

of dromedaries in Oman. Therefore, we have carried out a five years survey aimed at determining the type of GI helminths eggs/oocytes infesting camels, their prevalence and annual distribution in different governorates of the Sultanate.

#### Materials and methods

This study was conducted on fecal samples received from veterinary clinics throughout all governorates in Oman during January 2009 to December 2013. The fecal samples were collected from the dromedaries and placed in universal sampling bottles, preserved in a cool box with ice and transported directly to the parasitology section at Animal Health Research Center. Fecal eggs counts were determined by fecal flotation technique using saturated sodium chloride solution as the floating medium to assess the level of infestation (Anon., 1977). The eggs/oocytes were identified based on morphologic and microscopic features under Olympus light microscope (X10 and X40 objectives) (Soulsby, 2006). The Chi-square test was used for comparison of infection rate in different seasons.

#### Results and discussions

Out of the 509 dromedaries examined during the study period, 212 cases (41.7%) were positive for different types of GI eggs in their faces. A significant difference ( $\chi^2 = 12.97$ ,  $df = 4$ ,  $p = 0.011$ ), (fig. 1) was found on the annual prevalence of GI helminths. A high prevalence rate was recorded during 2012 as compare to other four years. The GI eggs recovered from dromedaries are illustrated in (fig. 2). A significant difference ( $\chi^2 = 124.0$ ,  $df = 6$ ,  $p < 0.001$ ) was observed in the percentage of infection rate; higher percentage was found in *Trichostrongylus sp.* 31.1% and mixed Infections, 29.2%. On the other hand, infection with *Strongyloides sp.* and coccidial oocytes was found at same percentages (12.3% and 12.7%) respectively. The results of this study have given true evidence that GI helminths are important health problem in dromedaries of Oman. An attention should be focused in this problem in order to reduce the loss and to save the economic impact of camel's production in Oman.

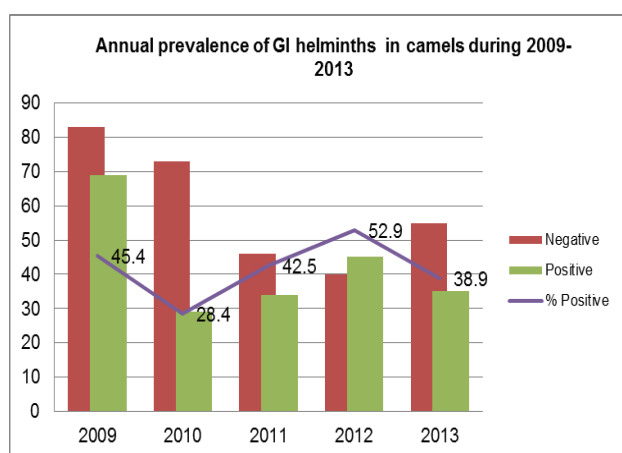


Figure 1. Annual prevalence of GI helminths in dromedaries during (2009- 2013) in Oman

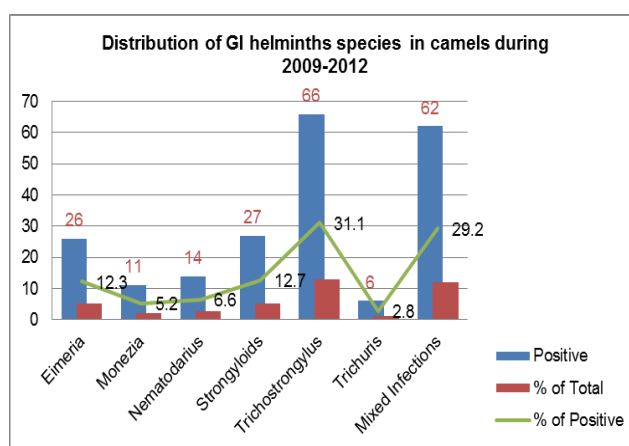


Figure 2. Distribution of GI helminths species in dromedaries during five years (2009-2013)

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### MONITORING OF CAMEL MILK QUALITY IN INTENSIVE DAIRY FARM

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#### Abstract

The implementation of intensive camel dairy farm aiming to put milk and milk products (pasteurized or fermented milk, cheese) on the national market is not possible without a control of the high hygienic quality of the raw matter. In consequence, the daily routine microbiological control is an important step of the milking and milk processing. The present communication is focused on the results after one-year monitoring of milk quality in intensive camel dairy farm, including the control of each milking (morning and afternoon), of mixed milk before and after pasteurization, whey after cheese making and leben. Coliforms and total flora are checked. By applying Good Milking Practices (GMP), the milk quality was improved, the mean coliforms in raw milk decreasing by 3 logs ( $10^6$  UFC/ml to less than  $10^3$  UFC/ml) and the total flora passing from  $3.5 \times 10^5$  UFC/ml to  $1.8 \times 10^4$  UFC/ml. Similar trends were observed for processed milk with a significant improvement of the quality.

*Keywords: Camel milk, microbiology, coliforms, total flora, pasteurization.*

## БЕЛСЕНДІ СҮТ ФЕРМАЛАРЫНДА ТҮЙЕ СҮТІ САПАСЫНЫҢ МОНИТОРИНГІ

Түйе сүтін өндіруші фермаларда сүтті таратудың белсенділігін арттыру мақсатында шикізат сапасына жоғары гигиеналық бақылаусыз ұлттық нарыққа сүт және сүт өнімдерін (пастерленген немесе сүт қышқылды, ірімшік) шығару мүмкін емес. Күнделікті жұмыс нәтижесі бойынша сауын мен сүт өңдеудің маңызды шарттары микробиологиялық бақылау болып табылады. Бұл жұмыс бір жыл ішінде жүргізілген сүт өндіруші фермалардағы сүттің сапасы, әрбір сауымның (таңертеңгі және күндізгі) жүйесі мен аралас сүттің пастерленгенге дейін және кейінгі ірімшік жасаудағы сарысудың сапасы зерттеу нәтижесіне бағытталған. Сүттің колиформдық және барлық флорасы тексеріліп отырады. Түйе саууда GMP-ді қолданғаннан сүттің сапасы жоғарылады, сүттің құрамындағы колиформалық бактериялардың орташа мөлшері 3-тен төмен (106 UFC / мл ден 103 UFC / мл дейін), ал жалпы флорасы  $3,5 \times 10^5$  UFC / мл ден  $1,8 \times 10^4$  UFC / мл дейін болды. Ұқсас тенденциялар сүт өңдеуде де жақсы сапа көрсететіндігі байқалды.

*Түйін сөздер: түйе сүті, микробиологиясы, колиформасы, жалпы флора, пастеризация.*

## МОНИТОРИНГ КАЧЕСТВА ВЕРБЛЮЖЬЕГО МОЛОКА НА ИНТЕНСИВНОЙ МОЛОЧНОЙ ФЕРМЕ

Создаются интенсивные молочные верблюдоводческие фермы с целью предложения молока и молочных продуктов (пастеризованные и/или кисломолочные продукты, сыры) на национальном рынке, которые невозможны без организации контроля для высокого гигиенического качества сырья. В результате, ежедневный микробиологический контроль является центральным местом в доильном и молочном цехах. Вашему вниманию предложены результаты одного года мониторинга качества молока в интенсивной верблюдоводческой ферме, в том числе система управления каждой дойкой (утром и днем), сборного молока до и после пастеризации, сырной сыворотки и Leben (кисломолочный продукт). Основные показатели – обсемененность на кишечную палочку и общая микрофлора. После полного внедрения требований GMP в ежедневной доильной практике, качество молока улучшилось, средние бактерии кишечной палочки в сыром молоке составляют менее 3-его разведения (106 UFC /мл, что составляет менее чем 103 UFC/мл), а общая микрофлора составляет от  $3,5 \times 10^5$  / мл UFC  $1,8 \times 10^4$  UFC / мл. Аналогичные тенденции наблюдались при переработке молока со значительным улучшением качества.

*Ключевые слова: верблюжье молоко, микробиологии, колиформы, всего флора, пастеризация.*

### Introduction

The implementation of intensive camel dairy farm aiming to put milk and milk products (pasteurized or fermented milk, cheese) on the national market is not possible without a control of the high hygienic quality of the raw matter (Faye and Loiseau, 2000). In consequence, the daily routine microbiological control is an important step of the milking and milk processing (Nagy et al., 2013). The present communication is focused on the results of one-year monitoring of milk quality after the implementation of camel dairy farm.

### Material and Methods

**The camel farm:** The camel dairy farm of the FAO project UTF/SAU/044/SAU was established at Al-Kharj (Saudi Arabia) in December 2012 in the Conservation and Genetic Improvement Center (CGIC) with camels from different origins. Approximately, 10 to 15 camels were milked simultaneously every day. The animals were regularly dewormed and treated against mange. They were submitted to different experiments regarding milking or feeding improvement. The control of mastitis was done with California Mastitis Test (CMT) in routine once a week. SCC control is expected in the future.

**The milking:** The Milking parlor was implemented in January 2013 firstly with individual milking pots, then later equipped with medium-pipeline (1.8 meters) milking stalls and electronic pulsator (BouMatic, Itak Company, Riyadh, Saudi Arabia). The milkers were accustomed to milk cows, but they received training on camel milking at Watania camel dairy farm (Al-Jouf, Saudi Arabia). The milking occurred twice a day, at 6:00 and 16:00 with one hour shift between winter and summer time. Just after milking, the milk is collected in milk can, weighed and introduced in the dairy plant for processing, besides the milking parlor.

**Milk processing:** The milk is processed in the morning into cheese (Haloumi, Feta, Mozzarella) or into leben, using the milk of the morning and of the former evening, let in refrigerator overnight at 4°C. Once a week, the milk is pasteurized at 63°C for 20 min. The products are sold in the dairy shop of the Centre.

**Microbiological analyses:** The microbiological control includes the assessment of total flora and coliforms. Total flora is determined by using Plate Count Agar (PCA) milieu in Petri dish with different dilution of milk ( $10^{-1}$  to  $10^{-5}$ ). Coliforms are determined by using Violet Red Bile Agar (VRBL) with similar methodology. The control involves the mixed milk of each milking (morning and afternoon), mixed milk used for pasteurization (before and after processing), for leben (before processing) or for cheese (before processing, the whey being control at the end of processing). Once a week, the individual milk is controlled using the same methods. After putting in oven for 24 hours (coliforms) and 72 hours (total flora), the colonies are manually counted. All data are collected in the database of the project from December 2013.

### Results and discussion

**Herd data:** during the first months of the milking activities during the year 2013, the microbiological quality was regarded as non-sufficient for the processing. However, by applying Good Milking Practices (GMP), the milk quality was improved rapidly and the mean coliforms in raw milk was decreasing by 3 logs ( $10^6$  UFC/ml to less than  $10^3$  UFC/ml). In the same time, total flora was passing from  $3.5 \times 10^5$  UFC/ml to  $1.8 \times 10^4$  UFC/ml between the first milk analyses in February 2013

and November 2013. The GMP implemented progressively all along the year 2013 included: (i) the double cleaning of milking machine with acid and alkaline detergent, (ii) the wearing of special clothes for the milkers with mask, gloves and cap, (iii) the udder cleaning with clean water, (iv) the introduction of individual udder towel, (v) the filtration of milk at pouring into can, (vi) immediate refrigeration of the can. It is known that the milking practices could have an important effect on the milk quality (Tourette et al., 2002).

After the introduction of the entire GMP program, the data being introduced in the database, the monitoring became readable through graphs (figures 1 and 2 for example). However, during the year 2014, a high variability in milk quality occurred in spite of the GMP program. The values for coliforms in bulk milk of each milking varied between  $0.2 \times 10^1$  and  $1.12 \times 10^6$  with a mean of  $4.04 \times 10^4$  UFC/ml. For total flora, the values were  $3.98 \times 10^3$  to  $2.0 \times 10^6$  with a mean of  $1.11 \times 10^5$  UFC/ml. As shown in the graphs 1 and 2, sudden increases were observed in February, April and during summer time followed by a progressive decrease of the microbiological charge up to the end of the year. Nowadays, the level was on average 280 coliforms/ml and less than  $1.0 \times 10^4$  total flora/ml. The peaks observed all along the year 2014 were linked to different events affecting the milking machine: (i) in February, teat cups were cracked and changed after 2 weeks only, (ii) in April, milk residue were found in the vacuum pipes of the machine milking contributing to the contamination of all the milking circuit, (iii) in summer, the clusters were changed after long delay. In clear, GMP must include a strict management of the milking machine.

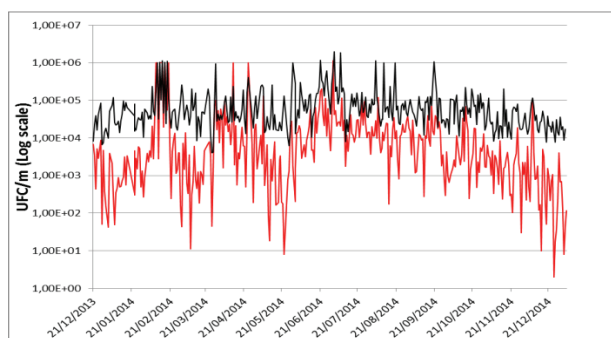


Figure 1: Daily changes of coliforms (red) and total flora (black, in Log UFC/ml) all along the year 2014

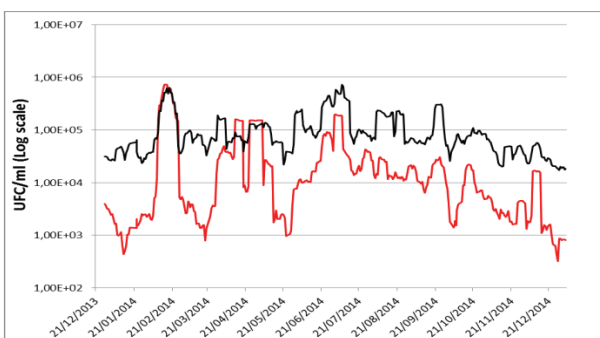


Figure 2: Changes of coliforms (red) and total flora (black, in Log UFC/ml) all along the year 2014 (mobile means over 7 days)

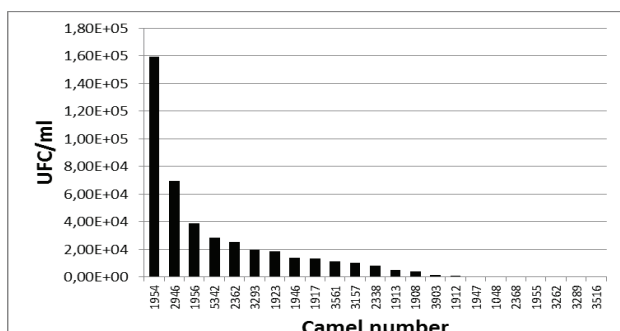


Figure 3: Annual mean values of coliforms (UFC/ml) in the different camels all along the year 2014

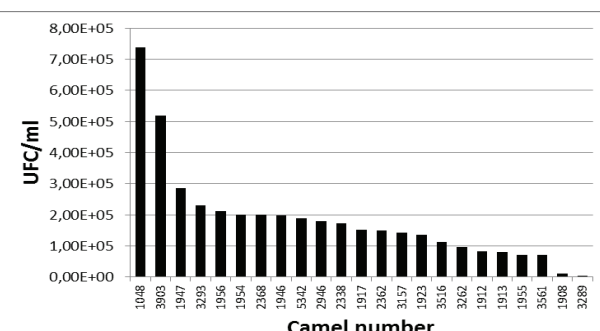


Figure 4: Annual mean values of Total Flora (UFC/ml) in the different camels all along the year 2014

**Individual data :** the mean UFC/ml according to the different camels varied highly. Two camels presented on average more than  $6 \times 10^4$  UFC/ml coliforms and 2 others more than  $5 \times 10^5$  UFC/ml total flora. The number of camels with less than  $10^2$  coliforms and  $10^4$  Total flora were 5 and 7 respectively

(Figure 3 and 4). The two camels with high level of coliforms were positive to CMT and treated by antibiotics.

There was no correlation between the level of coliforms and total flora in the individual milk. The high level of total flora ( $1.6 \times 10^6$  UFC/ml) observed in the camel n°1048, characterized elsewhere by a low level of coliforms ( $2.54 \times 10^2$  UFC/ml) was probably linked to the old age of the animal (23 years).

In conclusion, hygienic practices all along the milking process is primordial for the quality preservation of camel milk in spite of the believe that it can resist to contamination thanks to its antibacterial properties.

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