Holstein cows in early lactation:

milk and plasma fatty acids contents along with plasma métabolites and hormones as influenced by days in milk, parity and yield

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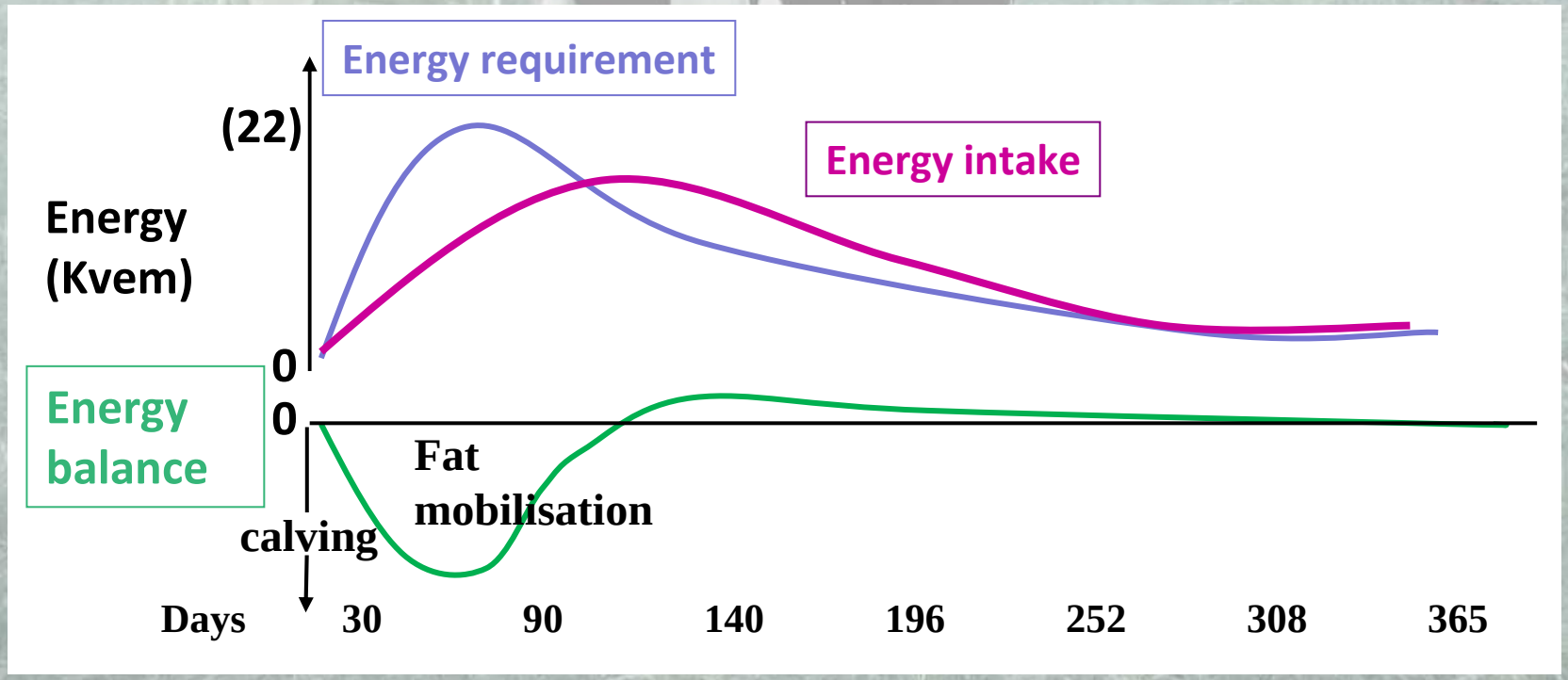
Introduction

1. **Energy métabolism is physiologically affected by :**
   a. Days in milk
   b. Lactation number
   c. Yield



Introduction

2. **Monitoring the energy metabolism during the waiting period is essential but difficult :**
   a. Tools are inaccurate : ex. BCS, Fat/P in the milk
   b. Tools are invasive and demanding: BHB, glucose, NEFA…
3. **Fatty acids could be better tools to manage this period :**
   a. Fatty acids are linked to nutrition (short chains)
   b. Fatty acids are linked to fat mobilisation (long chains)
4. **Interpretation of the fatty acids profil is unusual in routine :**

So : the aim of the study was to assess the influence of days in milk, parity and yield on fatty acids profil in blood and milk and hormones in blood

I. Materials and methods

1. **Characteristics of the farms :**
   a. 32 cows from 5 private farms
   b. Good management with achievement of the goals by the farmers :
      - Production and milk quality: 7727 ± 1201.2 kg milk, 43.3 ± 3.1 g fat/l and 34 ± 1.0 g proteins/l , 250.8 ± 27 mg urea/l , 271 150 ± 89924 cells/ml,
      - Reproduction : AFC 26.8 ± 1.8 months, CI 397 ± 14.0 days
      - Sanitary : prophylaxy and IBR status in order
      - Nutrition : mostly grass silage (60%), balanced to achieve production goals
2. **Samples :**
   a. Taken every month, from the first milk recording to the positive pregnancy test (3-5th milk recording)
   b. blood, milk and gynecologic examination (sonograph)

II. Results

1. Influence of the days in milk

a. In the milk

		Fatty acids profil in milk (%)					Fat (g/kg)
		C4-C14	**C16**	**C18:0**	**C18:1**	**Polyuns.**	
Days in milk	**<50**	**18.3^{a}**	**32.6^{a}**	**14.5^{b}**	**28.7^{b}**	2.7^{b}	44.9
	50-99	21.4^{b}	35.6^{b}	12.4^{a}	24.7^{a}	2.4^{a}	41.8
	≥ 100	21.4^{b}	34.3^{a,b}	12.9^{a}	25.2^{a}	2.7^{b}	42.8
SEM		*0.32*	*0.44*	*0.22*	*0.47*	*0.05*	*0.07*
P>F		***	*	***	***	*	**NS**

- During the first period (<50 d.) the following majors changes were:
  - Increase of the C18:0 and C18:1 (fat mobilisation)
  - Decrease of the C4-C14 (rumen function)
  - C16 : less clear but double origin (blood and neosynthesis)
- Changes in the fatty acids profil without any changes of fat content

II. Results

b. In the blood : hormones and metabolites

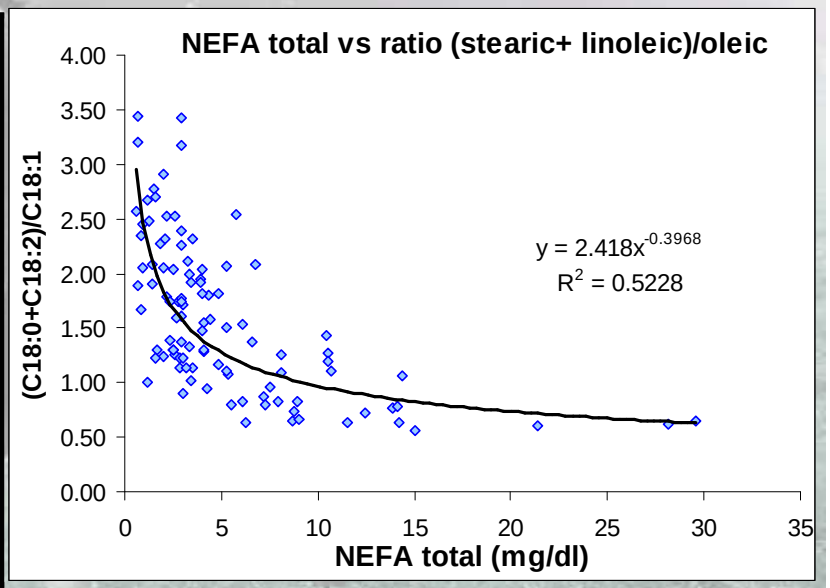
		Chol. (mmol/dl)	TG (mmol/dl)	Glu (mg/dl)	BHB (mg/dl)	NEFA (mg/dl)	Insulin (µUI/ml)	IGF1 (ng/ml)	P_4 (ng/ml)
Days in milk	**<50**	**4.2^{a}**	**0.14^{a}**	**60.1^{a,b}**	**1.1^{b}**	**8.0^{b}**	**7.2^{a}**	**32.7^{a}**	**2.9^{a}**
	50-99	**5.3^{b}**	**0.15^{b}**	63.3^{a}	**0.8^{a}**	**3.9^{a}**	**9.9^{b}**	**63.0^{b}**	**4.9^{b}**
	≥ 100	5.7^{b}	**0.2^{c}**	**54.8^{b}**	0.6^{a}	4.1^{a}	13.9^{b}	76.6^{b}	6.6^{b}
SEM		*0.12*	*0.01*	*1.11*	*0.05*	*0.45*	*0.46*	*2.78*	*0.38*
P>F		***	***	*	***	***	***	***	***

- As in milk, it was in the first period that most changes happened.
  - Lower contents in cholesterol, TG, insulin, IGF1 and progesterone.
  - Higher concentrations in BHB, NEFA
- The metabolic pathways in the liver were directed to produce fuels utilized largely by organs like brain, mammary gland…

II. Results

b. In the blood: fatty acids profile in the NEFA fraction

		Fatty acid profil of th NEFA fraction (%)			
		C16:0	C18:0	C18:1	C18:2
Days in milk	**<50**	24.7	**36.0^{a}**	**35.3^{b}**	**3.9^{a}**
	50-99	23.8	**40.1^{b}**	**28.4^{a}**	**7.7^{b}**
	≥ 100	24.2	40.4^{b}	28.5^{a}	6.9^{b}
SEM		*0.31*	*0.7*	*0.72*	*0.5*
P>F		NS	*	***	**



- C18 : 1 decreased to alarge extent with the days in milk while C18:0 and C18:2 increased.
- C18:1 and the ratio C18:2+C18:0 / C18:1 could be a reliable and better marker of the fat mobilization than total NEFA

II. Results

2. Influence of the parity

In the milk	Fatty acids profile in milk (%)					Prod. (kg)	Fat (g/kg)
	C4-C14	**C16**	**C18:0**	**C18:1**	**Polyuns.**		
Primiparous	**19.4**	32.3	**14.4**	**27.7**	2.9	**28**	42.8
Pluriparous	**21.4**	36.1	**12.2**	**24.7**	2.3	**36.9**	44.5
SEM	*0.32*	*0.44*	*0.22*	*0.47*	*0.05*	*0.7*	*0.07*
P>F	**	***	***	**	***	***	+

In the blood	TG (mmol/dl)	BHB (mg/dl)	NEFA (mg/dl)	Fatty acids in the NEFA fraction				IGF1 (ng/ml)
				C16	C18	C18:1	C18:2	
Primiparous	0.14	**0.65**	**6.4**	23.1	**36.2**	**33.5**	6.9	**71.5**
Pluriparous	0.13	**1.02**	**4.7**	25.3	**40.6**	**28.7**	5.5	**43.3**
SEM	*0.01*	*0.05*	*0.45*	*0.31*	*0.7*	*0.72*	*0.5*	*2.78*
P>F	*	**	**NS**	**	*	**	**NS**	***

- Larger mobilization (milk and blood) in young animals even when multiparous had higher yield
- A faster adaptation of the liver to negative energy balance for pluriparous cows

II. Results

3. Influence of the yield

In the milk	Fatty acids profil in milk (%)					Fat (g/kg)
	C4-C14	C16	C18:0	C18:1	Polyuns.	
< 29 kg milk/d	20.4	36	12.9	25.1	2.4	43.3
30-39 kg m/d	20.7	33.4	13.4	26.5	2.6	44.4
>39 kg m/d	20.0	32.0	13.9	27.8	2.8	43.3
SEM	*0.32*	*0.44*	*0.22*	*0.47*	*0.05*	*0.07*
P>F	**NS**	**	**NS**	**NS**	**NS**	**NS**

- Almost no differencies between yield levels
- Turn over in the liver faster in higher producing cows

In the blood	TG (mmol/dl)	Chol. Mmol/dl)	Glu. (mg/dl)	BHB (mg/dl)	NEFA (mg/dl)	Fatty acids in the NEFA (%)				P4 (ng/ml)	IGF1 (ng/ml)
						C16	C18	C18:1	C18:2		
< 29 kg milk/d	0.13^{a}	4.1^{a}	59.7	0.92	**3.9^{a}**	24.6	41.6^{b}	30.1	5.1	4.7	56.5
30-39 kg m/d	0.17^{b}	5.2^{b}	61	0.78	$5.5^{a,b}$	24.6	$37.6^{a,b}$	30.8	5.9	4.6	28.1
>39 kg m/d	0.18^{b}	5.9^{c}	57.5	0.79	**6.7^{b}**	23.6	35.9^{a}	31.3	7.7	5.1	57.6
SEM	*0.01*	*0.12*	*1.1*	*0.05*	*0.45*	*0.31*	*0.7*	*0.72*	*0.5*	*0.38*	*2.78*
P>F	***	***	**NS**	**NS**	**NS**	**NS**	*	**NS**	**NS**	**NS**	**NS**

- High producing cows can ajust their energy metabolism if the management of the farm is adapted.

III. Conclusion

a. As expected, primiparous animals vs pluriparous cows:
   - Mobilized more
   - Adapted their metabolism much slowly
   - Number of lactation will be an important criterion to classify cows in the interpretation of the fatty acid profil

b. Minimal differencies between yield classes :
   - Liver metabolism faster for high yielding cows
   - It is possible to keep healthy high yielding cows in early lactation if good management practices.

c. The evolution of the blood and milk parameters in early lactation suggested :
   - That fatty acids in milk could provide good information on the management of the energy balance in early lactation
   - Further research is needed to specify fatty acids and their changes and the link with reproduction performances or pathologies