Quality of raw milk in Kerman province

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Abstract:

BACKGROUND: Microbiological and chemical qualities of milk are among the most important issues in public health. **OBJECTIVES:** Although there are a few published studies which have been conducted in south east of Iran this study was performed to investigate quality of raw milk delivered to a dairy industry company Kerman Province. **METHODS:** A total of 10^9 raw milk samples were collected at the time of delivering to the company. All the samples were transferred to the food lab of Veterinary School for total counting and psychotropic and *Staphylococcus aureus* counting. The chemical contents, residues of microbial inhibitors and Beta Lactam antibiotics residues were evaluated by Lactostar, Copan kit and Beta star test, respectively, and somatic cells were counted by a cell counter. **RESULTS:** Based on the comparison with national standard criteria, only 26 out of 109 samples (23.8; 95% CI: 16.2-33.0) were at standard limits in terms of all the factors. A large number of out-of-standard sample (50 out of 83), were in contrast with the defined criterion due to low protein. **CONCLUSIONS:** Classification of the samples based on all the defined criteria without considering protein content showed that the main problem of the milk was its low protein percent.

Introduction

Animal-originated food products play an important role in the sufficiency and balance of human nutrition. Milk and milk products are among the most important food products with an animal origin. Milk is often described as a complete food because it contains protein, sugar, fat, vitamins, and minerals (Ruegg, 2003). As a nutritional, balanced foodstuff, milk is well-known for being a medium which favors the growth of several microorganisms (Kivaria et al., 2006).

Traditionally, raw or unpasteurized milk has been a major vehicle for transmission of pathogens (Vasavada, 1988). It is well established that consumers demand clean, wholesome, and nutritious food which is produced and processed in a sound and sanitary manner and is of course free from any pathogens (El-Zubier et al., 2008).

Studying milk quality and its hygiene is of great importance. Milk quality depends upon its physical, chemical, and bacteriological characteristics (Ali, 2010). Evaluation of milk in terms of being free from any physical, biological, and chemical problems is considered in the quality control investigation (Cempírková and Mikulová, 2009). The microbial component of milk is a major feature in determining its quality. Mastitis is responsible for decreasing milk production and compromising the quality of milk, which represents a risk to the public health (Benites et al., 2003). Somatic cell count of bulk milk is a hygienic quality index of milk and mastitis status of the herds (Lombin and Esievo, 1979).

Based on the importance of hygienic quality of raw milk and the limited data about safety criteria of milk in the region, this study was carried out to compare milk quality in Kerman Province with national standard criteria.

Materials and Methods

Sample collection: This study was carried out from September to November 2011 during which 109 raw milk samples were obtained from Dairy Industry Company in Kerman Province. After mixing milk in raw milk tankers, the samples were taken to sterile dishes. Then, the samples were transferred to Food Lab of Kerman School, Shahid Bahonar University of Veterinary in cold conditions. First, the microbial and chemical tests were done, and in the next step the residues of microbial inhibitors and antibiotics were tested.

Microbial tests: The samples were counted for aerobic mesophilic bacteria, psychotropic, and *Staphylococcus aureus*. For counting aerobic mesophilic bacteria, the Nutrient Agar and pure plate methods were used (Merck Company, Germany). The plates were incubated at 32°C for 72 h. To count psychotropic bacteria, we used a plate count agar (Merck Company, Germany) at 30°C for 48 h. *Staphylococcus aureus* was cultured by surface plate method on Baird Parker (Merck, Germany) and was incubated at 37°C for 48 h. The coagulase test was used to confirm the suspected colonies.

Chemical tests: The milk components (fat, protein, solid not fat, lactose) and the freezing point were determined by lactostar (Funkegerber Co., Germany).

Testing residues of microbial inhibition and antibiotics of beta lactam group: To investigate the presence of microbial inhibition residues, we used the Copan kit (Christian Hansen Company, Denmark). Then, the positive samples were tested for the presence of antibiotics of Beta Lactam group, using the Beta star test (Neogen Co. USA)

Somatic cells test: To count somatic cells, Fossomatic cell counter 5000 (Foss Co., Denmark) was used.

Data analysis: All the data were classified and analyzed in Stata 10.1 by descriptive statistics at 95% confidence interval (CI).

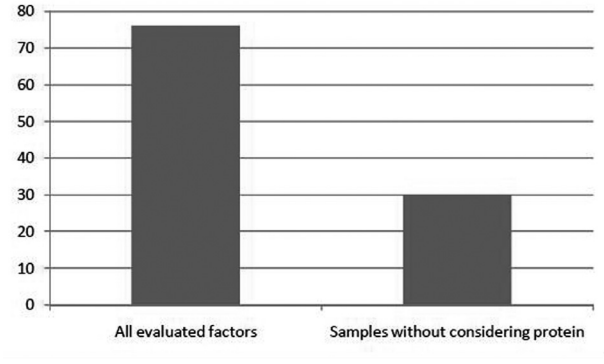

Figure 1. Non-standard samples based on all evaluated factors and without considering protein according to Standard and Industrial Research of Iran in south east of Iran.

Results

Result of microbial count: Comparing the total count of each of the samples with the Institute of Standard and Industrial Research of Iran (ISIRI) criteria, the samples were categorized into several groups: super group (13 cases), first degree group (15 cases), second degree group (38 cases), third degree group (19 cases), and out-of-standard group (24 cases). Most of the samples were placed in the second-degree group. Super group has the fewest samples. The frequency of the groups is shown in Table 1.

The microbiological test results are shown in Table 2. According to the results, 106 out of 109 (97.2%; 95% CI: 94.1-100) samples were in the standard limit of ISIRI, in terms of the number of somatic cells per ml. The mean somatic cell count was 1.56×10^5/ mL (95% confidence interval: 138354-176582).

Chemical test results: The mean protein percent of all the samples was lower than the standard mean (3-3.3%). Other measured factors (fat, lactose, solid no fat, and freezing point) were within the standard limit (Table 3).

The results showed that only 2 out of 109 samples had positive Copan test (residues of microbial inhibitors).

Based on the results, 26 out of 109 samples fell into the standard in terms of all the factors and 83 samples did not meet the national standards in terms of at least one of the one of the studied factors. Most

Table 1. Frequency of different milk grades based on total count according to Standard and Industrial Research of Iran grading in south east of Iran. (1) less than 30,000 colonies per mL. (2) equal to or more than 30,000 and less than 100,000 colonies per mL. (3) equal to or more than 100,000 and less than 500,000 colonies per mL. (4) equal to or more than 500,000 and less than 1,000,000 colonies per mL. (5) equal to and more than 1,000,000 per mL.

Milk grade	Percent	95% confidence interval
Super grade(1)	11.9	5.7-18.1
First degree(2)	13.8	7.2-20.3
Second degree(3)	34.9	25.8-44
Third degree(4)	17.4	10.2-24.7
Out of standard(5)	22.0	14.1-29.9

Table 2. Mean of total, psychrotroph and *Staphylococcus aureus* count of the 10^9 milk samples. Investigated in south east of Iran.

Microbial test	Mean of colonies per mL milk	95% confidence interval
Total count	1.64×10^6	4.84×10^5-2.81×10^6
Psychrotroph	1.56×10^6	4.05×10^5-2.72×10^6
Staphylococcus aureus	4.42×10^2	3.16×10^2-5.68×10^2

Table 3. Mean of chemical factors in109 of milk samples delivered to Dairy Industry Company in south east of Iran.

Chemical factor	Mean	95% confidence interval
Fat	3.57%	3.52-3.62
Protein	2.94%	2.92-2.95
Lactose	4.33%	4.30-4.36
Solid no fat	8.24%	8.20-8.28
Freezing point	-0.539	(-0.537)-(-0.542)

of the out-of-standard samples had lower protein compared with the defined standards. Thus, 50 out of 83 samples were out-of-standard only in terms of protein contents. The samples were classified based on all the defined criteria without considering protein criterion, which showed that the main problem of the milk delivered from dairy farms was the low content of protein (Figure 1).

Discussion

Regarding the results obtained from microbial tests in this study, the mean colonies of total count, psychotropic, and *Staphylococcus aureus* counts were 1.64×10^2-8.92×10^3 and4.42×10^2 per mL milk, respectively. In the study, 60 samples of raw milk collected from the north of Khartoum, Sudan, were investigated and total count and *Staphylococcus aureus* count were reported. The prevalence of contamination in total and *Staphylococcus aureus* counts was 9.88×10^6 and 1.20×10^6, respectively (Ali, 2010). The results of Ali's (2010) and Mohamed's, (2007) studies revealed that high microbial count in the milk of the same region compared with the present study, mainly in terms of *Staphylococcus aureus*. Cempirkova and Mikulova (2009) conducted a study in the south of Bohemia on 491 raw milk samples collected from 8 dairy farms. The authors stated that the mean microbial count in milk was $1.89\pm1.87\times10^4$, and the mean psychotropic count was $2.93\pm4.59\times10^3$ per mL in all the samples. Their results demonstrated a lower microbial count compared with the results of the present study. Lingathurai et al. (2010) investigated microbiology of raw milk from 60 dairy farms in Madurai, India, and reported that the mean total count of the samples was 12.5×10^6 and the mean psychotropic bacteria was 5×10^3 per mL. *Staphylococcus aureus* was isolated from more than 61.7% of the samples, the average of which was 6.2×10^3 per mL.

The mean somatic cell count in 106 samples out of 109 was 1.57×10^5/mL of milk, which met the national standard limit ($\leq5\times10^5$/mL) in this study.

In some countries, the current legal limit for bulk tank SCC is 750.000 SCC/mL. Also, based on cutoff levels, which vary from country to country, the results of somatic cell count or bacteria may be used to accept or reject milk samples for processing or consumption (Pistocchini et al., 2009).

In the present study, mean percentage of fat, protein, lactose, solid not fat content, and freezing point were 3.57%, 2.94 %, 4.33%, 8.24% and -0.539° Hort, respectively. All the data, except protein, were in the standard limit, which was in accordance with ISIRI. In a study performed in Sudan, mean percentage of fat, protein, lactose, ash, solid not fat content, and freezing point were 4.14%, 3.48%, 4.33%, 8.58%, and -0.520°C, respectively, in the mixture of raw milk samples (Elrahman et al., 2009), which showed high percent in terms of all the factors compared with the samples of the present study. A large number of out-of-standard samples contradicted the defined criterion due to a low protein percentage. A total of 50 out of 83 standard samples were not in the standard limit in terms of protein percentage. Classification of the samples based on the defined criteria, without considering protein percentage, showed that the main problem of the milk was its low

protein content. Protein is one of the most important components of milk that is valuable in human nutrition and also in dairy technology. Today, protein content of milk has a high economical value in most of the developed countries. The amount and also the type of milk proteins are of great importance, especially in cheese making industry. The amount and type of protein has a considerable effect on quality and quantity of the final product. The results of this study showed that the main problem of milk is its low content of protein. Some of the factors affecting the milk component are breeding and livestock characteristics, associated with producing milk, and environmental factors such as livestock feeding, milking, interval of milking, and some diseases such as mastitis. Livestock feeding can be changed to incline the milk compound toward the determined standards. Indeed, until dairy products industry rely only on fat percentage when purchasing milk, farmers are not forced to change food of livestock in order to increase the protein percentage of milk. The results of microbial and antibiotic inhibition residues showed that only 2 out of 109 samples were contaminated with microbial inhibition residues (positive Copan). One of samples was contaminated with antibiotic residues (positive beta star) and 1 case was suspicious. Habibi (2008) used the Copan kit for the raw milk delivered to Pasteurized Milk Factory in Sanandaj and reported that 38.21% of the samples were contaminated with microbial inhibitors. The study on the collected milk samples using Copan kit in Parsabad, Ardebil, Iran showed a 14% contamination in the milk samples (Movasaq, 2011).

In a study on 2785 raw milk samples from 2006 to 2009 in the north east of Romania, the 4.45% contamination with antibiotics and 4.67% suspicious cases were associated with Beta Lactam group (Gradinaru et al., 2011).

In Pakistan, 137 raw milk samples were tested in terms of Beta Lactam antibiotic residues; 36.5% of which were positive (Khaskheli et al., 2008).

Comparing the results with those of previous studies, we observed a low level of contamination in the milk delivered to Kerman factory. Indeed, industries and consumers expect the contaminations to be minimized. The presence of antibiotic residues in milk is one of the main problems regarding the production of fermented products and public health. Since industries pay more attention to this issue and control the milk in terms of contamination, mixing the milk of cows treated with antibiotic and the milk of other cows is avoided. The withdrawal time between antibiotic usage and milk harvesting must be considerd to reduce residual contamination, especially after using intra mammary antibiotics.

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کیفیت شیر خام در استان کرمان

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چکیده

زمینه مطالعه: کیفیت میکروبی و شیمیایی شیر خام یکی از مهمترین موضوعات در بهداشت عمومی می باشد. **هدف:** اگر چه مطالعات کمی در جنوب شرقی ایران انجام شده است، این موضوع به منظور مطالعه کیفی شیر تحویلی به یکی از کارخانجات در استان کرمان انجام گرفته است. **روش کار:** مجموع ۱۰۹ نمونه شیر خام در زمان تحویل به کارخانه جمع آوری گردید. تمام نمونه ها به آزمایشگاه مواد غذایی دانشکده دامپزشکی منتقل گردید و شمارش کلی میکروب ها، شمارش سرماگراها و شمارش استافیلوکوکوس آرئوس انجام شد. محتویات شیمیایی، بقایای مهارکننده های میکروبی و آنتی بیوتیک های بتالاکتام توسط لاکتواستار، کیت کوپن و آزمایشات بتا استار به ترتیب انجام گرفت و شمارش سلول های سوماتیک توسط سل کانتر انجام شد. **نتایج:** بر مبنای مقایسه با معیارهای استاندارد ملی ایران فقط ۲۶ نمونه از ۱۰۹ نمونه (۲۳/۸: ۹۵٪) با ۳۳/۰ - ۱۶/۲ :CI در محدوده استاندارد از نظر تمام فاکتورها قرار داشته اند. تعداد زیادی از نمونه های خارج از استاندارد (۵۰ از ۸۳) در اثر کمبود پروتئین بوده است. **نتیجه گیری نهایی:** طبقه بندی نمونه ها بر مبنای تمام معیارها بدون در نظر گرفتن پروتئین نشان داد که مشکل اساسی این شیرها کمبود میزان پروتیئن بوده است.

واژه های کلیدی: باقیمانده های آنتی بیوتیکی، کیفیت شیر خام، سلول های سوماتیک

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