Session 1 Poster 31

HORMONAL (Thyroxin, Cortisol) AND IMMUNOLOGICAL (Leukocytes) RESPONSES TO CISTERN SIZE AND HEAT STRESS

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INTRODUCTION

- Cistern size is correlated to milk production, and milk production decreases under heat stress.
- Heat stress response in farm animals involves activation of the hypothalamus. Hormones such as cortisol and thyroxin are released and might be used as stress indicators. High cortisol levels might cause depression of the immune system.
- The objective of the present study was to measure hormonal and immunological responses to cistern size, heat stress and their interaction.

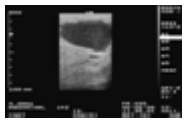
MATERIALS & METHODS

Animals

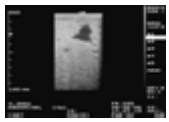
- Sixty Holstein multiparous cows raised In Tunisia (37° 3' 41" N and 9° 39' 45" E)
- DIM: 170 ± 15
- Milk yield/cow/d: 18 ± 5 l/d
- Twice daily milking (4 am & 4 pm)

Grouping Cistern Size

- Ultrasonography: Aloka AMB7v (Quebec, Canada) was used with a linear probe of 4 MHZ
- Cistern evaluation according to Ayadi et al (2003)



Large cistern (44 ± 13cm²)



Small cistern (21 ± 8 cm²)

Test days (year 2006)

D1: April – 5 no heat stress
D2: July – 19 heat stress
D3: August – 19 heat stress
D4: September – 19 heat stress

Environmental parameters

- Ambient temperature (Ta) & Relative Humidity (RH) (Thermohygrometre, HANNA)
- THI = 1.8 x Ta – (1- RH) x (Ta – 14.3)+ 32 (Kibler, 1964).

Laboratory analyses

Blood was collected every test day at 12:30h by jugular vein puncture. The serum was used to analysis :

- Thyroxine (T4) and Cortisol using the RIA technique. Concentrations of T4 were measured only during the hot period D2 – D4.
- Smears were prepared with Wright and Giesma stains. Leucocytes (lymphocytes, eosinophils, neutrophils and monocytes) were counted differentially using light microscopy.

RESULTS

Table 1. Environmental data during test days – mean (min – max).

Item	April - 5	July - 19	August - 19	September - 19
Ta (°C)	16.9 (14 - 18)	30.4 (27 - 33)	33.0 (29- 38)	29.0 (28 - 30)
RH (%)	75 (67 - 85)	53 (47- 65)	59 (46 - 80)	52 (48- 56)
THI	62 (58- 64)	79 (75- 81)	84 (81- 88)	77 (77- 78)

Table 2. Effect of cistern size on Cortisol and Thyroxin (T4) hormone of dairy cows (Least square means ±SE)

Hormones	Cistern		Effect	
	Large Cistern	Small Cistern	Cistern	Cistern*Period
T4 (nmol/l)	52.66 ± 0.06^{a}	67.66 ± 0.07^{b}	**	ns
Cortisol (nmol/l)	28.35 ± 0.11	32.27 ± 0.11	ns	ns

** $p < 0.01$; ns = not significant ($p > 0.05$)

Table 3. Least squares means of Thyroxin and Cortisol hormones of dairy cows at each test day

Hormones	Test day				Effect	
	April - 5	July - 19	August - 19	September - 19	Period	Cistern*Period
T4 (nmol/l)	Not measured	87.37 ± 0.07^{a}	42.77 ± 0.09^{b}	53.51 ± 0.08^{b}	***	ns
Cortisol (nmol/l)	25.00 ± 0.25	37.31 ± 0.10	28.91 ± 0.12	31.04 ± 0.10	ns	ns

*** $p < 0.001$; ns = not significant ($p > 0.05$)

- During summer, T4 concentration were significantly higher ($p < 0.05$) in cows with small cisterns compared to cows with large cisterns.
- During summer, T4 concentrations decreased over time. T4 was lowest when THI was highest.
- Cortisol concentrations were effected neither by test day nor by cistern size.

Table 4. Least squares means of Leukocyte of dairy cows at each test day

Leukocytes	Test day				Effect		
	April (5)	July (19)	August (19)	September (19)	Cistern	Period	Cistern*Period
Neutrophile (%)	23.42 ± 2.68^{ab}	20.03 ± 1.04^{b}	22.82 ± 1.32^{b}	26.81 ± 1.05^{a}	ns	***	$p = 0.09$
Eosinophil (%)	1.21 ± 2.2^{c}	11.51 ± 0.85^{a}	4.69 ± 1.08^{c}	8.17 ± 0.86^{b}	ns	***	ns
Lymphocyte (%)	73.58 ± 2.72^{a}	64.69 ± 1.06^{b}	65.62 ± 1.34^{b}	60.42 ± 1.06^{c}	ns	***	ns
Monocyte (%)	1.79 ± 0.96^{c}	3.84 ± 0.37^{b}	5.05 ± 0.47^{a}	4.61 ± 0.37^{ab}	ns	*	$p = 0.10$

*** $p < 0.001$; * $p < 0.05$; ns = not significant ($p > 0.15$)

- Proportions of lymphocytes decreased in summer compared to spring.
- Proportions of neutrophyles, eosinophils and monocytes increased in summer compared to spring.
- Proportions of individual leukocyte classes did not depend on cistern size.

CONCLUSIONS

1. T4 concentrations:
   - Hot environments might be more stressful for large – compared to small – cisterned cows.
   - Impact of heat stress might depend on exposure time.
2. Lymphocyte %:
   - Immune system of cows might be depressed during summer.

REFERENCES

- Ayadi M, Caja G, Such X and Knight CH 2003. Use of ultrasonography to estimate cistern size and milk storage at different milking intervals in the udder of dairy cows. J. Dairy Res 70, 1-7.

- Kibler HH 1964. Thermal effects of various temperature-humidity combinations on Holstein cattle as measured by eight physiological responses. University of Missouri Agricultural Experiment Station, Research Bulletin 862, 1- 42.

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