland shall adopt uniform provisions of the EU Directive 92/46. Concentration and specialisation of milk production is a feature characteristic of the dairying of the EU member states where family farms are dominating. The concentration of commercial production goes on together with the concentration of land and increase of the average number of cows in the herd. The basis for commercial production is constituted by the farms, which manage above 30 cows and more. On the other hand, the feature of Polish dairying is too high scattering (disintegration) and it should be supposed that during the first stage of the integration of Poland with the European Union, we may consider only the farms, possessing 7-10 cows and more as the appropriate basis for production. It is the initial scale of production, giving a guarantee of the suitable technological level and maintaining the profitability of production [4, 6, 7, 8, 9, 13, 14, 15, 16, 17].

CONCLUSIONS

1. Concentration of dairy cows in the farms, specialised in milk production for the needs of the dairy industry leads to the increase of production of the raw milk with a good hygienic quality and technological value.
2. The raw milk, being qualified as extra class is characterised by the best chemical composition and technological properties: suitability for production of butter and cheese.
3. Indices of suitability of the raw milk for butter and cheese manufacture may, apart from fat and protein units, characterise the raw milk in respect of its technological suitability for processing.
4. Chemical composition of the raw milk is subjected to seasonal variations. The balanced feeding affects favourably the quantity of usable components of the milk.
5. There is an urgent need to utilise the raw milk, which does not meet the requirements of the former quality class II (6.5% of total deliveries of raw milk).
6. Over the next 3 years, 48% of all milk deliveries shall require a strict monitoring as to meet the quality requirements of standards connected with the accession of Poland to the European Union.
7. The accession of Poland to the European Union shall require the harmonisation in the field of concentration and specialisation of the dairy production, the increase of milk yield and urgent improvement of hygienic quality of the raw milk in relation to the EU requirements.

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