BACTERIOLOGICAL QUALITY AND SAFETY OF RAW CAMEL MILK IN EGYPT

BY

R.A. Ombarak* and A.M. Elbagory
Food Hygiene & Control Department, Faculty of Veterinary Medicine, Sadat City University, Menofia Governorate, Egypt.
*Corresponding author: rabee_alhossiny@vet.menofia.edu.eg
(Accepted. 1/7/2014)

SUMMARY

Consumption of camel’s milk in Egypt is increasing and mainly consumed in its raw state. So this study was planned to investigate the bacteriological quality of camel milk and the possible presence of some milk borne pathogens as E. coli, S. aureus, Salmonella spp. and Listeria monocytogenes. Thirty five composite raw camel milk samples were collected from a camel farm in Matrouh Governorate, Egypt. The mean value of aerobic plate count (APC) was 1.19±0.254x10⁷ cfu/ml, while the mean count value of Enterobacteriaceae was 2.72±0.391x10⁶ cfu/ml. Coliforms could be detected in 85.71% of the examined samples, with mean count value of 8.49±0.784x10⁶ cfu/ml. E. coli was isolated from 25.71% of examined samples. The isolated E. coli belonged to three serotypes: 0119, 0124 and untypable. S. aureus was detected in 42.86% of the examined samples with mean count value of 2.4±1.0x10⁶ cfu/ml. Salmonella and Listeria monocytogenes were not detected in the examined samples.

Key words: Camel milk, Bacteriological quality, E. coli, S. aureus, Salmonella, Listeria monocytogenes.

INTRODUCTION

Camel milk not only contains more nutrients compared to cow milk, but also it has therapeutic and antimicrobial agents (El-Agamy et al., 1992). Camel milk is slightly saltier than cow’s milk, three times as rich in Vitamin C, rich in iron, unsaturated fatty acids and B vitamins. It is a natural and essential food in areas where there is a scarcity of water and forage. Camel milk and meat are the principal foods in arid and semi-arid areas of the African and Asian countries (El-Ziney and Al-Turki, 2007).

In Russia, Kazakhstan and India, camel milk is often prescribed to convalescing patients and in Africa, it may be recommended for people living with AIDS. Also, it is claimed that camel milk has a role in reducing diabetes and coronary heart disease (FAO, 2011).

Camel milk does not contain β-lactoglobulin and low content of α-casein. Therefore, it is considered a useful dietary component for individuals that show allergic reactions to the protein fraction of cow, ewe or goat milk (Restani et al., 1999).

The fact that camel milk is mainly consumed raw state, the high ambient temperature and the lack of refrigeration facilities in many arid areas results in its hygienic problems (Radwan et al., 1992; Semereab & Molla, 2001; Saad & Thabet 1993; Younan, 2004).

Raw camel milk may contain pathogenic microorganisms and their source may be from inside or outside the udder. Pathogenic bacteria may present in raw milk as a direct consequence of udder disease. Among the organisms commonly causing mastitis are the pathogenic E. coli and S. aureus (Sinell, 1973). Nowadays the consumption of raw camel milk in Egypt is increasing especially among those who suffer from liver diseases.

Therefore the main objectives of this study were to investigate the bacteriological quality of raw camel's milk and detect the pathogenic bacteria which might transmit to human as a result of consuming raw camel's milk and constitute a health hazard to those consumers.

MATERIALS AND METHODS

Collection of samples

Thirty five raw composite camel milk samples were collected in clean plastic bottles from a camel farm in Matrouh Governorate, Egypt. Collected samples were transported in ice box to the laboratory of Food Hygiene and Control, Faculty of Veterinary Medicine, Sadat City.

Bacteriological enumeration

Initially, 25 ml of each raw milk sample were dispensed into a sterile flask containing 225 ml of 0.1% peptone water and mixed thoroughly. Subsequent serial decimal dilutions of each sample were prepared in 0.1% peptone water. Viable cell counts were performed by the standard pour plate method: Aerobic plate count (APC) was carried out on plate count agar according to Morton (2001). Enterobacteriaceae count was carried out on Violet Red Bile Glucose (VRBG) Agar according to Komaclci & Johnson (2001). Coliform bacteria were enumerated by a most probable number (MPN) multiple-tube fermentation method (FDA, 2002). The identification of E. coli was confirmed by colony morphology on eosin methylene blue agar (EMB) and performing biochemical tests according to Holt et al. (1994). Serological identification of isolated E. coli was done according to Varnam & Evanis (1991). Staphylococcus aureus count was carried out by direct plate count method on Baird Parker agar supplemented with egg yolk tellurite emulsion according to Lancette & Bennett (2001).

Detection of Salmonella

Detection of Salmonella was done using the presence/absence method (FDA, 2011). The suspected isolates were identified according to Forbes et al. (2007).

Detection of Listeria monocytogenes

Detection of Listeria monocytogenes was done according to the most widely used approaches which based upon FDA method (Hitchin, 1990). Identification of suspected colonies was done according to Hitchins (1995).

RESULTS AND DISCUSSION

Generally the analyzed samples were highly contaminated with the tested bacterial groups (Table 1). The aerobic plate count (APC) is an indication of the sanitary conditions under which the food is produced (Andrews, 1992). The APC ranged from $5.6 \times 10^5$ to $6.5 \times 10^7$ cfu/ml with a mean value of $1.19 \times 0.254 \times 10^7$ cfu/ml, being higher than those reported by Al-Mohizea (1986), Al-Mohizea et al. (1994), Mahmoud (1997) and Omer and Eltinay (2008). On the other hand, these findings, were close to those reported by Semereab and Molla (2001), Selia et al. (2003) and Ahmed et al. (2010). This reflects the poor sanitary conditions under which the camel's milk was produced, and, hence, the potential hazards associated to its consumption. Generally, the total bacterial count depends on several parameters such as the contamination of the camel udder and contamination from the milking personal, containers and milking environment etc.

The low total counts obtained by some authors may reflect the good sanitation practices applied in the farm and during milking process. Also, the low total counts of aerobic bacteria could be due to the presence of lysozyme in camel's milk which characterized by its antibacterial activity spectrum similar to that of egg white lysozyme (Barbour et al., 1984 and El-Agamy et al., 1992).
A total of 88.57% of the examined samples were contaminated with *Enterobacteriaceae*, with counts ranging from 7.4 x 10^3 to 8.0 x 10^6 cfu/ml with mean count of 2.72 ±0.391 x 10^6 cfu/ml (Table 1). Comparatively lower counts were recorded by El-Ziney and Al-Turki (2007). Jayarao& Wang (1999) stated that milk from the farm can become contaminated with gram negative bacteria present on teats, the teat ends, teat canal, udder surfaces, mastitic udders and contaminated water used to clean the milking systems and those that are resident in the milking system.

The incidence of coliforms was 85.71% and the count ranged from 2x10^4 to 1.1x10^6 cfu/ml with a mean count value of 8.49±0.784 x 10^5 cfu/ml (Table 1). These findings were higher than those reported by Al-Mohizea (1986), Al-Mohizea et al. (1994), Mahmoud (1997), El-Jakee (1998), Aly (2005) and Orner and Eltinay (2008), in the other hand it agree to some extent to that obtained by Jebreel (2006). Such high coliform contamination is indicative for neglecting of any hygienic measures in the camel dairy farms, inadequate refrigeration of milk, and probable use of unclean dairy utensils. The heavy coliform contamination of milk may result in undesirable changes in milk rendering it unmarketable or even unfit for human consumption.

Coliforms other than *E. coli* have been found in camel milk with different percentages (Barbour *et al.*, 1985; El-Jakee, 1998; Semereab and Molla, 2001 and Abd El-Gadir *et al.*, 2005). The incidence of *E. Coli* isolated in this study was relatively higher than those reported by Semereab and Molla (2001), Sela *et al.* (2003) and Abd El-Gadir *et al.* (2005), and relatively agreed with that recorded by Hadush *et al.* (2008), while higher incidence was reported by Mahmoud (1997).

Table (1): Mean counts (cfu/ml) and prevalence of bacterial groups of hygienic significance in camel's milk

<table>
<thead>
<tr>
<th>Bacterial counts</th>
<th>Positive samples (n=35)</th>
<th>cfu/ml</th>
<th>Min.</th>
<th>Max.</th>
<th>Mean ± SEM*</th>
</tr>
</thead>
<tbody>
<tr>
<td>APC</td>
<td>35</td>
<td>100</td>
<td>5.6x10^5</td>
<td>6.5x10^7</td>
<td>1.19±0.254x10^7</td>
</tr>
<tr>
<td><em>Enterobacteriaceae</em></td>
<td>31</td>
<td>88.57</td>
<td>7.4x10^3</td>
<td>8x10^6</td>
<td>2.72±0.391x10^6</td>
</tr>
<tr>
<td><em>Coliforms</em></td>
<td>30</td>
<td>85.71</td>
<td>2x10^4</td>
<td>1.1x10^6</td>
<td>8.49±0.784x10^5</td>
</tr>
<tr>
<td><em>S. aureus</em></td>
<td>15</td>
<td>42.86</td>
<td>1.5x10^4</td>
<td>1.6x10^5</td>
<td>2.4±1.0x10^5</td>
</tr>
</tbody>
</table>

*SEM = Standard error of the mean

Table (2): Incidence of isolated coliform organisms among examined camel’s milk samples

<table>
<thead>
<tr>
<th>Isolates</th>
<th>Positive samples (n=35)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Escherichia coli</em></td>
<td>9</td>
<td>25.71</td>
</tr>
<tr>
<td><em>C. freundii</em></td>
<td>1</td>
<td>2.86</td>
</tr>
<tr>
<td><em>E. coli inactive</em></td>
<td>2</td>
<td>5.71</td>
</tr>
<tr>
<td><em>Ent. cloacae</em></td>
<td>1</td>
<td>2.86</td>
</tr>
<tr>
<td><em>Klebsiella oxytoca</em></td>
<td>3</td>
<td>8.57</td>
</tr>
<tr>
<td><em>K. pneumoniaesub.spp. ozona</em></td>
<td>1</td>
<td>2.86</td>
</tr>
<tr>
<td><em>K. pneumoniaesub.spp. pneumoniae</em></td>
<td>2</td>
<td>5.71</td>
</tr>
<tr>
<td><em>Hafnia alvei</em></td>
<td>3</td>
<td>8.57</td>
</tr>
</tbody>
</table>
Serological typing of isolated *E. Coli* showed that they belonged to serotypes O119 (1 strain), and O124 (2 strain) while the other six strains were untyped (Table 3).

The presence of presumably pathogenic *Staphylococcus aureus* in 42.86% of the examined samples, with counts ranging from $1.5 \times 10^4$ to $1.6 \times 10^6$ cfu/ml with mean value $2.45 \pm 1 \times 10^5$ cfu/ml indicating the poor hygienic quality under which this milk was produced. *S. aureus* counts and incidence from this study are higher than that obtained by Barbour *et al.* (1985), Al-Mohizea (1986), Saad and Thabet (1993) and Omer and Eltinaey (2008). While relatively lower incidences were reported by El-Ziney and Al-Turki (2007).

The presence of *S. aureus* was attributed to contamination from the skin, mouth, or the nose of the food handler (Andrews, 1992). Also, the high incidence (19.5%) of mastitis in camel herds and the high frequency of *S. aureus* (31.5%) as the causal agent (Obeida *et al.*, 1996) may explain the present findings.

*Salmonella* and *L. Monocytogenes* were not detected in any of examined camel milk samples. Similar results were recorded by Aly (2005), Omer & Eltinaey (2008) and Rahimi *et al.* (2010). El-Agamy *et al.* (1992) found that camel milk lysozyme was effective against *Salmonella* which may explain the present finding. On the other hand, incidence of *Salmonella* was recorded by El-Ziney and Al-Turki (2007).

The present study showed that raw camel milk may contain microorganisms pathogenic for man such as *S. aureus* and *E. Coli*, which may gain access into milk as a direct consequence of udder disease or because of poor management and unhygienic milking practices prevalent in the traditional husbandry systems (Abdurahman *et al.*, 1995; Obeida *et al.*, 1996; Almaw and Molla, 2000; Woubit *et al.* 2010).

The occurrence and persistence of the microorganisms in air, wall surfaces, udder and teat surfaces and milk utensils and equipment have been largely overlooked as a problem in the hygienic condition of milk (Anderson *et al.*, 1999). Also, pastoral production conditions, environmental contamination are likely to play a bigger role in the hygiene of raw camel milk than initial bacterial contamination of the camel milk (Younan, 2004).

### Table (3): Serodiagnosis of *E. coli* strains isolated from the examined milk samples. (n=35)

<table>
<thead>
<tr>
<th><em>E. coli</em> serotype</th>
<th>No. of strains</th>
<th>Strain character*</th>
</tr>
</thead>
<tbody>
<tr>
<td>O119:K69</td>
<td>1</td>
<td>EPEC</td>
</tr>
<tr>
<td>O124:K72</td>
<td>2</td>
<td>EIEC</td>
</tr>
<tr>
<td>Untypable</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9</strong></td>
<td></td>
</tr>
</tbody>
</table>

* EPEC = Enteropathogenic *E. coli*, EIEC = Enteroinvasive *E. coli*

**CONCLUSION**

In conclusion, the obtained results showed that raw camel milk obtained under the current production system is highly contaminated with harmful microorganisms. It is strongly recommend to apply appropriate hygienic measures in camels milking process and handling as is required for any other milk destined to human consumption.
REFERENCES


الجودة البكتيريولوجية وسلامة حليب الأبل الخام في مصر

يتزايد استهلاك حليب الأبل الخام في مصر بشكل ملحوظ لذا صممت هذه الدراسة للكشف عن
الجودة البكتيريولوجية لهذا النوع من الحليب ومعرفة مدى تواجد الميكروبات المرضية به مثل;
الاسريشياكوئات، المكورات العنقودية الهيكلية Staph. aureus، E. Coli، Enterobacteriacae،
المكورات العنقودية الدهنية Monosporotigen. لهذا الغرض أجريت هذه الدراسة على خمسة وثلاثين عينة من مزرعة للأبل بمحافظة
مطروح لمعرفة الحالة الصحية للعينات المختبرة، ومدى تلوثها بالميكروبات المرضية، وقد أظهرت
الدراسة أن متوسط العدد الكلي للبكتيريا كان 1,119 ± 101 لكل مل من لبن الأبل الخام،
وتواجدت الميكروبات المعوية Enterobacteriacae، بنسبة 88,57% بمتوسط قدره 2.72 ± 0.391 × 102
 لكل مل. وكانت ميكروبات الكوليفورم متواجدة بنسبة 85,71% وكان متوسط العدد الاحتمالي من مجموعة
الميكروبات القولونية هو 8.449 × 100. لكل مل. ونسفر الفحص البكتيري لعينات
الاسريشياكوئات التي تم عزلها من العينات عن أنها تتعلق إلى O0119 و O124، وتمكن عزل ميكروب
المكور العنقودي الدهني الذي تواجد بنسبة 3.68% بمتوسط قدره 2.440 ± 100 لكل مل.، ولم
يتواجد ميكروب المالمونيا أو الاليستريا مونوسورتيجن في أي من العينات المختبرة.