

## Importance of camel milk and production potential of dromedary breeds

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### ABSTRACT

The population of the dromedary in the country has gone down from 1.1 m to 0.5 m in last 3 decades. In recent past camel milk has been recognized as a possible tool to sustain the dromedary *in situ*. In this context this study was carried out in 6 Bikaneri and 4 Kachchhi camels. Two teat milking was followed. The average production from front and rear teats in the morning was  $903.81 \pm 15.82$  and  $1113.31 \pm 18.40$  ml and in the evening was  $615.56 \pm 14.36$  and  $776.11 \pm 16.76$  ml respectively. The average daily milk production pooled over breeds for the initial 16 months was  $3606.31 \pm 64.59$  ml and for rest of the months till 24 month was  $2108.64 \pm 93.49$  ml. The effect of breed was nonsignificant but that of individuals was significant. Out of 10 camels 9 continued till 16 months and the 1 camel, which discontinued giving milk in 14<sup>th</sup> month, got conceived in the 12<sup>th</sup> month of lactation. Therefore the lactation in the camels was considered to be of 16 months duration. Accordingly the average lactation yield was 3462 litres. In second phase of lactation about 58% reduction in average daily milk yield was noticed. The average daily milk production was highest in third parity ( $4847.09 \pm 40.24$  ml). The peak yield was observed in the third month of lactation. The promotion of camel milk will not only conserve this threatened species of desert ecosystem but also support the life to weaker section of the society.

**Key words:** Bikaneri, Camel, Kachchhi, Lactation, Milk, Production

Camel in Indian context is considered as an integral part of desert eco-system. The population of the dromedary in the country has gone down from 1.1 m to 0.5 m in last 3 decades (Livestock Census 2007). The world has 25.38 m camels spread across 47 countries. Of the 47 camel rearing countries, 25 produces milk to the tune of 1.63 m tonnes per annum and 37 produces 0.336 m tonnes of meat per annum. Looking at the country wise statistics 24 countries produce both milk and meat and 13 countries produce only meat. Nine countries, mostly belonging to the Indian subcontinent have neither been recognised as milk nor meat producing countries (FAOSTATdata 2010). India with the production of 23.08 thousand tonnes per annum may rank at 7<sup>th</sup> position in the world (Mehta *et al.* 2009). However, race and meat production potential have not received enough momentum in this country but the milk production potential has emerged as a tool to sustain the species *in situ*.

The population of camel in India is 516828 (Livestock Census 2007). Mewari is the least numerous breed with 8834 camels in the main breeding tract. The Kachchhi is second

with a population of 29505 heads followed by Jaisalmeri 106867 heads and Bikaneri and its crosses 306135 heads.

Under the changed perspectives of the camel husbandry milk, meat and race are coming up as the traits of interest. Also there is increased focus on the species with respect to its unique genetics which is reflected in terms of survivability in the most adverse climate on the earth, immunological features and disease resistance, longevity, adaptability and several other features designate this species as the reservoir of unique genes. Therefore, the conservation of this live gene bank i.e. the species as whole, is very important.

The camel milk is three times richer in vitamin C and rich in iron, zinc, copper, sodium, magnesium, manganese and potassium and low in lactose as compared to the cattle milk. Camel milk has been considered unique in terms of having low fat with much higher concentration of long chained fatty acids than short chained fatty acids. The water content in the milk is high and the remarkable feature is that a dehydrated camel continues its lactation and secretes milk with higher water content. The camel is also unique in terms of having 2 teat canals; occasionally there may three canals per teat. The colostrums phase is considered up to 7–10 days (Wernery 2006). The ratio of  $\beta$ -casein to k-casein is considerably higher in camel milk. Lysozyme C and  $\beta$ -lactoglobulin are absent and whey acidic protein and peptidoglycan recognition protein are present (Kappeler

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et al. 2003). The fresh and fermented camel milk provide potential health benefits including angiotension I-converting enzyme-inhibitory activity, hypocholesterolaemic effect, hypoglycaemic effect (Sahani et al. 2005), antimicrobial (Gorakhmal et al. 2001) and hypoallergenicity effect (Al haj and Al Kanhal 2010).

The basic animal husbandry statistics of the year 2008 revealed that the country has an average per capita milk availability of 252 g/day but only 10 states, viz. Punjab, Haryana, Gujarat, Rajasthan, Himachal Pradesh, Jammu and Kashmir, Uttarakhand, Andhra Pradesh, Uttar Pradesh and Madhya Pradesh are above the targeted milestone of 250 g and rest of the states and union territories are much below with the lowest availability of 15 g in Daman and Diu. Promotion of camel milk will not only minimize the health hazard to human life but will also conserve this threatened species of desert ecosystem and support the life to weaker section of the society. In order to provide best breeding studs to the camel farmers for enhancing their milk production capabilities, the centre has initiated a programme on milk production potential of the species.

## MATERIALS AND METHODS

Six females of Bikaneri and 4 of Kachchhi breed of National Research Centre on Camel, Bikaner were selected. In Bikaneri breed, 3 females each belonged to 1<sup>st</sup> and 2<sup>nd</sup> lactation. Of the 4 Kachchhi females, one belonged to 3<sup>rd</sup> lactation and 3 to 4<sup>th</sup> lactation. Since proper let down of milk in camel takes place with the suckling of milk by the calf, two teat milking was followed. One front and one rear teat of one side was milked and the other side was left for the calf. Three times milking was followed for initial 3 months for better nourishment of the calf; thereafter two times milking was followed. The total milk production of the day included the production of milk from front and rear teats during morning, noon and evening for first 3 months and that of morning and evening after 3 months. The milking females were reared under semi intensive system of management. The milking females were sent out for grazing for about 5 h a day and at the farm they were offered concentrate ration @ 3 kg/day. At the farm they were also provided fodder consisting of *guar phalgati* (*Cyamopsis*

Table 1. Average daily milk production : Individuals and breeds

(Two teat milking, milk yield in ml)

| Animal no. | Parity | Morning                |                          | Evening                |                        | Total                    |                         |
|------------|--------|------------------------|--------------------------|------------------------|------------------------|--------------------------|-------------------------|
|            |        | Front                  | Rear                     | Front                  | Rear                   | Phase I                  | Phase II                |
| Pooled     | -      | 903.81±15.82<br>(4661) | 1113.31±18.40<br>(4661)  | 615.56±14.36<br>(4645) | 776.11±16.76<br>(4645) | 3606.31±64.59<br>(4703)  | 2108.64±93.49<br>(1030) |
| Breed      | -      | NS                     | NS                       | NS                     | NS                     | NS                       | NS                      |
| Bikaneri   | -      | 812.20±61.33<br>(2858) | 1002.09±71.29<br>(2858)  | 549.28±55.63<br>(2842) | 667.77±64.96<br>(2842) | 3158.94±250.36<br>(2877) | 1910.64±178.74<br>(798) |
| Kachchhi   | -      | 995.42±91.97<br>(1803) | 1224.53±106.91<br>(1803) | 681.84±83.42<br>(1803) | 884.44±97.41<br>(1803) | 4053.68±375.45<br>(1826) | 2306.64±361.19<br>(232) |
| ID         | -      | **                     | **                       | **                     | **                     | **                       | **                      |
| K-83       | 4      | 1234.64±77.51<br>(474) | 1476.08±90.09<br>(474)   | 965.39±70.30<br>(472)  | 1141.73±82.09<br>(472) | 5017.81±316.37<br>(479)  | 3358.48±272.07<br>(182) |
| K-103      | 4      | 715.92±77.70<br>(394)  | 922.59±90.32<br>(394)    | 504.98±70.49<br>(389)  | 591.00±82.31<br>(389)  | 2961.11±317.18<br>(395)  | -                       |
| K-105      | 4      | 445.69±77.54<br>(456)  | 600.82±90.14<br>(456)    | 385.01±70.31<br>(466)  | 472.31±82.11<br>(466)  | 1939.04±316.41<br>(473)  | -                       |
| K-117      | 3      | 1378.36±76.86<br>(480) | 1614.27±89.35<br>(480)   | 857.23±69.72<br>(477)  | 1006.43±81.41<br>(477) | 5078.78±313.79<br>(480)  | 1198.00±269.19<br>(51)  |
| B-515      | 2      | 884.67±77.50<br>(477)  | 1093.15±90.09<br>(477)   | 552.06±70.31<br>(471)  | 741.69±82.10<br>(471)  | 3530.35±316.36<br>(479)  | -                       |
| B-523      | 2      | 881.16±77.51<br>(471)  | 1117.76±90.10<br>(471)   | 542.92±70.31<br>(470)  | 741.23±82.10<br>(470)  | 3457.35±316.35<br>(481)  | 1969.68±271.51<br>(226) |
| B-537      | 2      | 798.48±77.50<br>(479)  | 1000.89±90.08<br>(479)   | 599.87±70.29<br>(477)  | 780.96±82.08<br>(477)  | 3396.10±316.37<br>(479)  | 1889.71±273.70<br>(217) |
| B-541      | 1      | 720.10±77.50<br>(478)  | 940.34±90.08<br>(478)    | 477.42±70.30<br>(475)  | 658.25±82.09<br>(475)  | 3007.52±316.36<br>(480)  | 1883.34±273.70<br>(116) |
| B-543      | 1      | 1081.90±77.18<br>(476) | 1294.87±89.72<br>(476)   | 715.62±70.01<br>(475)  | 887.86±81.75<br>(475)  | 4215.44±315.07<br>(480)  | 2352.62±271.40<br>(238) |
| B-545      | 1      | 861.15±77.50<br>(476)  | 1072.33±90.09<br>(476)   | 555.08±70.30<br>(473)  | 739.62±82.10<br>(473)  | 3459.65±316.38<br>(477)  | -                       |

Figures in parenthesis indicate number of observations.

*tetragonoloba*), moth chara (*Phaseolus aconitifolius*) and groundnut fodder (*Arachis hypogea*) @ 12kg/animal/day. The milking females were provided water *ad lib*. However, no separate pens were provided to individual camel and they were housed in a group pen. Hand milking was followed and traditionally trained persons of Raika community were engaged in milking. The milk recording commenced from day 15<sup>th</sup> after calving and was continued till 24 months unless the animal ceased yielding milk. The data so recorded was analysed to study the effect of breed, individual, month and parity of lactation using least-squares maximum likelihood programme (Harvey 1987).

### RESULTS AND DISCUSSION

The average daily milk production from front and rear teats as well as for morning and evening milking is presented in Table 1. The average production from front and rear teats in the morning was 903.81±15.82 and 1113.31±18.40 ml and in the evening was 615.56±14.36 and 776.11±16.76 ml respectively. The rear udder contributed 55.41% of the total milk as compared to 44.59% from the fore udder.

Higher milk production from rear teats as compared to the front teats and that in the morning as compared to the evening was consistently observed every day in all animals

and hence clearly established the above milking trend in dromedary. Sahani *et al.* (1998) also reported higher milk production in morning as compared to evening in Bikaneri and Jaisalmeri breeds of camel. Sahani *et al.* (1996) also reported higher milk production from rear teats as compared to the front teats in Bikaneri camels. Eisa and Hassabo (2009) observed in Arabi-Lahwee breed of Sudan that the depth of forequarters (20.9±0.75 cm) was significantly higher than that of the rear quarters (13.1±0.75 cm). Whereas, the diameter of rear teats (2.5±0.1 cm) was significantly higher than the fore teats (2.1±0.1 cm). The data pertaining to milk yield and composition of the fore and rear udder quarters indicated that rear udder produced 57.5% of the total milk yield, whereas the fore quarters yielded only 42.5%. It is also reported that to produce 1 L of milk 500 litres of blood is pumped through the udder (Wernery 2006). Under above circumstances it is envisaged that the amount of blood flow to different quarters appears to be a more important factor than the depth of the quarters for the quantity of milk produced. The average daily milk production pooled over breeds for the first phase of lactation was 3606.31±64.59 ml with Bikaneri producing 3158.94±250.36 ml and Kachchhi producing 4053.68±375.45 ml. Sahani *et al.* (1998) reported little higher values for Bikaneri (4.19±0.11 kg) but the same

Table 2. Month wise average daily milk production over entire lactation

(Two teat milking, milk yield in ml)

| Month | Bikaneri |         |         |          |          |         | Kachchhi |         |         |          |
|-------|----------|---------|---------|----------|----------|---------|----------|---------|---------|----------|
|       | 523      | 515     | 537     | 541      | 543      | 545     | 83       | 103     | 105     | 117      |
| 1     | 2686     | 3108    | 2237    | 2749     | 2593     | 2518    | 5897     | 4253    | 2864    | 5260     |
| 2     | 2906     | 3915    | 3279    | 3532     | 3435     | 2962    | 7856     | 4958    | 3861    | 6651     |
| 3     | 4346     | 4483    | 3729    | 3355     | 4181     | 3600    | 7192     | 4260    | 3749    | 8525     |
| 4     | 3543     | 4237    | 3569    | 2813     | 4231     | 3967    | 6993     | 3690    | 3228    | 8290     |
| 5     | 3570     | 3905    | 3020    | 2543     | 4140     | 3948    | 6723     | 3237    | 2823    | 7957     |
| 6     | 3207     | 3867    | 3073    | 2573     | 4003     | 3427    | 6507     | 3140    | 2810    | 6577     |
| 7     | 3203     | 3820    | 3277    | 2413     | 3633     | 3450    | 5893     | 2837    | 2520    | 5277     |
| 8     | 2940     | 3773    | 3337    | 2260     | 4083     | 3260    | 5523     | 3177    | 2467    | 6040     |
| 9     | 2720     | 3203    | 3050    | 2713     | 4137     | 3357    | 5873     | 3597    | 2287    | 5357     |
| 10    | 2740     | 2963    | 3103    | 2553     | 3903     | 3183    | 5470     | 3697    | 2200    | 4973     |
| 11    | 2753     | 2737    | 2890    | 2887     | 4097     | 3673    | 4863     | 3377    | 2247    | 5007     |
| 12    | 3103     | 2887    | 2907    | 2807     | 3877     | 3713    | 4550     | 2443    | 1660    | 4627     |
| 13    | 2800     | 2510    | 2723    | 2287     | 4093     | 2797    | 4327     | 1993    | 1883    | 4590     |
| 14    | 2937     | 1550    | 2890    | 1803     | 4120     | 1997    | 3338     | 1433(6) | 1597    | 4010     |
| 15    | 2547     | 1390    | 2200    | 1873     | 3013     | 1567    | 3187     | -       | 937     | 2621     |
| 16    | 2162     | 768(28) | 1917    | 1800     | 2778     | 566(28) | 3179     | -       | 643(23) | 2250     |
| 17    | 2013     | -       | 2050    | 1830     | 2580     | -       | 3452     | -       | -       | 1546     |
| 18    | 2123     | -       | 1987    | 1760     | 2550     | -       | 3780     | -       | -       | 1196(23) |
| 19    | 2250     | -       | 2060    | 1677     | 2377     | -       | 4217     | -       | -       | -        |
| 20    | 2090     | -       | 2007    | 1442(26) | 2567     | -       | 4000     | -       | -       | -        |
| 21    | 1655     | -       | 1530    | -        | 2517     | -       | 3216     | -       | -       | -        |
| 22    | 1413     | -       | 1307    | -        | 1937     | -       | 2707     | -       | -       | -        |
| 23    | 1097     | -       | 1033    | -        | 1407     | -       | 2900(1)  | -       | -       | -        |
| 24    | 1350(16) | -       | 1129(7) | -        | 1243(28) | -       | -        | -       | -       | -        |

Figures in parenthesis indicate the number of days for which the recording was done, when it was for less than one months period.

may be accounted for the higher lactation length (16 months) in present study as compared to the shorted recording period (12 months) in the referred study. Further, the recording in referred study was carried out only twice a week as compared to daily milking in the present study.

The lactation length of dromedary was divided in to two phases. The first phase comprised initial 16 months and the second phase comprised the rest of the months till 24 months for the reasons discussed below. The average daily milk production for first phase of lactation was  $3606.31 \pm 64.59$  ml with  $3158.94 \pm 250.36$  ml in Bikaneri and  $4053.68 \pm 375.45$  ml in Kachchhi. However, the effect of breed was non-significant ( $P > 0.05$ ). The highest milk production was  $5078.78 \pm 313.79$  ml of K-117, which was in third parity. The average daily milk production of the individuals varied significantly ( $P < 0.01$ ). Six animals continued giving milk beyond 16 months (second phase) and the average daily production in the second phase was  $2108.64 \pm 93.49$  ml with  $1910.64 \pm 178.74$  ml in Bikaneri and  $2306.64 \pm 361.19$  ml in Kachchhi breed. One female (K-117) out of these 6 also stopped giving milk in 18<sup>th</sup> month of lactation. All 5 she camels (B-515, B-545, K-105, K-117 and K-103) which discontinued the lactation were conceived and 4 of them

calved in the next calving season (Tables 1–2).

Out of 10 camels 9 continued till 16 months and the one (K-103) which discontinued giving milk in 14 month got conceived in the 12<sup>th</sup> month of lactation. Therefore the lactation in the camels was considered to be of 16 months duration. Accordingly the average lactation yield was 3462 litres. The second phase of lactation i.e. 16 to 24 months was also evaluated and it was observed that only 3 camels continued giving milk in the 24<sup>th</sup> month of lactation and there was about 58% reduction in average daily milk yield, Hence it was decided not to milk the animals beyond 16 months. There are several reports on the lactation length of the camel. Yagil (2000) reported that camels have the ability to maintain lactation length for much longer periods than cattle. Lactation length of 8–18 months (FAO, 2006), 12–18 months (Farah *et al.* 2007) and even up to 24 months has been cited. However, in the present study 16 months lactation has been worked out with proper support of the production data.

The average daily milk production varied significantly ( $P < 0.01$ ) with the month of lactation and parity (Tables 2–3). The average daily milk production was highest in third parity ( $4847.09 \pm 40.24$  ml) followed by fourth ( $3506.92 \pm 92.90$  ml), first ( $2722.33 \pm 18.52$  ml) and second

Table 3. Average daily milk production in different months and lactations

(Two teat milking, milk yield in ml)

|                | Parity                          |                                 |                                |                                 |
|----------------|---------------------------------|---------------------------------|--------------------------------|---------------------------------|
|                | 1 <sup>st</sup>                 | 2 <sup>nd</sup>                 | 3 <sup>rd</sup>                | 4 <sup>th</sup>                 |
| Over all Month | $2722.33 \pm 18.52(1789)$<br>** | $2574.68 \pm 12.31(1879)$<br>** | $4847.09 \pm 40.24(530)$<br>** | $3506.92 \pm 92.90(1528)$<br>** |
| 1              | $2620.22 \pm 75.59(90)$         | $2686.19 \pm 52.92(92)$         | $5620.33 \pm 109.89(30)$       | $4338.00 \pm 151.86(90)$        |
| 2              | $3309.55 \pm 75.59(90)$         | $3361.43 \pm 53.21(91)$         | $6651.00 \pm 109.89(30)$       | $5558.33 \pm 151.86(90)$        |
| 3              | $3712.11 \pm 75.59(90)$         | $4186.00 \pm 53.50(90)$         | $8525.33 \pm 109.89(30)$       | $5066.89 \pm 151.86(90)$        |
| 4              | $3670.44 \pm 75.59(90)$         | $3785.62 \pm 53.80(89)$         | $8290.00 \pm 109.89(30)$       | $4637.22 \pm 151.86(90)$        |
| 5              | $3543.89 \pm 75.59(90)$         | $3498.33 \pm 53.50(90)$         | $7956.67 \pm 109.89(30)$       | $4261.11 \pm 151.86(90)$        |
| 6              | $3334.44 \pm 75.59(90)$         | $3382.22 \pm 53.50(90)$         | $6576.67 \pm 109.89(30)$       | $4152.22 \pm 151.86(90)$        |
| 7              | $3165.55 \pm 75.59(90)$         | $3433.33 \pm 53.50(90)$         | $5276.67 \pm 109.89(30)$       | $3750.00 \pm 151.86(90)$        |
| 8              | $3201.11 \pm 75.59(90)$         | $3350.00 \pm 53.50(90)$         | $6040.00 \pm 109.89(30)$       | $3722.22 \pm 151.86(90)$        |
| 9              | $3402.22 \pm 75.59(90)$         | $2991.11 \pm 53.50(90)$         | $5356.67 \pm 109.89(30)$       | $3918.89 \pm 151.86(90)$        |
| 10             | $3213.3 \pm 75.59(90)$          | $2935.55 \pm 53.50(90)$         | $4973.33 \pm 109.89(30)$       | $3788.89 \pm 151.86(90)$        |
| 11             | $3552.22 \pm 75.59(90)$         | $2793.33 \pm 53.50(90)$         | $5006.67 \pm 109.89(30)$       | $3495.55 \pm 151.86(90)$        |
| 12             | $3465.55 \pm 75.59(90)$         | $2965.55 \pm 53.50(90)$         | $4626.67 \pm 109.89(30)$       | $2884.44 \pm 151.86(90)$        |
| 13             | $3058.89 \pm 75.59(90)$         | $2677.78 \pm 53.50(90)$         | $4590.00 \pm 109.89(30)$       | $2742.69 \pm 152.72(89)$        |
| 14             | $2640.00 \pm 75.59(90)$         | $2458.89 \pm 53.50(90)$         | $4010.00 \pm 109.89(30)$       | $2358.46 \pm 178.70(65)$        |
| 15             | $2157.75 \pm 76.01(89)$         | $2048.86 \pm 54.10(88)$         | $2620.68 \pm 111.77(29)$       | $2080.32 \pm 184.47(61)$        |
| 16             | $1740.91 \pm 76.44(88)$         | $1642.07 \pm 54.41(87)$         | $2232.00 \pm 109.89(30)$       | $2039.21 \pm 201.74(51)$        |
| 17             | $2205.00 \pm 92.58(60)$         | $2031.67 \pm 65.52(60)$         | $1546.42 \pm 113.75(28)$       | $3451.61 \pm 258.76(31)$        |
| 18             | $2155.00 \pm 92.58(60)$         | $2054.24 \pm 66.08(59)$         | $1195.65 \pm 125.51(23)$       | $3780.00 \pm 263.04(30)$        |
| 19             | $2026.67 \pm 92.58(60)$         | $2155.00 \pm 65.52(60)$         | -                              | $4217.24 \pm 267.53(29)$        |
| 20             | $2044.64 \pm 95.83(56)$         | $2047.45 \pm 66.08(59)$         | -                              | $4000.00 \pm 258.76(31)$        |
| 21             | $2516.67 \pm 130.92(30)$        | $1593.44 \pm 64.98(61)$         | -                              | $3216.00 \pm 263.04(30)$        |
| 22             | $1944.83 \pm 133.16(29)$        | $1365.57 \pm 64.98(61)$         | -                              | $2706.00 \pm 263.04(30)$        |
| 23             | $1406.67 \pm 130.92(30)$        | $1066.10 \pm 66.08(59)$         | -                              | $2900.00 \pm 1440.72(1)$        |
| 24             | $1248.15 \pm 138.01(27)$        | $1282.61 \pm 105.83(23)$        | -                              | -                               |

Figures in parenthesis indicate number of observations.

(2574.68±12.31 ml) parity. The peak yield was observed in the third month of lactation in first, second and second parity but the same was observed in second month of fourth parity camels. Fourth and fifth month showed little decline from the peak yields followed by second month. Variation in milk yield with the month of lactation is an established fact however the same has also been reported by Sahani *et al.* (1996, 1998).

Though the milk production varies significantly with the parity but significant variation in the milk production of animals belonging to same breed and parity was observed. (Table 1). This study therefore substantiates the thinking that the camels in this country have not been bred for exploiting the milk production potential but draught had been their main purpose of rearing. The Centres' endeavour to go for selective breeding and production of elite males for the milk production potential will thus not only help us in conserving this threatened species of arid and semi-arid eco system but also ensure nutritional security to the weaker section

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