62nd Annual Meeting EAAP 2011
August 29th – September 2nd
Stavanger NORWAY

Milk partitioning and accumulation in the camel udder according to time elapsed after milking

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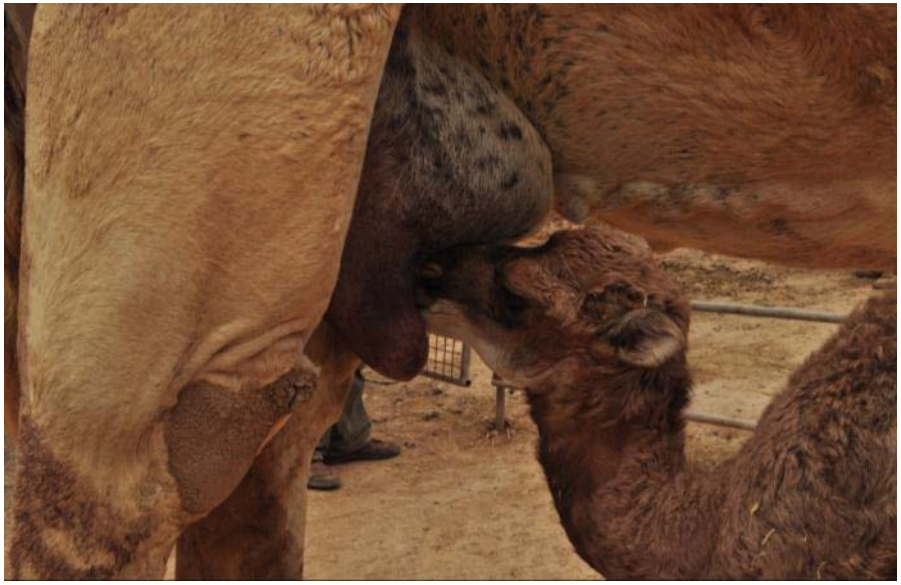
Introduction

- Camel is an important dairy specie for arid zones.
- Camel milk used for the treatment of tuberculosis and hepatitis B and might have insulin effects.
- Camel's lactation biology has remained neglected in comparison with other livestock species.
- Udder with 4 quarters (cow like) and teats with 2 canals (mare like).
- Milking usually done by hand using sucking camel calves for inducing milk letdown.
- Anatomical and physiological data are necessary for the development of camel's machine milking.
- Effects of milking frequency litlle known throughout lactation (Ayadi et al., 2002).
- Controversial data on camel udder cisterns:
  - No cisterns (Yagil et al., 1999)
  - Small cisterns (Ayadi et al., 2002).

Objectives

1) To study the **milk accumulation** pattern in the camel's udder according to time elapsed after milking.
2) To explore the **features and size of the cisternal compartment** (cistern or not cistern?)
3) **Cisternal recoil** after milk letdown.



Materials & methods (1/6)

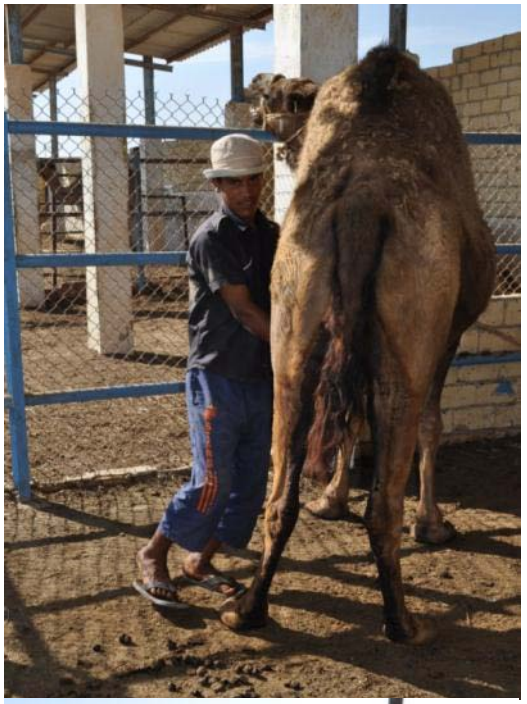
Animals & Management:

- **10 Egyptian she camels** in loose stalls at mid lactation from the camel station of APRI (Marsa Matrouh, Egypt).
- Camels of **10.3 ± 0.9 yr** (parity, 5.8 ± 0.6) and 484 ± 29 kg BW
- Feeding: 4.5 kg/d dry forages (bersim clover hay, saltbush and rice straw) and 3.5 kg/d concentrate (12%CP).
- **Hand milked 2x** daily (0800 and 2000 h) without the calf (281 ± 41 DIM, October) and average milk yield: **4.4 ± 0.4 L/d**

Materials & methods (2/6)

Study of milk accumulation in the camel's udder:

- **6 milking intervals** (4, 8, 12, 16, 20 and 24 h) at random during consecutive days.
- **Milk partitioning** by hand milking:
  - **Cisternal milk (CIS)** before udder stimulation
  - **Alveolar milk (ALV)** after an i.v. of oxytocin (OT, 6 IU/camel) in the jugular.
- Milk sampling for analysis (not done yet)
- **Udder scanning by ultrasonography** (SonoSite portable) of udder cisterns (Ayadi et al., 2002).
- **Cisternal recoil** (reverse milk letdown) 90 min after OT injection (Caja et al., 2004).



Materials & methods (3/6)

Milk accumulation procedure (Ayadi et al., 2002)**:**

1) **Cisternal scanning (1st)** of front udders quarters (left-right) in duplicate (before OT)
2) Hand milking of the whole udder (**CIS milk**)
3) **OT i.v. injection** (6 IU/camel)
4) Waiting time (1 min)
5) **Cisternal scanning (2nd)** of front udder quarters (left-right) in duplicate (after OT)
6) Hand milking of the whole udder (**ALV milk**)

Materials & methods (4/6)

Cisternal scanning of the **front quarter** using a **5 MHz sectorial probe** (Sonosite) vertically placed besides the teat and with contact gel (Ayadi et al., 2002).

Materials & methods (5/6)

Cisternal recoil procedure (Caja et al., 2004)**:**

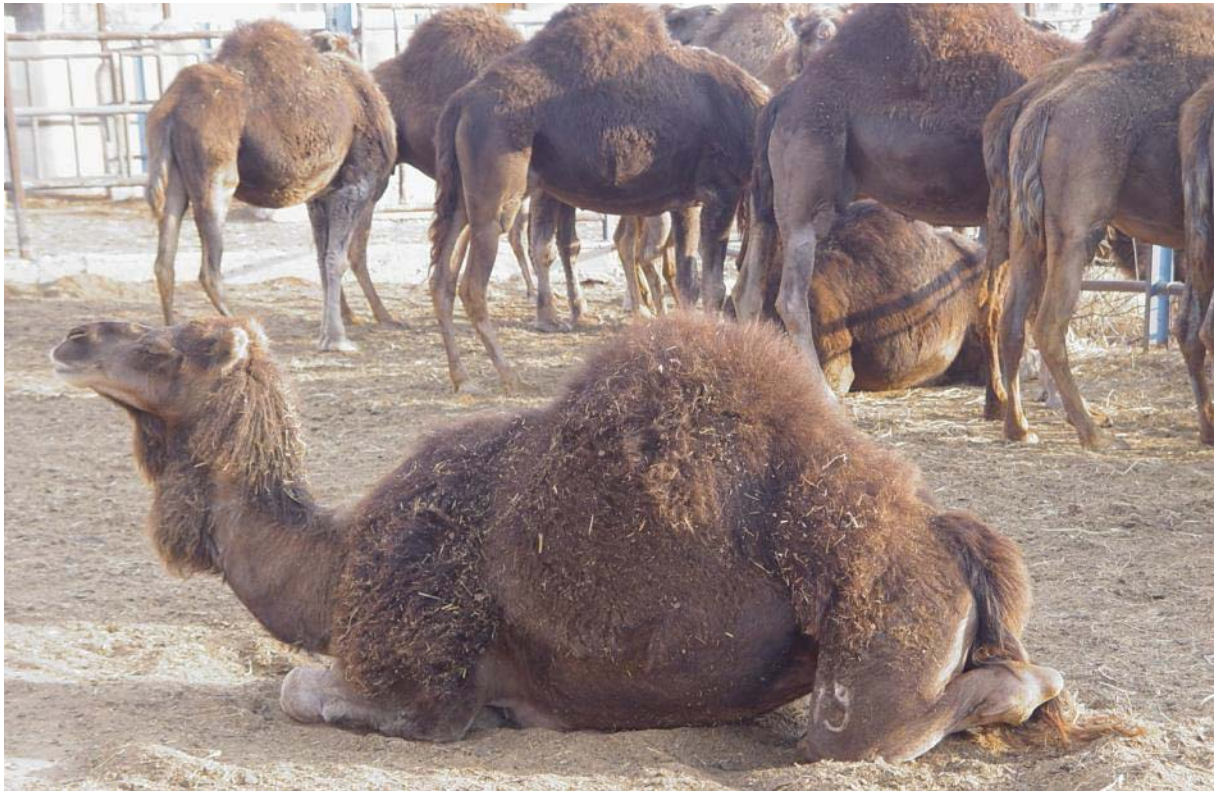
1) Previous scans of not stimulated udders used as a reference (0 min)
2) OT i.v. injection (6 IU/camel) in the jugular
3) Waiting time (5 min)
4) **Cisternal scanning (1st)** of a selected udder half (by quarter and in duplicate) according to a previously established random order.
5) **Milking of the contralateral udder half** by quarter (**V1**).
6) Waiting time (90 min).
7) **Cisternal scanning (2nd)** of the udder half previously scanned (by quarter and in duplicate).
8) **Milking of the scanned udder half** by quarter (**V2**).

Recoil = V1 (5 min) – V2 (90 min)

Materials & methods (6/6)

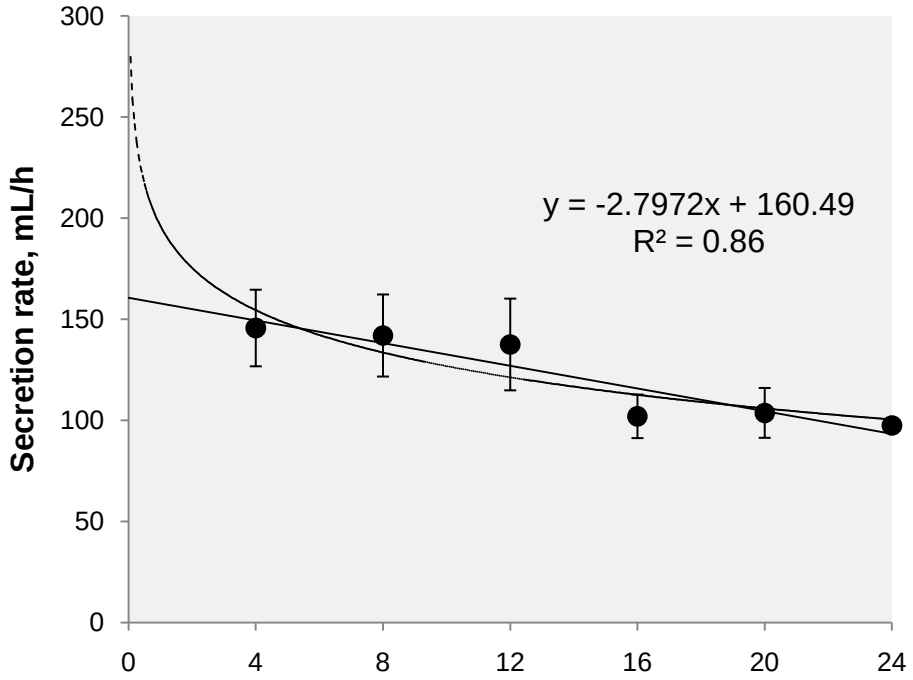
Statistical analyses:

- **PROC MIXED** for repeated measurements of **SAS** (v. 9.2, SAS Institute Inc., Cary, NC).
- Differences between LSM separated with the **PDIFF** test of SAS and significance declared at $P < 0.05$.

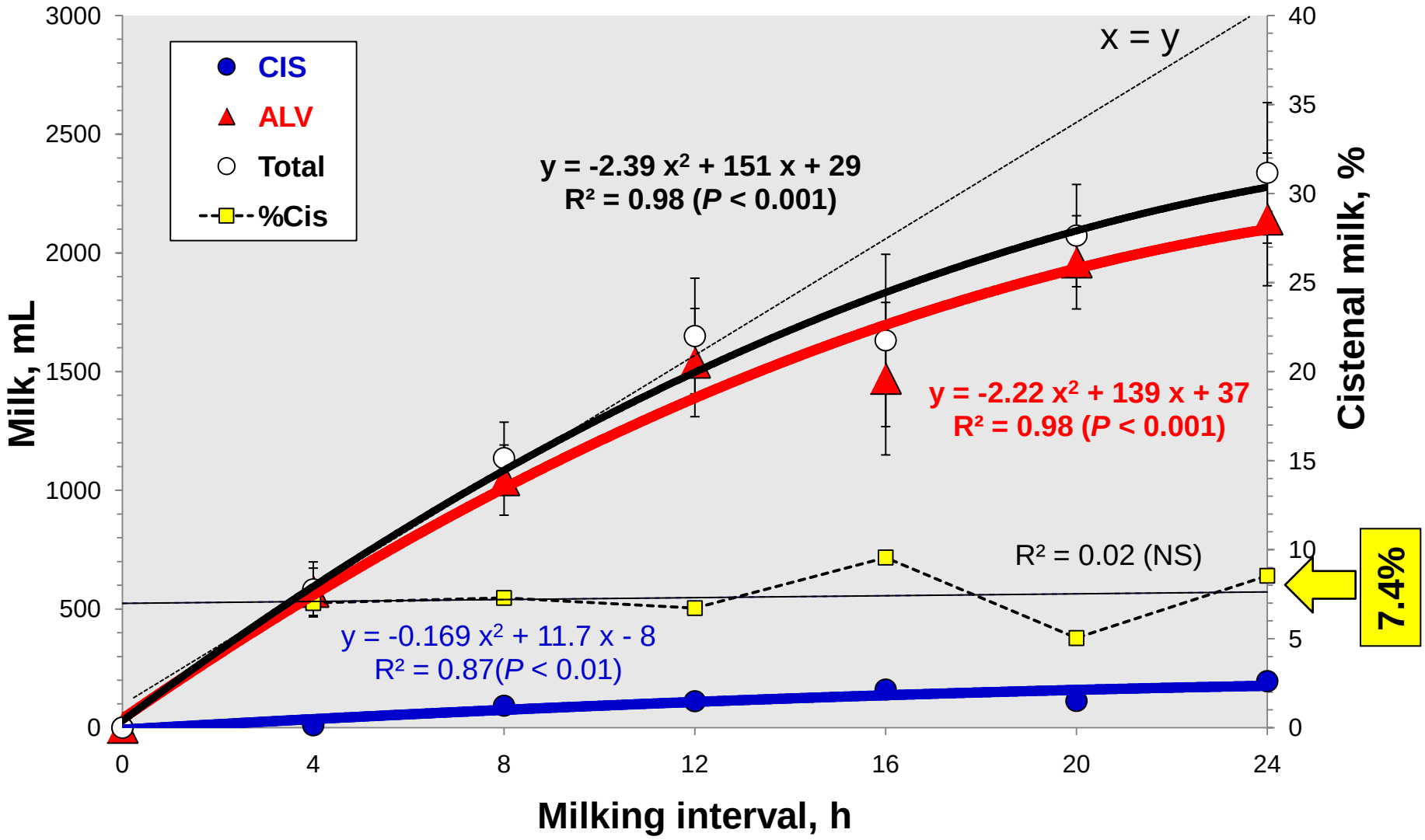


Udder compartments and secretion rate

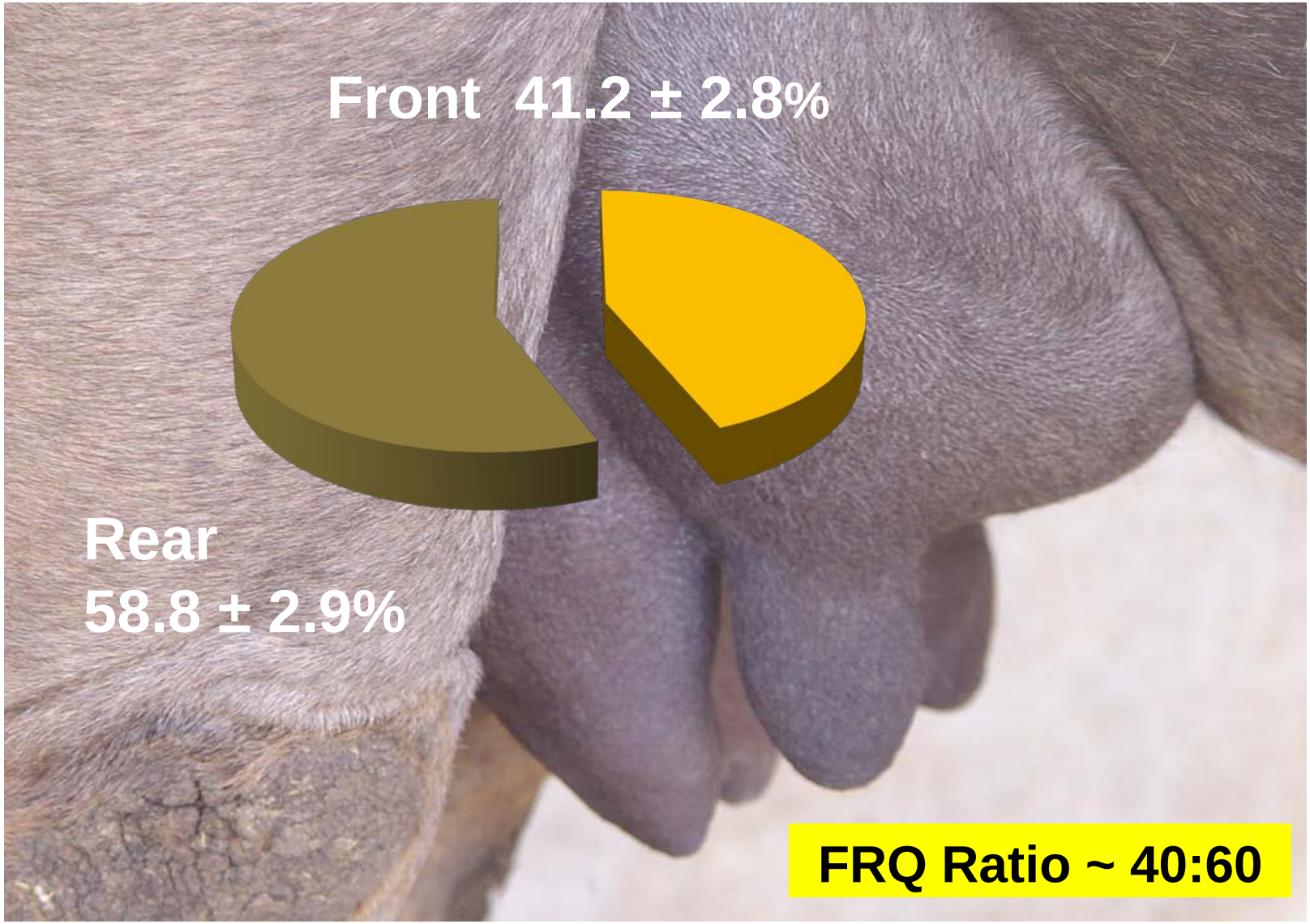
- Milk showed **quadratic** trends of accumulation in the udder:
  - **ALV: 92.6 ± 0.7%** (90-95%; $R^2 = 0.98$, $P < 0.001$)
  - **CIS: 7.4 ± 0.7%** (5-10%; $R^2 = 0.87$, $P < 0.01$)
  - **Total milk** ($R^2 = 0.98$, $P < 0.001$)
- Milk **secretion rate decreased linearly** ($R^2 = 0.86$) with time elapsed after milking:



Milk accumulation in the udder according to milking interval (up to 24 h) in dairy camels

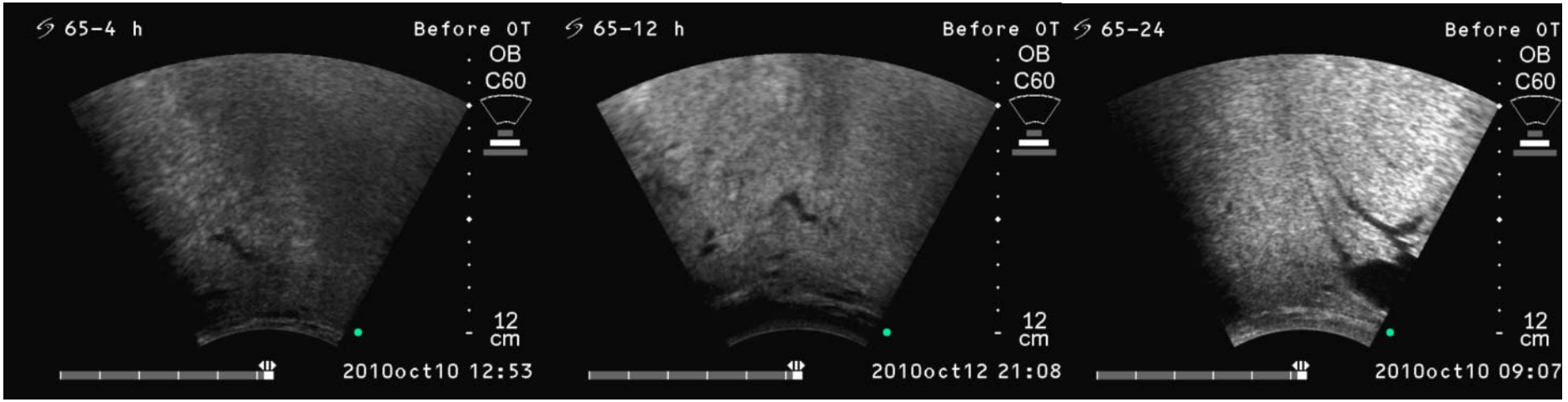


Front to rear quarter (FRQ) milk ratio in the udder of dairy camels

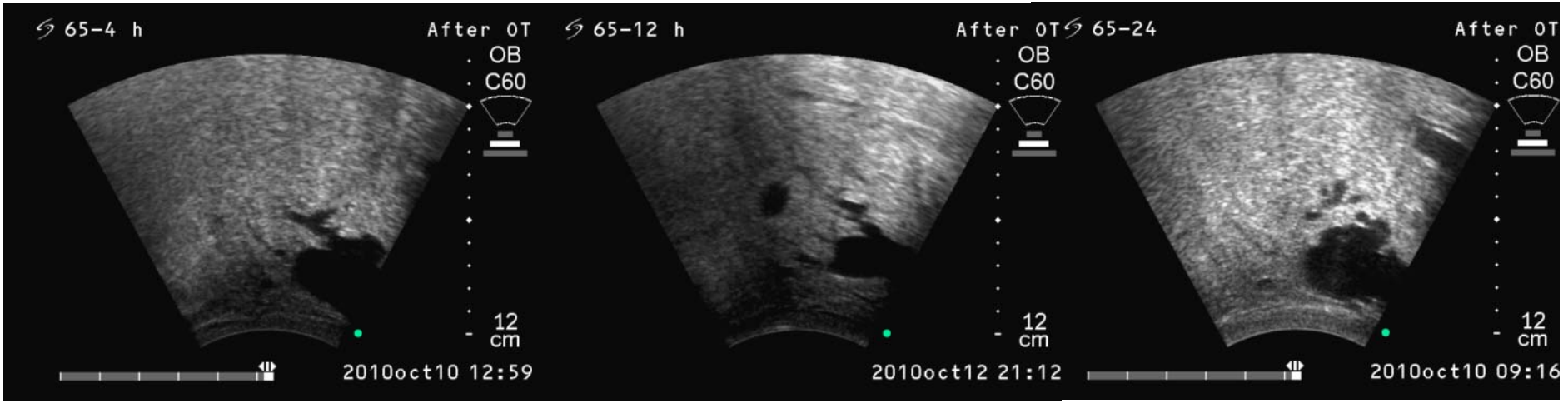


Cisternal scans of the camel´s udder: 4, 12 & 24 h

Camel #65: Before OT



Camel #65: After OT



Milk partitioning by udder quarter and cisternal recoil in dairy camels (mL)

Milking time after milk letdown (min)[1]	Udder quarter		Udder half Total milk
	Front milk	Rear milk	
V1 (5 min)	546 ± 54^{b} (41.2 ± 2.8%)	778 ± 107^{c} (58.8 ± 2.9%)	1,324 ± 159^{y} (100%)
V2 (90 min)	236 ± 53^{a} (46.5 ± 2.7%)	271 ± 105^{a} (53.5 ± 2.8%)	506 ± 157^{x} (100%)
Cisternal recoil (V1 – V2)	311 ± 53 (-56.9%)	507 ± 106 (-65.2%)	818 ± 156 (-61.8%)

–62%

[1]Induced by an i.v. injection of oxytocin (6 UI/camel)

$^{a, b, c}$ $P < 0.05$; $^{x, y}$ $P < 0.01$

Conclusions

- Milk accumulation decreased markedly after 12 h milking interval.
- No milking intervals longer than 16 h are recommended (i.e., daily milking schedule 12-12 or 8-16 h).
- Udder cisterns of small size detected by ultra-sonography after 4 h milking interval.
- Small cisternal milk (7%) needing improvement for selection to allow a better milkability.
- Dramatic decrease of milk after milkletdown by a strong cisternal recoil, needing a fast milking after stimulation.
- Further research is needed to improve milk yield in dairy camels.

Thanks for attention!