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季節及芻料來源對國內個別乳牛場總乳中乳脂肪酸組成之影響

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本研究旨在探討季節及芻料來源對國內個別乳牛場總乳中乳脂肪酸組成之影響。依據2022年8月至2023年7月每月收集國內3家（A,B及C）乳牛場總乳樣品，並以傅立葉紅外線光譜法（Fourier-transform mid-infrared, FTIR）進行36個樣品之乳脂肪酸分析，結果顯示A乳牛場飼糧中脂肪含量（3.91%）最低，且其總乳中新合成型脂肪酸含量（0.95 g/100 g）最高，可能與其飼糧中較低的脂肪含量及使用乾草而非青貯料有關。熱季三個乳牛場總乳中乳脂肪率有顯著差異，且以B乳牛場最低（ $P < 0.05$ ）。無論季節，總飽和脂肪酸、新合成型脂肪酸、混合型脂肪酸及棕櫚油酸含量以A乳牛場顯著較高（ $P < 0.05$ ）。乳牛場C總乳中預製型脂肪酸及油酸含量皆高於其他兩場（ $P < 0.05$ ），可能原因為乳牛場C位於南部熱緊迫可能會影響牛群採食量，且其飼糧中脂肪含量較高所致。上述結果說明，總乳中乳脂肪酸組成變化受到季節、飼糧中脂肪含量及芻料來源之影響。

表1. 三個乳牛場泌乳牛群飼糧組成

Table 1: The dietary data for milking cows at the three selected dairy farms

Farm A	
Major ingredient	concentrate ¹ , oat grass, Alfalfa
Crude protein (%)	15.49
Ether extract (%)	3.91 ^c
Neutral detergent fiber (%)	36.67 ^{ab}
Non-fiber carbohydrate (%)	37.94 ^a
Starch	21.08 ^a
Farm B	
Major ingredient	concentrate, oat grass, corn silage
Crude protein (%)	15.90
Ether extract (%)	4.45 ^b
Neutral detergent fiber (%)	37.26 ^a
Non-fiber carbohydrate (%)	35.73 ^b
Starch	20.07 ^b
Farm C	
Major ingredient	concentrate, oat grass, Alfalfa, Pennisetum grass, corn silage
Crude protein (%)	15.83
Ether extract (%)	6.09 ^a
Neutral detergent fiber (%)	35.14 ^b
Non-fiber carbohydrate (%)	37.15 ^a
Starch	22.01 ^a

1 Concentrate: milking cow concentrate and soybean hull.
a,b,c Means in the same item without the same superscript indicates a significant difference between farms ($P < 0.05$).

表2. 三個乳牛場總乳平均產乳量、乳脂肪率及乳脂肪酸含量

Table 2. Average milk yield, fat, and FA profile of bulk tank milk samples among the three selected dairy farms

Item	Farm		
	A	B	C
Milk yield (kg/day)	28.5±3.06	30.1±2.48	28.2±2.21
Fat (%)	3.90±0.17 ^{ab}	3.78±0.19 ^b	3.96±0.07 ^a
TSFA ¹ (%)	2.66±0.16 ^a	2.37±0.16 ^c	2.51±0.08 ^b
TUSFA (%)	0.95±0.10 ^b	1.04±0.09 ^a	1.11±0.06 ^a
De novo FA (%)	0.95±0.08 ^a	0.78±0.07 ^b	0.81±0.05 ^b
Mixed FA (%)	1.39±0.07 ^a	1.25±0.07 ^b	1.30±0.04 ^b
Preformed (%)	1.26±0.13 ^b	1.48±0.12 ^a	1.58±0.07 ^a
C14:0 (%)	0.37±0.02 ^a	0.32±0.02 ^b	0.33±0.01 ^b
C16:0 (%)	1.25±0.07 ^a	1.12±0.05 ^c	1.19±0.05 ^b
C18:0 (%)	0.34±0.04 ^b	0.37±0.04 ^b	0.40±0.02 ^a
C18:1 (%)	0.79±0.06 ^b	0.89±0.07 ^a	0.93±0.04 ^a

a,b,c Means in the same row without the same superscript indicates a significant difference between farms ($P < 0.05$).
1 TSFA: total saturated fatty acid; TUSFA: total unsaturated fatty acid; de novo fatty acids: C4:0, C6:0, C8:0, C10:0, C12:0, C14:0, and C14:1; mixed fatty acids: C16 and C16:1; preformed fatty acids: C15:0, C17:0, C18:0, C18:1, C18:2, C18:3, C20:0, C20:2, C 22:0, and C24:0.

表3. 三個乳牛場不同季節總乳平均產乳量、乳脂肪率及乳脂肪酸含量變化

Table 3. Variations in milk yield, fat, and FA profile of bulk tank milk samples among the three selected dairy farms within each season

Items	Farm	Season ¹		
		Cold	Hot	Warm
Milk yield (kg/day)	A	30.6±1.96	25.8±3.19	29.2±2.03
	B	30.7±2.29	28.7±2.29	31.1±2.78
	C	30.1±0.75	26.0±1.79	28.6±1.65
Fat (%)	A	4.00±0.18	3.81±0.09 ^{ab}	3.89±0.20
	B	3.95±0.09	3.61±0.10 ^c	3.78±0.19
	C	4.01±0.02	3.92±0.06 ^a	3.96±0.08
TSFA ² (%)	A	2.78±0.16 ^a	2.57±0.14 ^a	2.63±0.14 ^a
	B	2.52±0.10 ^b	2.22±0.11 ^c	2.38±0.13 ^b
	C	2.57±0.10 ^{ab}	2.49±0.06 ^{ab}	2.48±0.07 ^{ab}
TUSFA (%)	A	0.98±0.14	0.91±0.07 ^b	0.96±0.10
	B	1.10±0.04	1.00±0.11 ^{ab}	1.02±0.08
	C	1.13±0.07	1.07±0.01 ^a	1.13±0.08
De novo FA (%)	A	1.01±0.09 ^a	0.89±0.04 ^a	0.94±0.03 ^a
	B	0.86±0.02 ^b	0.70±0.04 ^b	0.77±0.06 ^{bc}
	C	0.86±0.03 ^b	0.76±0.01 ^{bc}	0.80±0.03 ^b
Mixed FA (%)	A	1.44±0.08 ^a	1.35±0.07 ^a	1.37±0.05 ^a
	B	1.32±0.04 ^{ab}	1.19±0.06 ^b	1.25±0.04 ^{bc}
	C	1.30±0.07 ^b	1.31±0.03 ^a	1.28±0.03 ^b
Preformed FA (%)	A	1.26±0.17 ^c	1.25±0.08 ^b	1.28±0.16 ^b
	B	1.53±0.05 ^{ab}	1.42±0.16 ^{ab}	1.50±0.13 ^{ab}
	C	1.60±0.06 ^a	1.54±0.03 ^a	1.60±0.10 ^a
C14:0 (%)	A	0.38±0.02 ^a	0.37±0.03 ^a	0.37±0.02 ^a
	B	0.33±0.01 ^{bc}	0.31±0.02 ^b	0.32±0.02 ^b
	C	0.33±0.01 ^c	0.33±0.01 ^{ab}	0.32±0.02 ^b
C16:0 (%)	A	1.27±0.08	1.25±0.09 ^a	1.24±0.06 ^a
	B	1.16±0.04	1.09±0.04 ^b	1.11±0.05 ^b
	C	1.17±0.06	1.24±0.03 ^a	1.16±0.03 ^{ab}
C18:0 (%)	A	0.34±0.05 ^b	0.33±0.03	0.34±0.06
	B	0.39±0.02 ^{ab}	0.35±0.05	0.36±0.03
	C	0.41±0.02 ^a	0.38±0.01	0.41±0.03
C18:1 (%)	A	0.81±0.08 ^c	0.75±0.03 ^c	0.80±0.06 ^b
	B	0.93±0.05 ^{ab}	0.85±0.07 ^{ab}	0.90±0.07 ^{ab}
	C	0.95±0.04 ^a	0.90±0.02 ^a	0.94±0.04 ^a

1 Cold: January, February, March, and December; Warm: April, May, October, and November; Hot: June, July, August, and September.
a,b,c Means in the same row without the same superscript indicates a significant difference between farms in the same season ($P < 0.05$).
2 TSFA: total saturated fatty acid; TUSFA: total unsaturated fatty acid; de novo fatty acids: C4:0, C6:0, C8:0, C10:0, C12:0, C14:0, and C14:1; mixed fatty acids: C16 and C16:1; preformed fatty acids: C15:0, C17:0, C18:0, C18:1, C18:2, C18:3, C20:0, C20:2, C 22:0, and C24:0.

