

Colour Stability, Fatty Acid Profile, and Lipid Oxidation in Meat Stored in Modified Atmosphere Packaging from Light Lambs Fed with Concentrate with Carob Pulp (*Ceratonia siliqua* L.)

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Table S1. Effect of batch (winter or summer) on meat colour parameters (L^* , a^* , b^* , C^* , chroma; and h° , hue angle), metmyoglobin formation (%MMb), drip loss, and lipid oxidation (MDA, malondialdehyde mg/kg meat) on *Semimembranosus* muscle.

Item	Batch		SEM ¹	<i>p</i> -value ²
	Winter	Summer		
L^*	44.8	46.8	0.40	<0.01
a^*	10.3	9.52	0.20	<0.01
b^*	8.40	8.77	0.18	0.159
C^*	13.4	13.0	0.21	0.141
h°	38.6	42.4	0.82	<0.01
%MMb	24.6	22.4	0.44	<0.01
Drip loss (%)	1.86	1.43	0.11	<0.01
Thawed loss (%)	3.50	5.96	0.29	<0.001
Moisture content (%)	76.0	76.0	0.16	0.886
MDA (mg/ kg meat)	0.41	0.42	0.05	0.945

¹Standard error of mean. ²Interaction between diet and batch was tested, and no significant effects were found.

Table S2. Effect of batch (winter or summer) on meat tocopherol (α , γ and δ) and cholesterol content of *Semimembranosus* muscle.

Item	Batch		SEM ¹	<i>p</i> -value
	Winter	Summer		
α -tocopherol μ g/g meat	2.85	2.17	0.16	<0.001
γ -tocopherol ng/g meat	158	151	13.4	0.660
δ -tocopherol ng/g meat	6.95	6.67	0.40	0.564
Cholesterol mg/g meat	0.86	0.84	0.03	0.597

¹Standard error of mean. ²Interaction between diet and batch was tested, and no significant effects were found.



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Table S3. Effect of batch (winter or summer) on total FAs (mg FAME/100 g meat) and the composition of saturated fatty acids (mg FA/100 g meat) of *Semimembranosus* muscle.

Item	Batch		SEM ¹	<i>p</i> -value ²
	Winter	Summer		
Total FA	2095	2063	113	0.842
C10:0	1.42	1.12	0.28	0.461
C11:0	0.17	0.19	0.03	0.665
C12:0	5.13	4.05	0.43	0.083
C13:0	10.5	10.3	0.45	0.792
C14:0	71.1	54.5	5.04	0.026
C15:0	17.1	15.8	0.63	0.156
C16:0	517	494	30.0	0.577
C17:0	32.8	33.7	2.12	0.761
C18:0	288	303	16.0	0.507
C19:0	0.86	0.91	0.12	0.758
C20:0	1.83	1.66	0.09	0.207
C21:0	0.84	0.81	0.10	0.811
C22:0	0.60	0.69	0.10	0.542
C24:0	0.10	0.06	0.02	0.138
Σiso-OBCFA	27.3	26.4	0.91	0.472
Σanteiso-OBCFA	13.1	11.7	0.62	0.116
ΣOBCFA	40.4	38.1	1.50	0.262
ΣDMA	71.2	73.6	6.00	0.979
ΣSFA Me	12.4	12.1	0.75	0.672
ΣSFA	947	921	52.0	0.718

¹Standard error of mean. ²Interaction between diet and batch was tested, and no significant effects were found. ΣOBCFA= sum of anteiso (*a*)- and iso (*i*)-fatty acids. ΣDMA=sum of dimethylacetals (DMA-C16:0 + DMA-C18:0 + DMA-C18:1). ΣSFA Me= ΣC14:0Me (C14:0-6Me + C14:0-8Me + C14:0-4Me + C14:0-10Me + C14:0-2.6DiMe) + ΣC15:0Me (C15:0-8Me + C15:0-4Me) + ΣC16:0Me (C16:0-2Me + C16:0-6Me + C16:0-8Me + C16:0-4Me + C16:0-12Me) + ΣC17:0Me (C17:0-12Me + C17:0-cyclo).

Table S4. Effect of batch (winter and summer) on the composition of mono- and poly- unsaturated fatty acids (mg FA/100 g meat) of *Semimembranosus* muscle.

Item	Batch		SEM ¹	<i>p</i> -value ²
	Winter	Summer		
C12:1	0.29	0.23	0.03	0.142
C14:1	2.48	1.55	0.15	<0.001
C15:1	2.07	2.04	0.14	0.888
C16:1	43.3	35.7	2.90	0.069
<i>cis</i> -C16:1	39.7	31.8	2.70	0.047
<i>trans</i> -C16:1	3.62	3.87	0.26	0.501
C17:1	28.7	31.7	2.00	0.314
<i>cis</i> -C17:1	27.2	30.3	2.00	0.283



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<i>trans</i> -C17:1	1.50	1.34	0.01	0.243
C18:1	742	752	49.0	0.871
<i>cis</i> 9-C18:1	607	614	40.2	0.899
<i>cis</i> 11-C18:1	50.8	54.0	4.38	0.615
<i>trans</i> 10-C18:1	28.9	28.7	2.90	0.964
<i>trans</i> 11-C18:1	24.4	25.3	2.40	0.795
<i>trans</i> 10/11-C18:1	29.2	27.9	1.82	0.626
C20:1	1.53	1.62	0.09	0.495
C22:1	0.47	0.57	0.04	0.070
C24:1	0.11	0.10	0.02	0.772
Σ <i>cis</i> -MUFA	756	762	50.2	0.938
Σ <i>trans</i> -MUFA	63.8	63.9	5.5	0.990
Σ MUFA	820	826	53.1	0.940
C18:2	184	182	9	0.837
C18:2n-6	177	175	8.69	0.836
C19:2n-6	0.81	0.75	0.06	0.475
C18:3n-6	1.45	1.53	0.08	0.495
C18:3n-3	9.13	7.51	0.48	0.022
C20:2n-6	1.42	1.35	0.07	0.467
C20:3n-9	12.6	13.8	0.78	0.320
C20:3n-6	5.75	5.46	0.2	0.322
C20:3n-3	0.07	0.09	0.01	0.166
C20:4n-6 ARA	71.9	70.0	3.2	0.681
C20:5n-3 EPA	7.94	5.64	0.58	0.009
C22:4n-6	4.51	5.46	0.21	<0.01
C22:5n-6	1.00	1.31	0.11	0.058
C22:5n-3 DPA	12.6	10.5	0.45	<0.01
C22:6n-3 DHA	5.80	3.87	0.39	<0.001
Σ CLA	7.91	7.32	0.41	0.314
<i>cis</i> 9. <i>trans</i> 11-C18:2	3.87	3.10	0.29	0.072
Σ n-6	264	261	11.68	0.833
Σ n-3	35.6	27.6	1.72	<0.01
Σ PUFA	327	316	13.7	0.570
n-6/n-3	7.59	9.72	0.39	<0.001
PUFA/SFA	0.36	0.35	0.01	0.819

¹Standard error of mean. ² Interaction between diet and batch was tested, and no significant effects were found. Σ *cis*-MUFA = C12:1 + C14:1 + *cis*8-C15:1 + *cis*9-C15:1 + *cis*7-C16:1 + *cis*9-C16:1 + *cis*11-C16:1 + *cis*15-C16:1 + *cis*5-C17:1 + *cis*7-C17:1 + *cis*9-C17:1 + DMAC18:1 + *cis*11-C17:1 + *cis*6/*cis*8-C18:1 + *cis*9-C18:1 + *cis*11-C18:1 + *cis*12-C18:1 + *cis*13-C18:1 + *cis*14-C18:1 + *cis*15-C18:1 + C20:1 + C22:1 + C24:1. Σ *trans*-MUFA = *trans*5-C18:1 + *trans*6/*trans*8-C18:1 + *trans*9-C18:1 + *trans*10-C18:1 + *trans*11-C18:1 + *trans*12-C18:1. Σ CLA = Sum of conjugated linoleic acids

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Table S5. Effects of dietary carob pulp inclusion (0, 15, and 30%) in the lambs' diet and display time (0, 7, 9, and 11 days) in Modified Atmosphere Packaging on the drip loss and thawed losses of lamb meat.

Item	Diet			SEM ¹	Display time (day)				SEM	<i>p</i> -value		
	C0%	C15%	C30%		0	7	9	11		Diet	Day	Diet*Day
Drip loss (%)	1.70	1.40	1.80	0.10	1.40	1.80	1.80	1.60	0.20	0.100	0.183	0.798
Thawed loss (%)	4.88	4.65	4.68	0.25	4.93 ^a	5.26 ^a	4.68 ^{ab}	4.08 ^b	0.29	0.363	0.004	0.084
Moisture content (%)	76.3	76.0	76.1	0.21	76.3	76.1	76.1	76.2	0.16	0.693	0.550	0.086

¹Standard error of the mean. ^{a,b} Least square means in the same row with different superscript letters are different ($p < 0.05$)



Table S6. Effects of carob pulp levels (0, 15, and 30%) in lambs' diet on the fatty acid composition (g FA/100 g of FAMES) of *Semi-membranosus* muscle from light lambs.

Variable	C0%	C15%	C30%	SEM [†]	<i>p</i> -value
C10:0	0.06	0.08	0.05	0.02	0.606
C11:0	0.01	0.01	0.01	0.002	0.867
C12:0	0.24	0.22	0.2	0.02	0.472
C13:0	0.66 ^a	0.54 ^{ab}	0.44 ^b	0.06	0.028
C14:0	3.18	3.1	2.74	0.19	0.183
C15:0	1.00 ^a	0.85 ^{ab}	0.67 ^b	0.06	0.003
C16:0	23.8	24.4	24.3	0.27	0.199
C17:0	1.80 ^a	1.58 ^b	1.44 ^b	0.05	<0.0001
C18:0	14.0	14.2	14.4	0.29	0.597
C19:0	0.04	0.04	0.04	0.01	0.577
C20:0	0.10 ^a	0.09 ^{ab}	0.07 ^b	0.01	0.012
C21:0	0.04	0.05	0.04	0.01	0.494
C22:0	0.02	0.03	0.04	0.005	0.156
C24:0	0.004	0.005	0.004	0.001	0.869
ΣBCFA	2.38 ^a	2.04 ^{ab}	1.6 ^b	0.150	0.004
ΣDMA	3.35	3.4	3.99	0.26	0.177
ΣSFA Me	0.64 ^a	0.62 ^{ab}	0.56 ^b	0.02	0.008
ΣSFA	45.0	45.2	44.5	0.57	0.656
C12:1	0.02	0.01	0.01	0.002	0.150
C14:1	0.12 ^a	0.10 ^{ab}	0.08 ^b	0.01	0.011
C15:1	0.11	0.1	0.1	0.01	0.639
C16:1	1.94	1.82	1.86	0.07	0.473
<i>trans</i> -C16:1	0.21	0.18	0.17	0.01	0.087
<i>cis</i> -C16:1	1.73	1.65	1.7	0.07	0.644

C17:1	1.49	1.34	1.51	0.07	0.153
<i>trans</i> -C17:1	0.08 ^a	0.07 ^a	0.06 ^b	0.01	0.001
<i>cis</i> -C17:1	1.4	1.27	1.45	0.07	0.146
C18:1	35.1	35.3	36.3	0.84	0.503
<i>cis</i> 9-C18:1	28.9	28.7	29.7	0.78	0.320
<i>trans</i> 10-18:1	1.43	1.61	1.2	0.150	0.195
<i>trans</i> 11-18:1	1.15	1.23	1.18	0.100	0.871
<i>cis</i> 11-C18:1	2.27 ^b	2.36 ^{ab}	2.74 ^a	0.140	0.044
C20:1	0.10 ^a	0.08 ^{ab}	0.07 ^b	0.01	0.028
C22:1	0.03	0.02	0.02	0.003	0.129
C24:1	0.01	0.005	0.005	0.001	0.461
Σ <i>trans</i> -C18:1	2.98	3.26	2.75	0.28	0.389
Σ <i>cis</i> -C18:1	32.0	32.0	33.5	0.84	0.320
Σ <i>cis</i> MUFA	35.8	35.5	37.2	0.83	0.320
Σ <i>trans</i> MUFA	3.1	3.36	2.84	0.26	0.367
Σ MUFA	38.9	38.8	40.0	0.88	0.530
C18:2	9.07	9.16	8.79	0.44	0.805
C19:2n-6	0.05 ^a	0.04 ^{ab}	0.03 ^b	0.01	0.037
C18:3n-6	0.08 ^a	0.07 ^{ab}	0.07 ^b	0.004	0.057
C18:3n-3	0.40	0.40	0.41	0.02	0.802
C20:2n-6	0.08 ^a	0.07 ^{ab}	0.06 ^b	0.01	0.021
C20:3n-9	0.67	0.61	0.67	0.05	0.572
C20:3n-6	0.31	0.28	0.26	0.02	0.121
C20:3n-3	0.005	0.010	0.003	0.001	0.081
C20:4n-6 ARA	3.55	3.51	3.45	0.2	0.941
C20:5n-3 EPA	0.33	0.33	0.33	0.03	0.977
C22:4n-6	0.28	0.25	0.23	0.02	0.142
C22:5n-6	0.05	0.06	0.06	0.01	0.132

C22:5n-3 DPA	0.61	0.58	0.54	0.04	0.422
C22:6n-3 DHA	0.24	0.25	0.22	0.02	0.715
Σ CLA	0.42 ^a	0.36 ^b	0.35 ^b	0.02	0.014
<i>cis</i> 9, <i>trans</i> 11- C18:2	0.21 ^a	0.16 ^{ab}	0.15 ^b	0.01	0.010
Σ n-6	13.1	13.1	12.6	0.6	0.760
Σ n-3	1.59	1.57	1.51	0.09	0.800
Σ PUFA	16.2	16.0	15.5	0.71	0.756

^aStandard error of the mean. ^{a,b} Least square means in the same row with different superscript letters are different ($p < 0.05$); Σ CLA= Sum of Conjugated Linoleic Acids. Σ BCFA= sum of a- and i-fatty acids. Σ DMA= sum of dimethylacetals (DMA-C16:0 + DMA-C18:0 + DMA-C18:1). Σ SFA Me= Σ C14:0Me (C14:0-6Me + C14:0-8Me + C14:0-4Me + C14:0-10Me + C14:0-2,6DiMe) + Σ C15:0Me (C15:0-8Me + C15:0-4Me) + Σ C16:0Me (C16:0-2Me + C16:0-6Me + C16:0-8Me + C16:0-4Me + C16:0-12Me) + Σ C17:0Me (C17:0-12Me + C17:0-cyclo). Σ cis-MUFA= 12:1 + 14:1 + *cis*8-15:1 + *cis*9-15:1 + *cis*7-16:1 + *cis*9-16:1 + *cis*11-16:1 + *cis*15-16:1 + *cis*5-17:1 + *cis*7-17:1 + *cis*9-17:1 + DMA18:1 + *cis*11-17:1 + *cis*6/*cis*8-18:1 + *cis*9-18:1 + *cis*11-18:1 + *cis*12-18:1 + *cis*13-18:1 + *cis*14-18:1 + *cis*15-18:1 + 20:1 + 22:1 + 24:1. Σ trans-MUFA= *trans*5-C18:1 + *trans*6/*trans*8-C18:1 + *trans*9-C18:1 + *trans*10-C18:1 + *trans*11-C18:1 + *trans*12-C18:1