DECREASING OF SOMATIC CELL COUNT IN RAW MILK THROUGH FRAUD EXPERIMENTAL MODEL

DIMINUIÇÃO DA CONTAGEM DE CÉLULAS SOMÁTICAS EM LEITE CRU ATRAVÉS DE MODELO EXPERIMENTAL DE FRAUDE

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SUMMARY

In order to increase industrial profitability and yield, the industries proposed a bonus/penalty system in which the price of premium milk would be higher while discounted for lower quality milk. Milk quality is determined by milk composition variables such as fat, protein and (SCC) somatic cell count. However, when quality is rewarded with higher pay, there is always the risk of fraud. This study aims to verify the feasibility of an experimental model for fraud, i.e., when SCC is artificially decreased by removing portions of the supernatant of milk, and evaluate the consequences of this subtraction on some milk components. Milk samples from 18 lactating cows were subjected to two different resting periods (30 and 60 minutes) and subsequently 5.0%, 7.5% and 10.0% of the milk supernatant was removed. The results showed that is possible to reduce milk SCC through the fraud experimental model described. The statistical analysis showed that the best results of reduced SCC were obtained when 7.5% of the supernatant was removed after the milk was left to rest for 30 minutes. The Premium Milk Payments should be used as an incentive to improve the quality of milk and to prevent fraud. The payment for fat content should be kept for the purpose of assessing correct milk sampling and as indication of possible fraud in the SCC. Despite the fact that the experimental model showed that it is possible to decrease SCC, which generates bonus for the producer, statistical analysis shows that SCC removal decreases other components used as parameters for quality reward and also milk volume, maybe resulting in an overall lower price.

KEY-WORDS: Somatic cell count. Fraud. Instruction 62. Quality.

RESUMO

Tendo em vista busca por rendimento industrial e lucratividade, as indústrias propuseram pagamento pela qualidade do leite produzido, assim o produtor receberia bonificação ou penalização referentes à composição do leite como teores de gordura, proteína e contagem de células somáticas (CCS). Porém, quando existem programas de melhoria de qualidade onde o produtor poderá ser bonificado/penalizado ocorre o risco de fraudes surgirem, a fim de atender o estabelecido. O objetivo desse estudo foi verificar a viabilidade do modelo experimental de fraude mediante a diminuição da CCS pela subtração de porções de sobrenadante de leite mantido em estação e avaliar as consequências desta subtração sobre alguns componentes do leite. Para tal, foram utilizadas amostras de leite de 18 animais, submetidas a dois diferentes períodos de estação e/ou repouso (30 e 60 minutos) e posteriormente subtraídos 5,0%, 7,5% e 10,0% dos sobrenadantes do leite oriundos destas vacas. Os resultados demonstraram que é possível diminuir a CCS do leite por meio do modelo experimental de fraude. Através das análises estatísticas pode-se concluir que o melhor modelo de diminuição de CCS é obtido pela subtração de 7,5% do sobrenadante por 30 minutos de repouso. Os programas de pagamento por qualidade devem ser usados como forma de incentivo à melhoria da qualidade do leite e para evitar as fraudes. O pagamento pelo requisito da gordura deve ser mantido para fins de avaliação da amostragem correta do leite e como um indicativo de possíveis fraudes na CCS do leite. Apesar do modelo experimental ter demonstrado a possibilidade da diminuição da CCS, trazendo bonificação ao produtor quanto a este componente, as análises estatísticas demonstraram que o mesmo não é viável, pois os produtores perderiam em outros componentes que também são utilizados como parâmetros para bonificação e em volume de leite, o que poderia gerar a penalização.

PALAVRAS-CHAVE: Contagem de células somáticas. Fraude. Instrução Normativa 62, Qualidade do leite.

INTRODUCTION

Milk has a high nutritional value, constituting a complex food, consisting of a three-phase system in perfect balance that comprises a solution of carbohydrates (lactose) in water, another solution called colloidal or colloid (protein), and finally the lipid emulsion phase (fats) where milk leukocytes are found in its suspended phase. The fat, due to its lower density, is concentrated on the surface with bacteria and somatic cells, which are aggregated to the fat globules (CASSOLI & MACHADO, 2006; GONZALEZ, 2001; PRATA, 1998). Milk composition varies with genetic (species, breed, individuals), physiological (age, disease occurrence and lactation), environmental and management (climate, season, temperature, power, quantity and milking range) factors, as well as due to milk tampering or fraud (KOBLITZ, 2011). Tampering with milk modifies the concentration of the main solid components (lactose, protein, fat and minerals) (ROBIN, 2011).

Higher compensation for a better quality product was a way used by the industry to improve the milking hygiene by the producer due to the demand for increasing industrial productivity and profitability. The highest bonuses have been paid for properties with reduced SCC since this parameter is directly linked to milk quality and yield (VAN SCHAIK et al., 2002; BOTARO et al., 2013.).

However, in 2012, the year that Instruction 62 was imposed, suspicions of fraud in SCC emerged after the analysis of milk in dairy farms. Since the most often reported SCC fraud cases are performed simply, directly in the cooling tank, without accuracy and measurement, it is necessary to understand it in order to detect and prevent it. Therefore, this study aims to better understand the SCC fraud experimental model by removing three different concentrations of supernatant from milk at two different times and evaluate how this removal changes other milk parameters, in order to understand better the fraud mechanism and ways to diagnose it.

MATERIAL AND METHODS

The trials were performed at APTALAC Paulista Agency of Agribusiness Technology (APTA), Polo Centre-East of Ribeirão Preto - SP to simulate the conditions of the alleged SCC fraud.

Three milk samples from individual cows were used. The cows to be sampled were chosen based on the SCC of the day before the harvest. The counting was performed using the Ekomilk Scan equipment at the laboratory APTALAC. Thus, the 18 cows with the highest SCC were selected (SCC ranging from 104,000 to 1,500,000 cells/mL), and milk samples of 1,500 and 1,000 mL were collected each day, in the next two days. The samples were collected from the cow total morning milking, and divided into fractions of 500 mL and packaged in plastic bottles with a capacity of 1,000 mL.

The 1,500-mL samples of the first day were used in trials to determine how much of the supernatant should be removed from the refrigerated milk at rest. Raw milk samples were also collected and kept as control. The plastic bottles were labeled according to the percentage of removed supernatant, 5.0%, 7.5% and 10.0%.

After labeling, the samples were homogenized (FAO, 2000), and taken to the cold room where they remained undisturbed for one hour (fixed time) at a temperature ranging from 3.5º to 5.0ºC. After this period, the bottles were removed carefully so that the milk was not mixed. The pre-determined amounts of supernatant were removed and the milk left in the bottle was sampled.

In the other test, the main question to be answered was how long should the milk be left for the supernatant to form. We tested two time periods, 30 and 60 minutes of complete rest. The 1,000 mL milk samples from 18 cows with the highest somatic cell count were used. The milk sampling followed the same procedure as before. The milk samples were let to rest for 30 and 60 minutes, so the supernatant separated from the milk, which practically starts occurring after the shutdown of the stirring blades motor of the cooling tank which keeps the milk refrigerated.

In the laboratory each 1,000 mL sample was properly homogenized, divided into two 500 mL fractions and transferred to 1,000 mL capacity plastic bottles. Prior to the treatments, raw milk samples were collected as control. All plastic bottles were placed in cold storage at temperatures ranging from 3.5 to 5.0°C until the supernatant was removed.

At the end of the 30 and 60 minute periods, the plastic bottles were carefully removed from the fridge, so as not to stir and mix the samples. Based on the results of the previous study with the three supernatant removal ratios, milk resting time was tested using the average supernatant removal rate of 7.5%. Therefore, 7.5% of the supernatant was removed for both the 30 and 60 minute resting periods. Both milk samples, the control (raw milk) and the tampered milk were taken for analysis.

In each experiment, two kinds of samples were generated:

a) properly homogenized raw milk, and,

b) tampered milk (after supernatant removal according to the test procedure)

SCCs were performed for each sample using the Ekomilk Scan® equipment, which analyzes somatic cells by adding a surfactant solution to the milk sample that under constant stirring forms a viscous gel, and then the somatic cell count is performed by the viscosity resulting from the reaction between the milk and the solution.

All statistical analyses were performed with the Statistical Analysis System, version 9.1.

To evaluate the data, the percent of supernatant removal and the resting time were compared by two linear mixed models, with repeated measures on the same animals to contemplate the fixed effect of the comparison group (60 minutes and raw milk samples

(0); 5.0, 7.5 or 10% supernatant removal), in addition to animal and residual random effects. The means comparison by the contrasts methodology was used to compare the different removal percentages (0 versus 5.0%; 0 versus 7.5% and 0 versus 10%) (SAS, 2003).

RESULTS AND DISCUSSION

The results were significantly different (P <0.05) for the comparison of raw milk and tampered milk regarding fat, protein, lactose, solids non fat (SNF) and SCC contents.

Regarding the experimental model (Table 1), the percentages of supernatant removal (5.0%, 7.5% and 10.0%) showed no significant differences (P>0.05) for protein, and lactose SNF when compared with the milk control sample. On the other hand, the supernatant removal affected significantly (P<0.05) the content of fat of tampered milk compared to the control sample, which was expected, because the fat concentrates in the supernatant. Furthermore, fat content was not significantly different for the different supernatant removal rate. The SCC was significantly different only for the 7.5% (P <0.05%) removal rate compared to control, probably due to the fact that leukocytes are found in the milk supernatant. In addition, the 7.5% removal did not differ from the 5.0% and 10.0% samples.

The lack of significant difference when the supernatant is removed at higher percentages can be explained by the resting time. It is suggested that if the samples had remained at rest longer than 60 minutes, the SCC for the 7.5% and 10% milk samples could be different.

The results show that only in the milk sample with 7.5% supernatant removal, the SCC was significantly different from the control sample.

When milk resting time is taken into consideration, no statistical differences were observed for the contents of protein, lactose, SNF and SCC between the two times studied. But the fat percentage was significantly (P <0.05%) different for the 60 minute resting time compared to the control and the 30 minute rest, as well.

This result is important because milk fat content is considered as an indicator of sample representativeness and is also a quality parameter used in the payment tables. It also indicates that until 30 minute resting time would be sufficient for fraud, without changing the other components of milk.

Table 1 - Comparison between the mean values of the components of refrigerated raw milk and milk adulterated with different supernatant removal percentages after 60 minutes resting time.

Components	Supernatant removal			
	Raw milk	5%	7.5%	10%
Fat %	3.06[a]	2.64[b]	2.58[b]	2.51[b]
Protein %	3.47	3.50	3.50	3.49
Lactose %	4.89	4.89	4.88	4.86
SNF %	8.83	8.87	8.52	8.85
SCC x 1000 cells/mL	491[a]	324[ab]	224[b]	295[ab]

Means followed by different letter in the same row differ (P<0.05).
SNF – solids non fat
SCC - somatic cell count

Table 2 - Milk components in the raw milk (control) and tampered milk samples in relation to the with respect to resting time studied.

Components	Raw milk	30 minutes	60 minutes
Fat %	3.25[a]	3.24[a]	2.81[b]
Protein %	3.59	3.64	3.64
Lactose %	5.06	5.12	5.09
SNF %	9.12	9.24	9.24
SCC x 1000 cells/mL	513	298	348

Means followed by different letter in the same row differ (P <0.05)
SNF – solids non fat
SCC - somatic cell count

It appears that the experimental model used to decrease SCC contributes to the knowledge for detecting tampering and pursuing milk quality that is adequate and within the legislation and regulations. Additionally, it helps develop techniques for fraud detection.

Payment programs for quality should be used as an incentive to improve the quality of milk and to avoid fraud. Payment by fat content should be kept for purposes of assessing the correct milk sampling and as an indication of possible milk tampering by decreasing the SCC, as observed in this study.

This study shows that fraud also changed the other milk components, which may in turn influence the quality reward payment. These results are similar to those reported by Fischer et al. (2010) and Rome Junior et al. (2010), who tampered with milk using livestock urea and observed changes in the components that influenced payment.

According to Alvin & Martins (2003), the changes imposed on the national dairy cattle established a new profile for the industry, because the incentive to improve quality, in addition to enhancing the product itself, also increases productivity. Therefore, the production and processing of high quality milk benefits the producers, industry and consumers, which is important to ensure consumer confidence and competitiveness of the milk production chain.

CONCLUSION

Regarding detection of fraud by supernatant removal to decrease SCC, the results show that the optimal experimental model was observed when 7.5% of the supernatant was removed after a 30 minute rest period. However, wich reduction off SCC in milk samples from bulk tank, other milk components will be reduced too, such a lactose, SNF, fat and protein, which used for quality bonus payment.

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