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BOVINE MAMMARY NUTRIGENOMICS AND CHANGES IN THE MILK COMPOSITION DUE TO RAPESEED OR SUNFLOWER OIL SUPPLEMENTATION OF HIGH-FORAGE OR HIGH-CONCENTRATE DIETS

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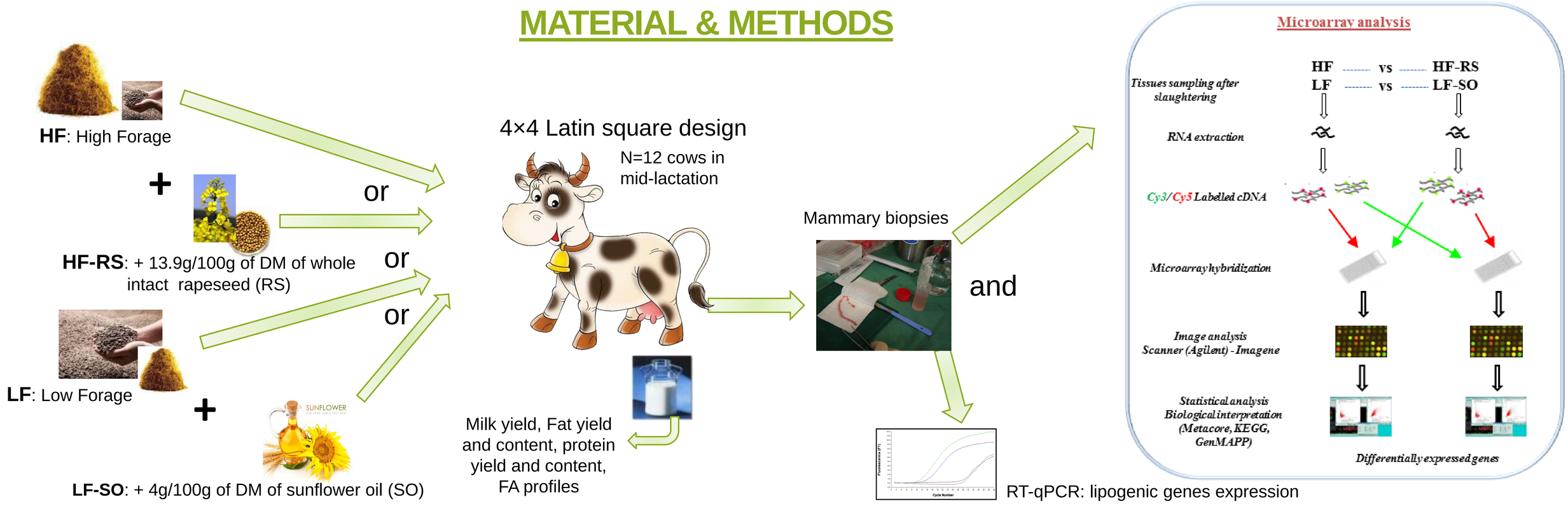
INTRODUCTION

The milk fatty acid composition is a major determinant of the nutritional quality of ruminant dairy products. Despite extensive studies on the effects of cow nutrition on milk fat composition, the overall mammary mechanisms underlying the variability of this composition are far from understood, especially for the diets used in husbandry. The present study examined the effect of two lipid supplements and two different forage-to-concentrate ratio diets on milk fatty acid composition and secretion. The effects of the addition of 2 types of lipids were also analysed on cow mammary genes expression.

MATERIAL & METHODS



RESULTS

MILK PRODUCTION AND COMPOSITION

Item	Treatment[1] HF	HF-RS	LF	LF-SO	SEM n= 12[2]	P
DMI, kg/d	18.08 b	17.03 a	18.62 b	17.78 ab	0.29	0.01
Milk, kg/d	18.4 a	17.5 a	17.9 a	20.5 b	0.43	0.001
Protein						
g/d	570 ab	535 a	550 a	610 b	14	0.02
g/kg	31.1 b	30.4 ab	30.8 b	29.8 a	0.25	0.008
Lactose						
g/d	913 a	881 a	889 a	1 043 b	23	0.001
g/kg	49.6 a	50.3 b	49.7 a	50.7 b	0.20	0.008
Fat						
g/d	733	735	716	758	20	0.56
g/kg	40.0 b	41.9 b	40.1 b	37.0 a	0.79	0.003
FFA[2]	0.55 b	0.44 a	0.58 b	0.61 b	0.034	0.02

[a-b] Means within a row with different superscripts differ ($P < 0.05$).
[1] Treatments: HF = high forage; HF-RS = high forage with whole intact rapeseeds; LF = low forage; LF-SO = low forage with SO,
[2] One missing value /48 samples
[3] FFA: free fatty acids expressed as mmoles/100 g of milk fat after 26-h storage at 4°C.

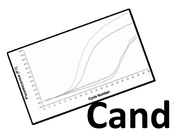
Item	Treatment[1] HF	HF-RS	LF	LF-SO	SEM n= 12[2]	P
C10 + C12 + C14	19.50 c	14.17 b	19.78 c	12.47 a	0.335	0.001
Σ C18	30.77 a	48.08 b	31.40 a	54.89 c	0.820	0.001
SAT FA[4]	70.02 c	61.07 b	70.75 c	53.39 a	0.635	0.001
Σ odd & branched	4.42 c	4.11 b	3.97 b	3.62 a	0.070	0.001
Σ FA *trans*	2.69 a	4.14 b	2.45 a	12.43 c	0.265	0.001

[a-c] Means within a row with different superscripts differ ($P < 0.05$).
[1] Treatments: HF = high forage; HF-RS = high forage with whole intact rapeseeds; LF = low forage; LF-SO = low forage with SO
[2] One missing value/48 samples
[4] SAT FA = saturated fatty acid

LF-SO *vs*. LF ⇨ an increase of milk, protein and lactose yield and lactose content whereas protein and fat content were decreased.
HF-RS *vs*. HF ⇨ only to an increase of lactose content

The lipid supplementation with both RS and SO of cow diets largely changed the milk FA composition with higher amplitude of response of milk composition with the addition of SO to LF diet than with RS addition to the HF diet.

GENE EXPRESSION ANALYSES

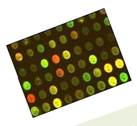


Candidate genes analysis: Using RT-qPCR, we showed that the dietary treatments had no effect on the mRNA abundance of 11 genes involved in lipids metabolism : *ACACA, FASN, SCD1, GPAM, DGAT1, CD36, FABP3, FABP4, XDH, INSIG1, MBTPS1*

HF-RS vs HF
N=8

Transcriptomic analysis:

⇨ No effect on mammary gene expression profiles



LF-SO vs LF
N=9

The mammary transcriptome modification was higher with the addition of SO to LF diet. 49 differentially expressed genes (DEG) with LF-SO compared to LF. Conversely, HF-RS diet compared with HF did not significantly affect the mammary transcriptome.

Transcriptomic analysis:

Functional category	Gene ID	Encode protein	Fold change	GenBank Accession n0.
Lipid metabolism and transport	ELOVL6	Elongation of very long-chain fatty acids protein 6	1.12	NM_001102155
	GDPD1	Ovis aries glycerophosphodiester phosphodiesterase domain containing 1	1.19	XM_004012407
	LPL	Lipoprotein lipase	0.83	NM_001075120
	APOH	Apolipoprotein H (beta-2-glycoprotein I)	1.14	NM_173992
	BTN2A1	Butyrophilin. subfamily 2. member A1	1.13	XM_002697557
Cell cycle, proliferation, differentiation, and death	APOH	BolA homolog 2B (E. coli)	1.14	NM_173992
	CNTN2	Contactin 2 (axonal)	1.11	XM_003583209
	GPRIN2	G protein regulated inducer of neurite outgrowth 2	1.22	NM_001205783
	KIAA0226	KIAA0226	0.88	NM_001101897
	KIAA1524	KIAA1524	1.14	NM_001103284
	LOXL3	Lysyl oxidase-like 3	1.16	NM_001192969
	RHOT2	Ras homolog family member T2	1.11	NM_178316
	TM4SF1	Transmembrane 4 L six family member 1	1.19	NM_001075980
Replication, transcription, translation	ADNP2	ADNP homeobox 2	0.92	NM_001101840
	CILP	Cartilage intermediate layer protein. nucleotide	1.11	XM_003582653
	EEPD1	Pyrophosphohydrolase	1.18	NM_001034409
	ELK4	Endonuclease/exonuclease/phosphatase family domain containing 1	1.13	NM_001081612
	ETV1	Ets variant 1	1.25	NM_001046492
	KDM6B	Lysine (K)-specific demethylase 6B	1.19	XM_003587412
	MYBBP1A	MYB binding protein (P160) 1a	0.93	XM_590665
	RBM5	RNA binding motif protein 5	1.11	NM_001046374
	RHOBTB2	Rho-related BTB domain containing 2	1.17	NM_001103104
	RNASE4	Ribonuclease. RNase A family. 4	1.21	NM_001040590
	ZNF592	zinc finger protein 592	1.16	NM_001102036
	ZNF653	zinc finger protein 653	1.09	XM_002688848
	ZNF821	zinc finger protein 821	1.13	NM_001038152

CONCLUSION

This study shows that lipid supplementation of cow diets using either RS or SO changed the milk fatty acid composition, Different effects were observed depending to the nature of lipid supplementation and the percentage of dietary concentrate on milk production, composition and mammary transcriptome with higher amplitude responses with SO addition to LF diet. A holistic view of the effects of SO addition to LF diet on mammary genes expression suggests the existence of mammary remodeling or transcriptional events due to the supplementation,

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