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THE RELATIONSHIPS BETWEEN COLLECTION SYSTEM, DELIVERY SIZE AND SEASON AND SOMATIC CELLS LEVEL COUNT IN RAW MILK CLASSIFIED TO THE HIGHEST QUALITY CLASSES

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ABSTRACT

The investigation of relationships between collection system, season and monthly delivery size and somatic cell count in 1 ml of milk classified to the highest quality classes (Extra and the First) in one of leading dairy co-operatives from the region of Central Poland was the aim of the study. Somatic cell count (SCC) of individual milk supplies constituted the research material. Results confirmed that milk collected directly from the farm by autocysternes had much lower SCC level. The increase of the average monthly milk supply had positive relationship with its hygienic quality. The worst milk quality was noticed in the summer season, i.e. in June, July and August, regardless of delivery system. The results show further possibilities of improvement of hygienic conditions of milk production and collection in Poland.

Key words: raw milk, somatic cell count, collection system, delivery size, season

INTRODUCTION

Deep changes in milk production sector in Poland were observed since nineties of the last century [18, 22, 23]. Hygienic quality of raw milk delivered for processing is getting better year by year. According to the official data of June 2002, 68% of raw milk was classified as Extra class, 20% as the First class and 12% as the Second class [5]. There were almost 1 million milk suppliers in 1990, and at present their number decreased to 380 590, including 166 783 delivering milk in the best class only [5]. The number of milk collection centers decreased

from 9 to 5 thousand units. Direct milk collection covered 53.8% of total milk deliveries in June 1999 [4]. Nowadays, the most of leading dairy co-operatives is equipped with specialized trucks enabling direct milk collection and transport as well as taking anonymous milk samples. The mobile and stable milk collection centres were partly or even permanently excluded from the milk collection chain and milkman profession no longer exists [1]. The SCC in raw milk delivered by farmers is one of the main criteria of its quality evaluation in all EU and North American countries [17]. The worldwide researches conducted by leading scientific institutes show that mastitis and SCC are the most common and vital problems. Gawel [3] stated, that in 1996-1998 from the total number of 22 130 scientific publications covering milk production and the dairy sector problems, listed by Dairy Sciences Abstracts, 1 390 related to mastitis, including as many as 510 items on SCC problems. It was the most frequent subject taken up by researchers dealing with dairy sector problems.

The mass occurred mastitis are the source of considerable losses directly borne by farmers (lower milk production and its price, growing costs of veterinary service, premature cows' culling ect.). All those financial losses drastically decrease farmers' income. Mastitis cases also negatively influence technological suitability of milk and create some public menace because of possible epidemic.

At present the problem of udder health became much more important in Poland because of the new, strict regulations concerning raw milk quality and the new payment system rules.

Total bacteria count (TBC) and SCC are the indicators of hygienic quality of raw milk according to the current Polish standard "Raw milk. Collection" PN-A-86002" [12]. From the 1st January 2003 the Second class of milk no longer exists, and milk qualified to the First class can be supplied only up to the end of 2006.

Problems of the influence of collection system, delivery size and season on milk hygienic quality were carried out by many authors quoted in the further part of the study.

The aim of presented study was to affirm whether the investigated factors also significantly influenced SCC in milk classified to the highest quality classes (Extra and the First) in one of leading dairy co-operatives from the region of Central Poland.

MATERIALS AND METHODS

The results of SCC evaluation in each batch of delivered milk to the one of leading dairy co-operatives from the region of Central Poland in a calendar year constituted the material for the research. Totally 53 586 records were analysed. Each single record consisted of: type of milk collection system, monthly delivery size, delivery season and SCC in 1 ml of milk. The following groups were taken into consideration:

- delivery system: 1. milk collected from farmers in cans and delivered by milkmen to milk collection centres (19 666 milk samples), 2. direct from the farm collection by autocysternes (1 902 samples),
- monthly delivery size: 1. up to 1 000 litres, 2. 1 001-2 000 litres, 3. above 2 000 litres,
- delivery season: 1. winter (December, January, February), 2. spring (March, April, May), 3. summer (June, July, August), 4. autumn (September, October, November).

The data were statistically analysed using multifactorial analysis of variances by SPSS 8.0 PL [20] as well as χ^2 test.

RESULTS AND DISCUSSION

The number and percentage of milk supplies classified to the highest quality classes (Extra class, First class) on base of SCC level are shown in [Table 1](#), and the least square means (LSM) and standard errors (SE) of SCC level in milk depending on delivery system, monthly milk supply and season in [Table 2](#). Over 78 per cent of milk deliveries from the farms served by autocysternes were qualified to the highest quality class, whereas only 38.4 per cent milk deliveries collected by milk collection centres fulfilled the requirements of that class. The results show unquestionable superiority of the direct milk collection system to the traditional one by the milk collection centres and its significant relationship with hygienic quality of raw milk. The direct from farm milk collection system enables cooling chain continuity as well as the shortest distance from cow's udder to processing in the dairy plant. This way the risk of milk contamination is lowered. Obtained results are no surprise, but the noticed statistical significance of differences is worth attention. The study performed by the others showed the similar results. Much better quality of milk collected by direct delivery was proved by Litwińczuk et al. [9], who investigated this subject in dairy co-operatives of Central and Eastern Poland. Papers presented by Pieróg et al. [11] as well as Przysucha et al. [14] also confirmed the superiority of direct collection system vs. traditional due to milk hygienic quality. Monthly delivery size had also high-significant the delivery of milk classified to the highest quality classes. Along to the amount of delivered milk increase, the percent of milk qualified to the Extra class increased too.

Table 1. The number and percentage of milk supplies classified to the highest quality classes (Extra class, First class) on base of SCC level

Specification	Extra class		First class		Total	
	N	%	N	%	N	%
Delivery system:						
1. milk collection center	19666	38.4	31494	61.6	51160	100.0
2. direct collection	1902	78.4	524	21.6	2426	100.0
$\chi^2 = 1537.9$ $p \leq 0.01$						
Monthly milk supply:						
1. up to 1000 litres	12897	34.6	24364	65.4	37261	100.0
2. 1001-2000 litres	5523	47.6	6089	52.4	11612	100.0
3. above 2000 litres	3148	66.8	1565	33.2	4713	100.0
$\chi^2 = 2131.4$ $p \leq 0.01$						
Delivery season:						
1. winter	4449	42.9	5924	57.1	10373	100.0
2. spring	5935	43.1	7840	56.9	13775	100.0
3. summer	4460	31.7	9617	68.3	14077	100.0
4. autumn	6724	43.8	8637	56.2	15361	100.0
$\chi^2 = 585.0$ $p \leq 0.01$						
Total	21568	40.2	32018	59.8	53586	100.0

Table 2. Least square means (LSM) and standard errors (SE) of SCC level in milk (000/ml) depending on delivery system, monthly milk supply and season

Specification	N	LSM	SE
Delivery system:			
1. milk collection center	51160	403.13 ^A	0.39
2. direct collection	2426	387.52 ^A	3.27
Monthly milk supply:			
1. up to 1000 litres	37261	413.05 ^A	4.71
2. 1001-2000 litres	11612	392.04 ^A	1.35
3. above 2000 litres	4713	380.88 ^A	0.76
Delivery season:			
1. winter	10373	394.06 ^A	1.90
2. spring	13775	395.05 ^{BC}	1.86
3. summer	14077	402.36 ^{AB}	1.93
4. autumn	15361	389.82 ^{AC}	1.88
Total	53586	395.32	1.66

A – averages marked by the same capital letter differ significantly ($p \leq 0.01$)

There is out of discussion, that production of the highest quality milk requires special technical facilities on the farm. The specialized farm should be equipped with efficient milking and cooling equipment, manure removing devices installed in the modern barnhouse. Proved quality water access, ventilation and proper natural and artificial illumination are also crucial [13]. The necessary pieces of equipment are very expensive and only the big, specialized dairy farms, of high milk production and income level, can afford. Better care of production hygiene, proper milking technique, feeding and tending of animals observed in that farms has a reflection in better hygienic quality of milk. The results are in conformity with the observations of other authors. Borkowska [2] announced, that milk delivery size had influenced hygienic quality of milk produced in specialized farms. Raw milk classified to the Extra class and the First class was purchased from the biggest suppliers. Also Liwińczuk et al. [6, 9] affirmed the influence of delivery size on hygienic quality of milk supplied to the collection centres. Raw milk of the poorest quality came from the smallest suppliers. The research of Przysucha et al. [14] also confirm the tendency, that hygienic quality of milk improves along with the increase of its monthly delivery size. Another point of view was presented by Skrzypek [19], who had observed significant increase of SCC level along with herd size increase, which seems to be the equivalent to monthly delivery size of milk to the dairy plant. The author, quoting other researchers, states, that publications on the connection of herd size and SCC show diverse results, i.e. positive as well as negative dependances. Skrzypek marked, that the negative dependance were reported by the authors, who conducted their studies in small herds.

The highly significant influence of milk delivery season on the share of deliveries classified to the highest quality classed was observed. The best milk was collected in winter months, whereas the worst in the summertime. Increased level of somatic cells in milk during the summer season was also reported by Pieróg et al. [11], Sawa et al. [16] and Stenzel et al. [21]. Przysucha et al. [14] revealed the poorest hygienic quality of milk produced in the summer season, i.e. in June, July and August, both in milk collection centres system and direct collection. Other authors' results are not so clear-cut. Litwińczuk et al. [9] stated the significant influence of production season on hygienic quality of milk delivered to the collection centres. The most amount of milk classified to the Extra class was purchased in winter. The authors proved, that milk collected directly from the producers was of better quality, slightly influenced by the season. Earlier studies by the above mentioned research team [7, 8] showed the poorest quality of raw milk in summer. Borkowska [2], on the basis of her study conducted in specialized dairy farms, did not observe any influence of season of the year (air temperature) on hygienic quality of milk. However the authoress marked, that obtained results could be determined by more rigorous hygienic regime after the new standard for raw milk introduction. Pieróg et al. [11] reported, that the production season had the influence on hygienic quality of milk purchased by the collection centres only.

It is commonly known, that high milk quality is more difficult to obtain during the summer season [10, 15]. Higher air temperatures favours the increase of bacteria number, especially on the surfaces of not good enough cleaned up milking equipment, which become the potential source of infection. Small farms, dominating among milk producers, with multipurpose production, often have not enough time for the care of proper hygienic procedures like cows tending, equipment cleaning, because there are always other more important jobs to be done at the moment. There are such days, especially in the summertime, when farmer is able to do the basic jobs only: animals feeding, milking, manure removal as work on the field is of higher priority. There are also such days, usually at winter, when there is enough time for the proper care of animals, equipment and milking procedures. The different situation is found in specialized dairy farms, where cows husbandry is the main enterprise, and lack of time problem does not exist, because all the activities at the farm are subordinated to milk production.

Table 3. Interactions influencing average SCC level in milk (000/ml)

Specification		N	LSM	SE
Delivery season:	Monthly milk supply:			
	1. up to 1000 litres	8228	411.87	4.74
1. winter	2. 1001-2000 litres	1620	391.41	1.99
	3. above 2000 litres	525	378.91	2.07
	1. up to 1000 litres	9598	410.80	4.83
2. spring	2. 1001-2000 litres	2899	392.74	1.86
	3. above 2000 litres	1278	381.61	1.34
	1. up to 1000 litres	8745	418.98	4.92
3. summer	2. 1001-2000 litres	3759	398.27	1.89
	3. above 2000 litres	1573	389.83	1.22
	1. up to 1000 litres	10690	410.54	4.92
4. autumn	2. 1001-2000 litres	3334	385.73	1.77
	3. above 2000 litres	1337	373.17	1.30
		Significance $p \leq 0.01$		
Delivery system:	Monthly milk supply:			
	1. up to 1000 litres	37235	415.51	0.25
1. milk collection center	2. 1001-2000 litres	11287	401.96	0.47
	3. above 2000 litres	2638	391.91	1.02
	1. up to 1000 litres	26	410.59	9.41
2. direct collection	2. 1001-2000 litres	325	382.11	2.65
	3. above 2000 litres	2075	369.85	1.10
		Not significant		
Delivery system:	Delivery season:			
1. milk collection center	1. winter	10000	398.41	1.02
	2. spring	13139	401.52	.67
	3. summer	13388	414.36	.60
	4. autumn	14633	398.20	.66
2. direct collection	1. winter	373	389.72	3.77
	2. spring	636	388.57	3.75
	3. summer	689	390.35	3.89
	4. autumn	728	381.43	3.81
		Significance $p \leq 0.01$		

In the [Table 3](#) the interactions influencing average SCC level in milk are illustrated. Both, in the farms with direct collection and farms delivering milk to milk collection centres, the poorest quality raw milk was produced in the summer months.

However, it should be marked, that the first ones produced milk of better quality in summer than the second ones in winter. It proves there are lower seasonal fluctuations in milk quality at the specialized dairy farms.

CONCLUSIONS

1. Despite systematic improvement of hygienic quality of raw milk in Poland, factors like collection system, delivery size and season significantly influence it.
2. Much better hygienic quality, determined by SCC in 1 ml, characterized the milk from farms with direct collection system.
3. Along to the increase of monthly delivery size, the level of somatic cells in bulk milk decreases.
4. The poorest hygienic quality, determined by SCC in 1 ml, characterized the milk produced in summer season, i.e. in June, July and August regardless of from farm milk collection system.
5. Unambiguous proof of the relationships between investigated factors (collection system, delivery size and season) and SCC in raw milk purchased by dairy plants shows, that even at the farms selling milk qualified to the highest quality classes, there are still possibilities of further improvement of milk hygienic quality.

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