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Investigation of udder health and milk quality parameters of dairy farms in Northern Cyprus. Part II: Milk quality*

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Summary: The purpose of this study was to determine milk quality status of dairy farms in Northern Cyprus. For this purpose, total bacteria and coliform counts in milk samples taken from all 138 dairy farms were counted, and samples were evaluated in terms of dry matter, fat, total protein, casein, lactose, free fatty acids, fat-free dry matter, acidity-SH, density, freezing point, citric acid and antibiotic residues, once a month during a year. It was determined that annual median values of 71% of the dairy farms, and the total bacteria count (TBC) median value of 47% of the samples was 100.000 cfu/ml; and that the annual median value was 227.738 cfu/ml. Coliform count was >100 cfu/ml in 71.5% of the samples. Antibiotic residues were detected in 2.6% of the samples. Milk composition analysis showed that dry matter, fat, total protein, casein, lactose, free fatty acids, fat-free dry matter, acidity-SH, density, freezing point, citric acid rates were 12.03%; 3.30%; 3.49%; 2.62%; 4.56%; 1.13%; 8.75%; 6.56 SH; 1.031,50 g; -0.542˚H and 0.131%, respectively. In conclusion, results of the study showed that 1) annual average of TBC was high, 2) Coliform count was high in every season (especially summer), 3) Milk composition had seasonal changes.

Keywords: Dairy farm, milk quality, Northern Cyprus.

Kuzey Kıbrıs'taki sütçü işletmelerde meme sağlığı ve süt kalitesi parametrelerinin araştırılması. Bölüm II: Süt kalitesi

Özet: Bu çalışmanın amacı Kuzey Kıbrıs'taki sütçü inek işletmelerinde süt kalitesini araştırmaktı. Bu amaçla 138 işletmeye ait sürü tank sütünden bir yıl boyunca, ayda bir kez, toplam bakteri sayımı, koliform sayımı yapıldı ve örnekler kuru madde, yağ, toplam protein, kazein, laktoz, serbest yağ asitleri, yağsız kuru madde, asitlik-SH, yoğunluk, donma noktası, sitrik asit ve antibiyotik kalıntısı yönünden değerlendirildi. Yıl boyunca işletmelerin %71'inin, örneklerin ise %47'sinin toplam bakteri sayısı (TBS) medyan değerinin >100.000 cfu/ml olduğu, yıllık ortalama TBS medyan değerinin 227.738 cfu/ml olduğu saptandı. Koliform sayısı örneklerin %28.5'inde ≤100 cfu/ml; %71.5'inde ise >100 cfu/ml idi. Örneklerin %2.6'sında antibiyotik kalıntısı saptandı. Sütün bileşimi incelendiğinde kuru madde, yağ, toplam protein, kazein, laktoz, serbest yağ asitleri, yağsız kuru madde, asitlik- SH, yoğunluk, donma noktası ve sitrik asit oranı sırasıyla %12.03; %3.30; %3.49; %2.62; %4.56; %1.13; %8.75; 6.56 SH; 1 031,50 gr; -0.542˚H ve % 0.131 olarak tespit edildi. Sonuç olarak, çalışma sonuçları 1) Yıllık toplam bakteri sayısının yüksek olduğunu, 2) Koliform sayısının her mevsimde (özellikle yaz) yüksek olduğunu, 3) Süt bileşenlerinin mevsimsel olarak değiştiğini göstermiştir.

Anahtar sözcükler: Kuzey Kıbrıs, süt kalitesi, sütçü işletme.

Introduction

In order to benefit from nutritive properties of milk, firstly it must be of good quality. For this reason, raw milk must be produced at the highest quality (22). With the global rapid increase in milk and dairy product consumption, consumer concerns over food quality have also been increased. These developments have influenced the definition of high quality milk, and consumer expectations have begun to influence animal management practices (19).

Udder health and milk quality of farms may be evaluated with the incidence levels of mastitis, somatic cell counts in bulk-tank milk, TBC, coliform count, bulk-tank milk cultures, antibiotic residues, number of initial incubation, laboratory pasteurization numbers, and analysis of the substances that are present in milk (9, 12, 16, 20). However, none of the parameters that are used to determine milk quality give sufficient information on milk quality and contamination sources alone. For this reason, some of these tests must be applied concurrently (3).

* This manuscript is derived from the PhD thesis of the first author.

No studies have been done specifically evaluating status and variations of milk quality for Northern Cyprus. The purpose of this study was to examine variations of total bacteria counts, coliform counts, milk components (lactose, total protein, casein, fat, fat-free dry matter, dry matter, freezing point, acidity-SH, density, free fatty acids, citric acid), and antibiotic residues in samples during the year, in order to evaluate quality of the milk produced in dairy farms in Northern Cyprus.

Materials and Methods

***Study design**:* This study was conducted between October 2009 and September 2010 in Northern Cyprus. Bulk tank milk samples taken from 138 dairy farms (all farms in Northern Cyprus in that period, containing 15.552 Holstein cows in total) in Northern Cyprus was used as material. Samples were taken from the farms on a monthly basis for one year and 1643 bulk tank milk samples were examined (at the beginning of the study, number of farms were 134 and reached 138 at the end of the study). Therefore, 1643 bulk tank milk samples were collected. TBC, coliform count, antibiotic residue and milk components were analyzed in all samples.

***Sampling**:* Milk samples were collected in the morning using a sterile dip cup from the bulk tank which was mixed well after milking. Samples were taken into 3 sterile tubes. Disposable gloves were used during the samplings. One of each 3 sterile 20 ml milk bottles taken from the farms were frozen at -20 ºC and brought to the laboratory, and the others were sent to the laboratory at +4ºC.

***Measuring total bacteria counts**:* TBC measurements were performed with BactoScanTM FC (Foss ®, Denmark) device in Cyprus Turkish Milk Industry, Quality Control Department Laboratory.

***Determining coliform counts**:* Coliform count measurements were performed by culturing raw milk on Violet Red Bile Agar (VRB) in Cyprus Turkish Milk Industry, Quality Control Department Laboratory, Microbiology Section. Petris were incubated at 32 ºC temperature for 24 hours and results were evaluated.

***Determining antibiotic residues in milk**:* Antibiotic residue measurements were performed with CHARM ROSA MRL Beta-Lactam Test and TwinsensorBT (Beta 59 Lactam and Tetracycline Group) test in Cyprus Turkish Milk Industry, Quality Control Department Laboratory.

***Collecting meteorological data**:* In order for the obtained data to be evaluated according to climatic conditions, meteorological data (temperature, relative humidity, and rainfall data) were obtained from the Ministry of Public Works and Transportation, Meteorology Department, North Cyprus.

***Biochemical analyses**:* Measurements of lactose, total protein, casein, fat, fat-free dry matter, dry matter, freezing point, acidity-SH, density, free fatty acids, citric acid in milk samples were determined using a MilkoScan TM FT-120 device, and freezing point was determined with Fiske Mark 2 Cryoscope device in Turkish Cypriot Milk Industry, Quality Control Department Laboratory.

***Statistical analysis**:* Total bacteria counts and descriptive statistics for milk yields, coliform counts, milk chemical analysis results and antibiotic residue findings were calculated on monthly, seasonal and annual basis. In order to determine whether there was significant difference between TBC and milk yields, one-way ANOVA and Tukey's HSD tests from Post-Hoc tests were used. Chi-Square Test was performed in order to statistically compare the results of coliform bacteria obtained in sample basis in terms of seasons. To compare chemical analysis results of milk with reference values, One-Sample t-test method was used. Results obtained were tested at 95% significance level. Statistical analyses were performed using the SPSS® for Windows 14.01 (SPSS Inc., Chicago, Illinois, USA) (License No: 9869264) and STATISTICA®7 Package Program.

Results

Average number of the cows for each farm was 175, and the total number of cattle on the farms was 24.150 during the study period.

Meteorological data: Meteorological data (temperature, relative humidity, and rainfall data) received from the Ministry of Public Works and Transportation, Meteorology Department, Northern Cyprus are given in Table 1.

Evaluation of the findings on TBC: TBC median value was the highest during December (134.000 cfu/ml), March (122.000 cfu/ml) and February (112.000 cfu/ml); and TBC was similar across all seasons ($P>0.05$). TBC median average value was >100.000 cfu/ml for all seasons; but higher in winter following heavy rainfall (Table 2).

It was determined that 71% of the farms, and 47% of the samples had TBC median value >100.000 cfu/ml. At the end of the study, it was also determined that annual average TBC median value was 227.738 cfu/ml.

Evaluation of coliform count findings: It was determined that coliform count was high in every month throughout the year, and coliform count was high especially in months when the temperatures were higher (Figure 1).

Coliform count was very high during summer months, when temperatures were high (92.5% >100 cfu/ml). It is worth noting the fact that more than half of the samples exceeded 100 cfu/ml. Coliform counts were similar in autumn and spring, with the lowest and highest values seen in winter and summer respectively ($P<0.01$; Table 3).

Table 1. Monthly meteorological data received from Northern Cyprus, Ministry of Public Works and Transportation, Meteorology Department.
Tablo 1. Kuzey Kıbrıs Bayındırlık ve Ulaştırma Bakanlığı Meteoroloji Dairesi'nden alınan aylık meteorolojik veriler.

	Average of the Lowest Air Temperature	Average Air Temperature	Average of the Highest Air Temperature	Average Relative Humidity (%)	Rainfall Averages (mm)
October	17.8	22.8	28.4	62.0	35.5
November	12.3	16.7	21.5	66.2	41.9
December	10.6	14.3	18.5	75.3	154.5
January	9.3	13.0	16.8	73.5	112.0
February	9.0	12.8	16.7	73.2	158.0
March	10.0	14.8	19.6	68.9	7.6
April	12.3	17.7	23.0	62.3	12.7
May	16.1	21.2	26.6	63.3	13.9
June	19.6	24.7	29.8	63.1	7.6
July	22.2	27.2	32.2	66.2	2.3
August	24.6	29.6	35.2	62.5	0.4
September	21.5	26.5	31.8	61.1	2.1

Table 2. TBC according to the seasons.
Tablo 2. Mevsimlere göre toplam bakteri sayısı.

	Median	Min	Max
Autumn	114.333	20.666	3.262.333
Winter	178.166	32.666	3.598.333
Spring	182.000	8.666	8.979.333
Summer	131.166	8.000	6.531.000

Table 3. Coliform counts according to seasons.
Tablo 3. Mevsimlere göre koliform sayıları.

	≤100 cfu/ml	>100 cfu/ml
Autumn[b]	26.8	73.2
Winter[c]	48.7	51.3
Spring[b]	31.5	68.5
Summer[a]	7.5	92.5
P	<0.01	

[abc] The different letter in the same column symbolizes the difference.
[abc] Aynı sütundaki farklı harf anlamlılığı simgeler.

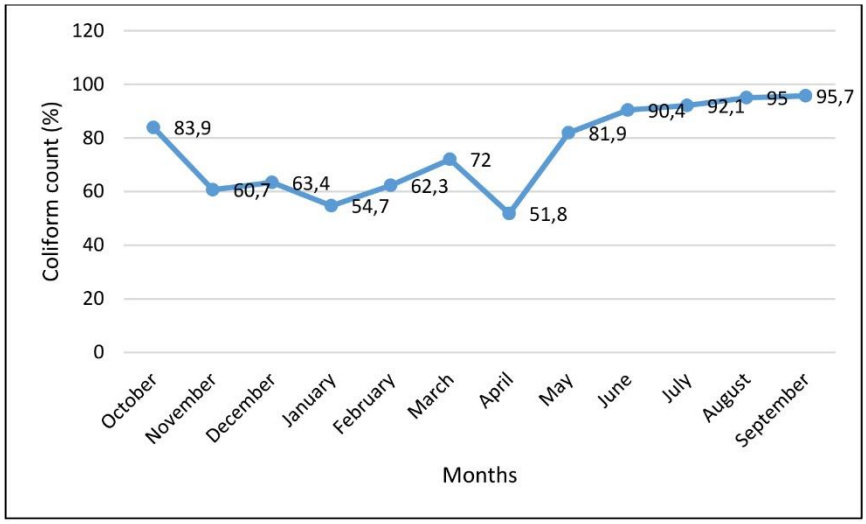

Figure 1. Coliform count according to months.
Şekil 1. Aylara göre koliform sayıları.

Table 4. Chemical analysis findings according to months ($\bar{x}$±SEM).
Tablo 4. Aylara göre kimyasal analiz bulguları ($\bar{x}$±SEM).

	Lactose (%)	Total protein (%)	Casein (%)	Fat (%)	Fat-free dry matter (%)	Dry matter (%)	Freezing point (˚H)	Acidity (SH)	Density (g)	Free fatty acids (%)	Citric Acid (%)
October	4.52±0.01	3.54±0.01	2.61±0.01	3.23±0.03	8.68±0.02	11.88±0.04	-0.533±0.001	6.57±0.04	1031.26±0.08	1.00±0.04	0.127±0.001
November	4.56±0.01	3.60±0.01	2.67±0.01	3.27±0.04	8.78±0.02	12.03±0.05	-0.541±0.002	6.88±0.16	1031.69±0.11	1.15±0.05	0.124±0.001
December	4.57±0.01	3.67±0.02	2.73±0.01	3.41±0.04	8.87±0.02	12.23±0.05	-0.543±0.001	6.73±0.05	1031.63±0.08	1.15±0.04	0.126±0.001
January	4.58±0.01	3.61±0.01	2.69±0.01	3.38±0.04	8.85±0.02	12.17±0.05	-0.544±0.001	6.69±0.04	1031.53±0.08	1.12±0.05	0.131±0.001
February	4.59±0.01	3.43±0.01	2.70±0.01	3.39±0.04	8.91±0.02	12.35±0.05	-0.528±0.001	6.63±0.04	1031.91±0.08	0.86±0.03	0.132±0.001
March	4.59±0.01	3.52±0.02	2.65±0.01	3.42±0.04	8.85±0.02	12.21±0.05	-0.559±0.002	6.42±0.05	1031.89±0.09	0.81±0.05	0.133±0.001
April	4.54±0.01	3.50±0.01	2.61±0.01	3.27±0.03	8.80±0.02	12.01±0.04	-0.553±0.001	6.46±0.04	1031.77±0.09	0.91±0.05	0.135±0.001
May	4.58±0.01	3.43±0.01	2.58±0.01	2.99±0.04	8.72±0.02	11.69±0.04	-0.548±0.001	6.58±0.04	1031.78±0.09	1.19±0.06	0.131±0.001
June	4.57±0.01	3.40±0.01	2.56±0.01	3.14±0.04	8.69±0.02	11.81±0.04	-0.545±0.001	6.47±0.03	1031.55±0.09	1.10±0.06	0.136±0.001
July	4.56±0.02	3.38±0.02	2.52±0.01	3.25±0.03	8.64±0.02	11.90±0.04	-0.537±0.001	6.55±0.11	1031.33±0.09	1.33±0.07	0.132±0.001
August	4.55±0.01	3.24±0.01	2.42±0.01	3.41±0.04	8.47±0.02	11.93±0.04	-0.54±0.001	5.98±0.05	1030.52±0.09	1.50±0.06	0.134±0.001
September	4.53±0.01	3.55±0.01	2.65±0.01	3.44±0.03	8.77±0.02	12.21±0.04	-0.542±0.001	6.70±0.04	1031.25±0.08	1.39±0.06	0.128±0.001

Table 5. Chemical analysis findings according to seasons ($\bar{x}$±SEM).
Tablo 5. Mevsimlere göre kimyasal analiz bulguları ($\bar{x}$±SEM).

	Lactose (%)	Total protein (%)	Casein (%)	Fat (%)	Fat-free dry matter (%)	Dry matter (%)	Freezing point (˚H)	Acidity (SH)	Density (g)	Free fatty acids (%)	Citric Acid (%)
Autumn	4.54±0.01^{b}	3.56±0.01^{a}	2.65±0.01^{b}	3.31±0.02^{a}	8.74±0.01^{c}	12.04±0.02^{b}	-0.538±0.001^{a}	6.71±0.06^{a}	1031.40±0.05^{b}	1.18±0.03^{b}	0.126±0.001
Winter	4.58±0.01^{a}	3.57±0.01^{a}	2.71±0.01^{a}	3.39±0.02^{a}	8.88±0.01^{a}	12.25±0.03^{a}	-0.538±0.001^{a}	6.68±0.03^{a}	1031.69±0.05^{a}	1.04±0.02^{c}	0.130±0.001
Spring	4.57±0.01^{a}	3.48±0.01^{b}	2.61±0.01^{c}	3.22±0.02^{b}	8.79±0.01^{b}	11.97±0.03^{b}	-0.553±0.001^{b}	6.49±0.02^{b}	1031.81±0.05^{a}	0.98±0.03^{c}	0.133±0.001
Summer	4.56±0.01^{b}	3.34±0.01^{b}	2.50±0.01^{d}	3.27±0.02^{b}	8.60±0.01^{d}	11.88±0.02^{bc}	-0.540±0.001^{a}	6.33±0.04^{c}	1031.13±0.06^{c}	1.32±0.04^{a}	0.134±0.001
P	*	*	*	*	*	*	*	*	*	*	NS

*: P<0.05; NS: P>0.05
^{abcd} The different letter in the same column symbolizes the difference.
^{abcd} Aynı sütundaki farklı harf anlamlılığı simgeler.

Milk components: Results are given according to months in Table 4, and seasons in Table 5.

Annual mean values for all these components were as follows: Lactose 4.56%; total protein 3.49%; casein 2.62%; fat 3.30%; fat-free dry matter 8.75%; dry matter 12.03%; freezing point -0.542˚H; acidity 6.56 SH; density 1.031,50 g; free fatty acids 1.13%; citric acid 0.131% (Table 6).

Antibiotic residues: There were no statistical differences in terms of antibiotic residues between seasons (P>0.05; Table 7). Antibiotic residues were found in 2.6% of the dairy farms throughout the year.

Table 6. Annual average levels of chemical analysis
Tablo 6. Kimyasal analiz bulgularının yıllık ortalaması.

Milk components	
Lactose (%)	4.56±0.004
Total protein (%)	3.49±0.005
Casein (%)	2.62±0.004
Fat (%)	3.3±0.01
Fat-free dry matter (%)	8.75±0.01
Dry matter (%)	12.03±0.01
Freezing point (˚H)	-0.542±0.001
Acidity (SH)	6.56±0.02
Density (g)	1031,50±0.03
Free fatty acids (%)	1.13±0.02
Citric acid (%)	0.131±0.001

Table 7. Rates of antibiotic residues according to seasons.
Tablo 7. Mevsimlere göre antibiyotik kalıntı oranları.

	Antibiotic Residue		
	Positive (%)	Negative (%)	*P*
Autumn	2	98	>0.05
Winter	2.7	97.3	
Spring	2.9	97.1	
Summer	2.9	97.1	

Discussion and Conclusion

TBC is a method used in monitoring udder health and milk quality. European Union Regulation number 92/46 requires that bacteria counts in milk must be <100.000 cfu/ml (4). In this study, annual average (median) of TBC in Northern Cyprus was 227.738 cfu/ml and TBC median value was higher particularly during the months of December (134.000 cfu/ml), February (112.000 cfu/ml) and March (122.000 cfu/ml). When examined in terms of seasons, median value was >100.000 cfu/ml across all seasons. However, there were no significant differences in TBC's according to seasons (P>0.05). These consistantly high levels in TBC led us to assume that milk production hygiene was not seen as a priority by milk producers.

Costello et al. (6) reported that TBC was increased in winter, and Rhone et al. (18) reported that TBC was increased in the tank-milk in the seasons when rainfall was higher in Thailand which has a tropical climate. In accordance with these findings, this study found the highest TBC during winter and spring (P>0.05). Stulova et al. (21) reported that TBC was the highest in 131 farms in Estonia in June, and the lowest in November; and that TBC was >100.000 cfu/ml in 0.02% (3/131) of the farms. Similarly, in this study, TBC was at the lowest level in November, however highest levels were seen during winter. In addition, average TBC was >100.000 cfu/ml in 71% of the farms. The fact that TBC is higher in winter months may be the result of cows being kept in wet conditions due to excessive rainfall; and as a result, udder becoming dirty and having poor hygiene care before milking.

Bouman et al. (5) reported that TBC was 558.000 cfu/ml in Uruguay in 1996, and 56.000 cfu/ml in 2004. They reported that the decreases in bulk tank milk somatic cell count (BTMSCC) and TBC thanks to the measures taken by the state in 1995, and to the quality classification of milk production, and added that the studies were still continuing. Similarly, Stulova et al. (21) conducted a study and reported that TBC was 500.000 cfu/ml in 1990; however, it was decreased to 5.000-10.000 cfu/ml during 2004-2007 period thanks to an intense works program and investments. The results of this study show that similar intensive program of work must be conducted and measures must be taken in Northern Cyprus to produce safe and quality milk and dairy products, because BTMSCC and TBC are currently above the required legal limits.

Another method for examining milk quality iscoliform counts in milk. Existence of coliform bacteria in bulk tank milk is an indicatior that feces have contaminated the milk. Another potential source of coliform infections is the water used for cleaning milking equipment. Drinking water on the farm may be contaminated by storage tanker, rodents, bird droppings, insects, dust and dirty buckets and hoses (11). Coliform count must be <100 cfu/ml in milk of good quality provided that it is pasteurized before consumption (19). High levels in coliform numbers seen throughout the year in Northern Cyprus, is a cause for concern. At the end of the study, it was determined that annual averages from coliform counts in 71.5% of the samples exceeded 100 cfu/ml. The lowest coliform count occurred during December, with levels ≤100 cfu/ml in 63.4% of the samples. It was considered that coliform count being high in bulk tank milk was associated with poor milking

hygiene practices, and/or milking devices being washed with contaminated water.

Seasonal coliform counts were 26.8%; 48.7%; 31.5% and 7.5% ≤100 cfu/ml in samples in autumn, winter, summer and spring, respectively. It was especially high exceeding the recommended levels in summer (92.5% >100 cfu/ml). It is important to note that, the results were higher than the limit values in more than half of the samples, in all seasons. Coliform count was similar (P>0.05) in autumn and spring, while higher in winter when compared to summer, spring and autumn; similarly, coliform count was higher in summer when compared to autumn and spring (P<0.01).

Jayarao and Wolfgang (12) conducted a study and reported that coliform mastitis was observed more during hot, humid weather conditions, and depending on this, led to increases in coliform count. As it was observed from the data received from Northern Cyprus Meteorology Department, depending on the increasing heat and humidity, coliform count was >100 cfu/ml in 92.5% of the samples, and this result confirmed the findings of Jayarao and Wolfgang (12).

Pantoja et al. (16) reported that the seasons influenced TBC and coliform count at different levels between the farms. Similarly, in this study, increases were determined in many farms in summer season especially for coliform counts, while in some of the farms coliform count was below the required level. These differences may stem from differences in management, nutrition, and milking hygiene protocols of the farms.

Jayarao et al. (11) reported that coliform count was <60 cfu/ml in 50% of the farms in 126 farms in the USA. In a similar study, Elmoslemany et al. (7) reported that coliform count was <50 in 89% of the 235 farms in Prince Edward Island in Canada, and that coliform count was higher in summer season when compared to other seasons. Lower results were obtained in the study that was conducted in Canada than the study conducted in the USA and Northern Cyprus. It was emphasized by Elmoslemany et al. (7) that this difference between the countries might stem from geographical regions, seasonal conditions and different management regimes on farms. Elmoslemany et al. (8) reported that high temperature values especially in summer might lead to growth of thermoduric bacteria and coliforms in milking equipment, and negatively affect the quality of the milk. In addition, authors have also reported that high coliform counts originated from mistakes during milking and storing practices, and these mistakes could be alleviated by ensuring good hygiene of equipment, using water at very high temperatures for cleaning milking.

Average values that should to be present in a good quality milk obtained from healthy udder which are not infected with mastitis are as follows; lactose 4.9%; total protein 3.61%; casein 2.8%; fat 4%; fat-free dry matter 8.9%; dry matter 13%; freezing point -0.530˚H; acidity 6.6 SH; density at 20˚C 1.027-1.033 g; free fatty acids 0.7%; citric acid 0.14% (10, 13, 14, 19). At the end of the study that was conducted to reveal various elements in milk obtained in Northern Cyprus average values were determined as follows; lactose 4.56%; total protein 3.49%; casein 2.62%; fat 3.3%; fat-free dry matter 8.75%; dry matter 12.03%; freezing point -0.542˚H; acidity 6.56 SH; density at 20˚C 1031.50 g; free fatty acids 1.13%; citric acid 0.131%. Harmon (10), Korhonen and Kaartinen (14), Ruegg (19) and Pyörälä (17) conducted studies and reported that as BTMSCC increased, rates of lactose, total protein, casein, fat, dry matter and fat-free dry matter, which existed in the milk were decreased. Similarly, Allore et al. (1) reported that, as BTMSCC rate increased, rate of fat might decrease by 10%, and rate of lactose and casein might decrease by 15%. In this study, significant decreases (P<0.01) were detected in important components of milk and this decrease was associated with average BTMSCC levels being high (it was shown that in the other part of the study). This result showed that subclinical mastitis level was one of the main factors that determined the quality of the milk.

Morsi et al. (15) reported that, as herd mastitis rates was increased, fat content of milk was decreased. In this study, similar results were obtained, and this situation supports the findings of Morsi et al. (15).

Rate of milk fat in Holstein cattle is around 3.56%. Mastitis influences the composition of milk, and feeding the cattle is also influential on the rate of fat in milk. Feeding in cows is closely related to milk yield and structure. For example, in cows that are fed with rations that possess less fibrous substances or that has rations rich in starch, fat content of milk decreases. These rations change the structure of volatile fatty acids in rumen; and fat metabolism in udder tip is also influenced by this situation. Ration changes generally do not influence milk-protein ratio, however, milk fat and protein ratios may decrease during summer period. Reason of this is the decrease in dry matter intake depending on the increase in atmospheric temperatures. Parallel to the increase in green vegetation in spring and autumn (fresh grass, wheat, barley and similar green plants contain carbohydrates that can be digested easily at a very high level), a decrease is observed in milk fat levels in cattle which graze on forage. Rate of milk fat and protein is lower than that in winter by 0.2-0.4%. In mastitis, fatty acids are disintegrated depending on increasing lipase enzyme activity within milk, therefore rate of milk fat decreases (as low as 10%), milk turns sour and odor changes, and therefore dairy products at the desired quality cannot be obtained (3).

Ballou et al. (2) conducted a study in 200 dairy farms in Wisconsin, the USA, for 1 year, and reported following values; fat 3.73%; protein 3.13%; lactose 4.65%; casein

2.42%; and associated the decrease in rates with high levels of BTMSCC. In this study, obtained values were as follows; fat 3.3%; total protein 3.49%; lactose 4.56% and casein 2.62%. It was considered that the changes in milk fat rates might be associated with the same reasons that were reported by Baştan (3) and Ballou et al. (2).

This study is the first nationwide report that provide important data about the state of the quality of bulk tank milk in dairy farms in Northern Cyprus. It has been concluded that there were important problems in terms of milk quality in the dairy farms in the Northern Cyprus, and that there were seasonal changes in fat, casein, total protein, lactose, fat-free dry matter, free fatty acids, and dry matter rates in milk. The study stands as a basic for future studies and can be valuable for veterinarians, advisor and farmers.

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References

1. **Allore H, Oltenacu P, Erb H** (1997): *Effects of season, herd size, and geographic region on the composition and quality of milk in the Northeast*. J Dairy Sci, **80**, 3040-3049.
2. **Ballou LU, Pasquini M, Bremel RD, et al.** (1995): *Factors affecting herd milk composition and milk plasmin at four levels of somatic cell counts*. J Dairy Sci, **78**, 2186-2195.
3. **Baştan A** (2010): *İneklerde Meme Sağlığı ve Sorunları*. Kardelen Publ., Ankara, Turkey.
4. **Blowey RW, Edmondson P** (1995): *Mastitis Control in Dairy Herds*. Farming Press, UK.
5. **Bouman M, Bianco R, Gianneechini E, et al.** (2005): *Mastitis Control in Uruguay: Strengths and Weaknesses*. 703-708. In: H Hogeveen (Ed), Mastitis in Dairy Production: Current Knowledge and Future Solutions. 2nd ed, Wageningen Academic Publishers, The Netherlands.
6. **Costello M, Rhee M-S, Bates MP, et al.** (2003): *Eleven-year trends of microbiological quality in bulk tank milk*. Food Prot Trends, **23**, 393-400.
7. **Elmoslemany AM, Keefe GP, Dohoo IR, et al.** (2009): *Microbiological quality of bulk tank raw milk in Prince Edward Island dairy herds*. J Dairy Sci, **92**, 4239-4248.
8. **Elmoslemany AM, Keefe GP, Dohoo IR, et al.** (2010): *The association between bulk tank milk analysis for raw milk quality and on-farm management practices*. Prev Vet Med, **95**, 32-40.
9. **Hamann J** (2005): *Diagnosis of Mastitis and Indicators of Milk Quality*. In: H Hogeveen (Ed), Mastitis in Dairy Production: Current Knowledge and Future Solutions. 2nd ed, Wageningen Academic Publishers, The Netherlands.
10. **Harmon R** (1994): *Physiology of mastitis and factors affecting somatic cell counts*. J Dairy Sci, **77(7)**, 2103-2112.
11. **Jayarao B, Pillai S, Sawant A, et al.** (2004): *Guidelines for monitoring bulk tank milk somatic cell and bacterial counts*. J Dairy Sci, **87**, 3561-3573.
12. **Jayarao BM, Wolfgang DR** (2003): *Bulk-tank milk analysis: A useful tool for improving milk quality and herd udder health*. Vet Clin North Am Food Anim Pract, **19**, 75-92.
13. **Kaartinen L** (1995): *Physiology of the Bovine Udder*. In: Sandholm M, Honkonen-Buzalski T, Kaartinen L, Pyörälä S (Eds), The Bovine Udder and Mastitis. Gummerus Kirjapaino Oy Jyväskylä: University of Helsinki, Faculty of Veterinary Medicine.
14. **Korhonen H, Kaartinen L** (1995): *Changes in the Composition of Milk Induced by Mastitis*. In: Sandholm M, Honkonen-Buzalski T, Kaartinen L, Pyörälä S (Eds), The Bovine Udder and Mastitis. Gummerus Kirjapaino Oy Jyväskylä: University of Helsinki, Faculty of Veterinary Medicine.
15. **Morsi NM, Saleh Y, El Gazzar H, et al.** (2000): *Effect of mastitis on milk fat content*. Pak J Biol Sci, **3**, 196-200.
16. **Pantoja J, Reinemann D, Ruegg P** (2009): *Associations among milk quality indicators in raw bulk milk*. J Dairy Sci, **92**, 4978-4987.
17. **Pyörälä S** (2003): *Indicators of inflammation in the diagnosis of mastitis*. Vet Res, **34**, 565-578.
18. **Rhone J, Koonawootrittriron S, Elzo M** (2008): *Factors affecting milk yield, milk fat, bacterial score, and bulk tank somatic cell count of dairy farms in the central region of Thailand*. Trop Anim Health Prod, **40**, 147-153.
19. **Ruegg PL** (2001): *Milk secretion and quality standards*. University of Wisconsin, Madison, USA.
20. **Rysanek D, Babak V, Zouharova M** (2007): *Bulk tank milk somatic cell count and sources of raw milk contamination with mastitis pathogens*. Vet Med (Praha), **52**, 223-230.
21. **Stulova I, Adamberg S, Kriščiunaite T, et al.** (2010): *Microbiological quality of raw milk produced in Estonia*. Lett Appl Microbiol, **51**, 683-690.
22. **Suriyasathaporn W, Vinitketkumnuen U, Chewonarin T** (2010): *Relationships among malondialdehyde, milk compositions, and somatic cell count in milk from bulk tank*. Songklanakarin J Sci Technol, **32**, 23-26.

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