

附錄一、 貯藏期間 (4) 乳過氧化酵素系統及乳鐵蛋白對絞碎豬肉¹ 總生菌數之影響

Appendix 1. Effect of lactoperoxidase system and lactoferrin on total plate count of ground pork during storage at 4

Time (days)	Control	LP 2	LP 10	LP 2 + LF	LF
0	4.22 ± 0.09 ^{aY}	4.19 ± 0.11 ^{aY}	4.11 ± 0.20 ^{aY}	4.13 ± 0.18 ^{aY}	4.07 ± 0.12 ^{aY}
2	4.27 ± 0.09 ^{aY}	4.16 ± 0.17 ^{aY}	4.16 ± 0.15 ^{aY}	4.13 ± 0.10 ^{aY}	4.14 ± 0.10 ^{aY}
4	4.77 ± 0.23 ^{aX}	4.68 ± 0.24 ^{aX}	4.66 ± 0.13 ^{aX}	4.53 ± 0.21 ^{aX}	4.66 ± 0.20 ^{aX}
6	5.63 ± 0.21 ^{aW}	5.35 ± 0.22 ^{abW}	5.32 ± 0.17 ^{abW}	5.28 ± 0.15 ^{bW}	5.34 ± 0.12 ^{abW}

Each value is the mean ± 1 standard deviation.

^{a-b} Mean in the same row with different superscripts are significantly different (P < 0.05).

^{W-Y} Mean in the same column with different superscripts are significantly different (P < 0.05).

¹ The same as table 4.

附錄二、 貯藏期間 (4) 乳過氧化酵素系統及乳鐵蛋白對絞碎豬肉¹假單胞菌數之影響

Appendix 1. Effect of lactoperoxidase system and lactoferrin on *Pseudomonas* species count of ground pork during storage at 4

Time (days)	Control	LP 2	LP 10	LP 2 + LF	LF
0	3.39 ± 0.13 ^{aZ}	3.08 ± 0.24 ^{aZ}	3.23 ± 0.24 ^{aY}	3.13 ± 0.24 ^{aZ}	3.15 ± 0.26 ^{aZ}
2	3.83 ± 0.20 ^{aY}	3.74 ± 0.25 ^{aY}	3.56 ± 0.24 ^{aY}	3.61 ± 0.26 ^{aY}	3.78 ± 0.22 ^{aY}
4	5.15 ± 0.22 ^{aX}	4.38 ± 0.25 ^{bcX}	4.66 ± 0.21 ^{bX}	4.19 ± 0.08 ^{cX}	4.54 ± 0.23 ^{bcX}
6	6.56 ± 0.17 ^{aW}	6.20 ± 0.07 ^{abW}	5.96 ± 0.14 ^{bW}	5.85 ± 0.12 ^{bW}	6.42 ± 0.14 ^{aW}

Each value is the mean ± 1 standard deviation.

^{a-c} Mean in the same row with different superscripts are significantly different (P < 0.05).

^{W-Z} Mean in the same column with different superscripts are significantly different (P < 0.05).

¹ The same as table 4.

附錄三、 貯藏期間 (4) 乳過氧化酵素系統及乳鐵蛋白對絞碎豬肉¹ pH 值之影響

Appendix 3. Effect of lactoperoxidase system and lactoferrin on pH value of ground pork during storage at 4

Time (days)	Control	LP 2	LP 10	LP 2 + LF	LF
0	5.77 ± 0.01	5.77 ± 0.01	5.78 ± 0.02	5.79 ± 0.03	5.78 ± 0.01
2	5.84 ± 0.10	5.83 ± 0.10	5.88 ± 0.17	5.88 ± 0.17	5.89 ± 0.16
4	5.83 ± 0.07	5.82 ± 0.08	5.86 ± 0.15	5.87 ± 0.15	5.88 ± 0.13
6	5.94 ± 0.17	5.86 ± 0.11	5.90 ± 0.17	5.89 ± 0.17	5.98 ± 0.20

Each value is the mean ± 1 standard deviation.

¹ The same as table 4.

附錄四、 貯藏期間 (4) 乳過氧化酵素系統及乳鐵蛋白對絞碎豬肉¹ TBARS 值之影響

Appendix 4. Effect of lactoperoxidase system and lactoferrin on TBARS value of ground pork during storage at 4

Time (days)	Control	LP 2	LP 10	LP 2 + LF	LF
0	0.16 ± 0.02 ^{bcY}	0.18 ± 0.03 ^{bcY}	0.25 ± 0.02 ^{aY}	0.20 ± 0.02 ^{bY}	0.15 ± 0.01 ^{cY}
2	0.19 ± 0.03 ^{dXY}	0.28 ± 0.01 ^{bX}	0.39 ± 0.02 ^{aX}	0.24 ± 0.02 ^{cX}	0.18 ± 0.02 ^{dXY}
4	0.23 ± 0.03 ^{cX}	0.28 ± 0.02 ^{bX}	0.45 ± 0.03 ^{aW}	0.28 ± 0.01 ^{bX}	0.20 ± 0.02 ^{cX}
6	0.29 ± 0.02 ^{dW}	0.34 ± 0.01 ^{cW}	0.47 ± 0.01 ^{aW}	0.39 ± 0.01 ^{bW}	0.25 ± 0.01 ^{dW}

Each value is the mean ± 1 standard deviation.

^{a-d} Mean in the same row with different superscripts are significantly different (P < 0.05).

^{W-Y} Mean in the same column with different superscripts are significantly different (P < 0.05).

¹ The same as table 4.

附錄五、 貯藏期間 (4) 乳過氧化酵素系統及乳鐵蛋白對絞碎豬肉¹ 非血基質鐵之影響

Appendix 5. Effect of lactoperoxidase system and lactoferrin on nonheme iron of ground pork during storage at 4

Time (days)	Control	LP 2	LP 10	LP 2 + LF	LF
0	1.59 ± 0.19 ^{bY}	1.87 ± 0.05 ^{aZ}	1.94 ± 0.06 ^{aZ}	1.69 ± 0.07 ^{bZ}	1.17 ± 0.08 ^{cZ}
2	2.71 ± 0.07 ^{aX}	2.74 ± 0.06 ^{aY}	2.81 ± 0.07 ^{aY}	2.23 ± 0.06 ^{bY}	1.91 ± 0.05 ^{cY}
4	2.82 ± 0.07 ^{bX}	3.17 ± 0.05 ^{aX}	3.08 ± 0.05 ^{aX}	2.73 ± 0.04 ^{bX}	2.31 ± 0.05 ^{cX}
6	3.57 ± 0.07 ^{aW}	3.55 ± 0.06 ^{aW}	3.48 ± 0.10 ^{aW}	3.49 ± 0.03 ^{aW}	3.05 ± 0.07 ^{bW}

Each value is the mean ± 1 standard deviation.

^{a-c} Mean in the same row with different superscripts are significantly different (P < 0.05).

^{W-Z} Mean in the same column with different superscripts are significantly different (P < 0.05).

¹ The same as table 4.

附錄六、 貯藏期間 (4) 乳過氧化酵素系統及乳鐵蛋白對絞碎豬肉¹ 硫氰酸根離子殘留量之影響
 Appendix 6. Effect of lactoperoxidase system and lactoferrin on residual thiocyanate of ground pork during storage at 4

Time (days)	Control	LP 2	LP 10	LP 2 + LF	LF
0	0.81 ± 0.01 ^{bW}	22.32 ± 2.43 ^{aW}	20.34 ± 3.76 ^{aW}	20.65 ± 0.44 ^{aW}	0.96 ± 0.06 ^{bW}
2	0.75 ± 0.03 ^{bW}	21.95 ± 0.87 ^{aW}	20.20 ± 2.03 ^{aW}	19.55 ± 2.22 ^{aW}	0.96 ± 0.02 ^{bW}
4	0.86 ± 0.04 ^{bW}	22.51 ± 1.89 ^{aW}	21.14 ± 1.43 ^{aW}	20.02 ± 2.64 ^{aW}	0.97 ± 0.10 ^{bW}
6	0.80 ± 0.03 ^{bW}	22.68 ± 1.91 ^{aW}	22.09 ± 1.00 ^{aW}	20.09 ± 2.92 ^{aW}	0.97 ± 0.02 ^{bW}

Each value is the mean ± 1 standard deviation.

^{a-b} Mean in the same row with different superscripts are significantly different ($P < 0.05$).

^W Mean in the same column with different superscripts are significantly different ($P < 0.05$).

¹ The same as table 4.

附錄七、 乳過氧化酵素系統及乳鐵蛋白對絞碎豬肉第 0 天之脂肪酸
分析

Appendix 7. Analysis of lactoperoxidase system and lactoferrin on fatty acid composition of ground pork at 0 day

Fatty acid (%)	Control	LP 2	LP 10	LP 2 + LF	LF
C4	0.58	0.13	ND	0.20	ND
C8	ND	0.12	ND	ND	ND
C10	0.24	0.25	ND	0.39	0.51
C12	0.13	0.08	ND	0.19	ND
C14	2.01	1.09	0.69	1.57	1.43
C15	0.38	ND	ND	0.67	2.29
C16	22.68	18.76	16.54	22.13	22.18
C16:1	4.64	2.75	2.51	3.13	3.62
C17	0.46	0.26	0.28	0.31	0.25
C17:1	0.29	ND	0.20	0.22	0.30
C18	0.11	11.25	10.87	10.52	10.22
C18:1	48.92	43.02	43.38	39.28	39.90
C18:2	14.61	14.21	16.67	13.84	13.34
C18:3	0.62	0.74	0.80	0.60	0.38
C20:1	ND	0.77	0.94	0.79	0.75
C20:2	0.37	0.60	0.65	0.26	0.44
C20:3	0.37	3.77	ND	3.58	3.10
C20:4	2.54	ND	4.74	ND	ND
C20:5	0.13	0.18	ND	0.15	ND
C21	0.13	0.24	ND	0.49	ND
C22	0.10	0.58	0.68	0.50	0.49
C22:6	0.28	0.49	0.50	0.52	0.39
C23	0.06	0.19	ND	0.11	ND
C24:1	0.37	0.52	0.64	0.57	0.41
SFA	26.88	32.95	28.97	37.08	37.37
MUFA	54.22	47.06	47.67	43.99	44.98
PUFA	18.92	19.99	23.36	18.95	17.65

ND, not detectable.

SFA: saturated fatty acid.

MUFA: monounsaturated fatty acid.

PUFA: polyunsaturated fatty acid.

附錄八、 乳過氧化酵素系統及乳鐵蛋白對絞碎豬肉 4 下貯藏 6 天

之脂肪酸分析

Appendix 8. Analysis of lactoperoxidase system and lactoferrin on fatty acid composition of ground pork stored at 4 for 6 days

Fatty acid (%)	Control	LP 2	LP 10	LP 2 + LF	LF
C4	1.08	1.48	ND	1.16	1.86
C6	ND	ND	ND	ND	0.03
C10	0.21	0.20	16.03	0.21	0.43
C12	0.09	0.07	ND	0.08	0.23
C14	1.20	0.89	0.90	1.28	1.79
C15	ND	ND	ND	0.19	ND
C16	21.25	18.68	16.70	22.38	25.35
C16:1	3.31	2.67	2.56	3.35	3.97
C17	0.27	0.33	0.26	0.30	0.25
C17:1	0.23	ND	ND	0.27	0.29
C18	10.38	11.08	9.47	11.03	9.40
C18:1	43.36	42.83	36.69	38.82	39.15
C18:2	12.72	14.31	12.06	14.24	12.37
C18:3	0.80	0.65	0.34	0.67	0.58
C20:1	0.69	0.68	0.73	0.65	0.46
C20:2	0.48	0.55	0.47	0.48	0.67
C20:3	2.59	3.59	ND	3.19	2.16
C20:4	ND	ND	2.69	ND	ND
C20:5	0.08	0.19	ND	0.15	ND
C21	ND	ND	ND	ND	0.14
C22	0.41	0.54	0.37	0.49	0.38
C22:6	0.30	0.53	0.33	0.45	0.30
C23	0.15	0.19	ND	0.15	ND
C24:1	0.39	0.55	0.42	0.46	0.18
SFA	35.04	33.46	43.73	37.27	39.86
MUFA	47.98	46.73	40.40	43.55	44.05
PUFA	16.97	19.82	15.89	19.18	16.08

ND, not detectable.

SFA: saturated fatty acid.

MUFA: monounsaturated fatty acid.

PUFA: polyunsaturated fatty acid.

由附錄七及附錄八得知,各處理組在第 0 天到第 6 天的飽和脂肪酸 (saturated fatty acid, SFA) 呈現上升趨勢、單元不飽和脂肪酸 (monounsaturated fatty acid, MUFA) 呈現下降趨勢及多元不飽和脂肪酸 (polyunsaturated fatty acid, PUFA) 呈現下降趨勢,這表示於貯藏期間長鏈脂肪酸氧化成短鏈脂肪酸,導致短鏈飽和脂肪酸增加的緣故。有文獻指出在肉品保存期限 (shelf life) 間,主要是傾向於不飽和脂肪酸的氧化,隨著展售期增加則酸敗程度增加 (Wood *et al.*, 2003)。

附錄九、 於第 0 天乳過氧化酵素系統及乳鐵蛋白對絞碎豬肉¹過氧化氫殘留量之影響

Appendix 9. Effect of lactoperoxidase system and lactoferrin on residual hydrogen peroxide² of ground pork at 0 day (n = 3)

Time (hours)	Control	LP 2	LP 10	LP 2 + LF	LF
0	-	-	-	-	-
2	-	-	-	-	-
4	-	-	-	-	-
6	-	-	-	-	-
8	-	-	-	-	-

¹ The same table 4.

² Use 5% titanium sulfate solution and 0.1% vanadium sulfate solution.

- : negative.

(行政院衛生署, 2001)

原理 (1) :

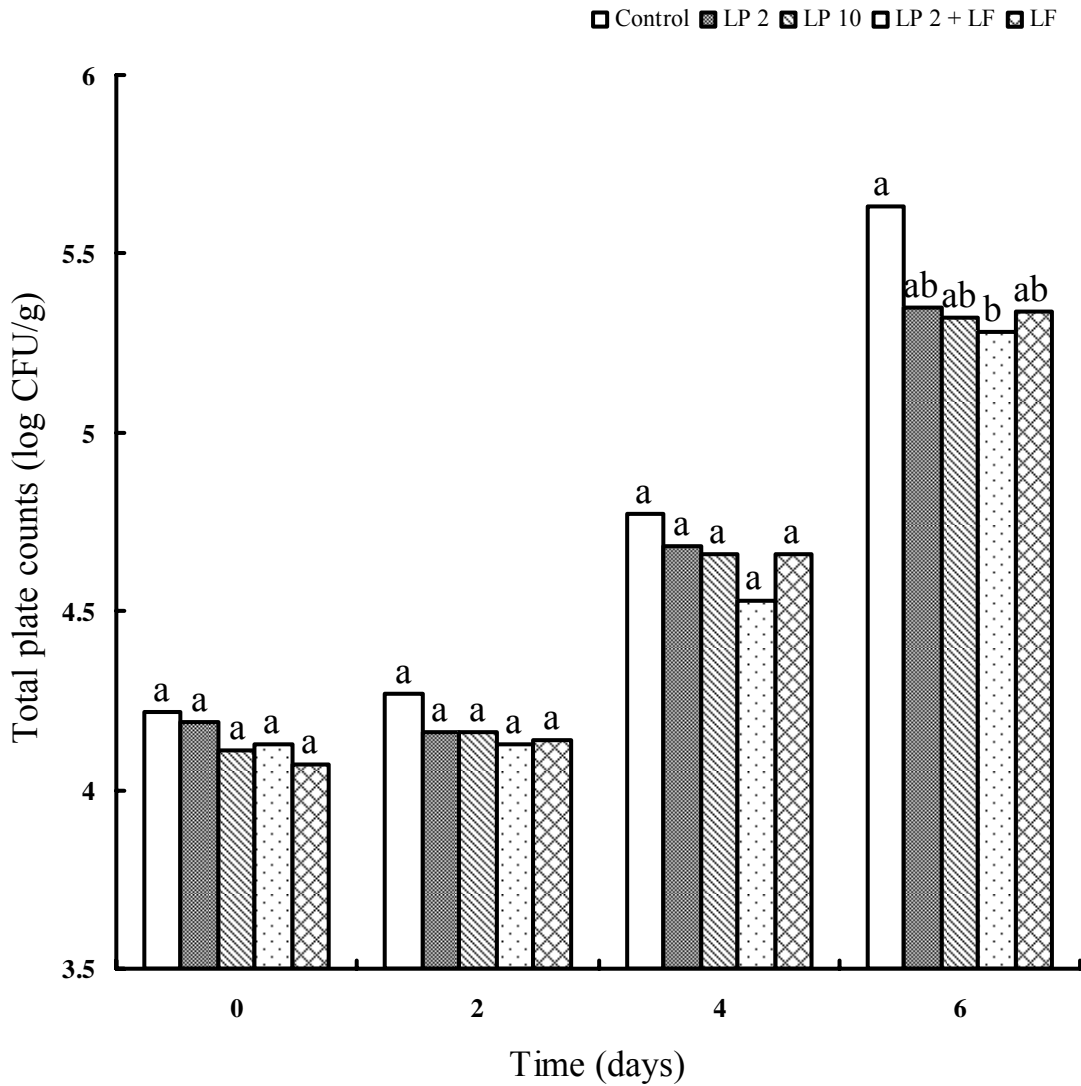
過氧化氫在酸性溶液中, 與鈦離子生成穩定橙色化合物。反應式如下 :



原理 (2) :

五氧化二鈦 (V₂O₅) 為兩性 (amphoteric) 分子, 在強酸中會形成淡黃色的 dioxovanadium 離子 (VO₂⁺), 若 V₂O₅ 與 H₂O₂ 反應則形成紅色的 peroxovanadates。 (Lee, 1996)

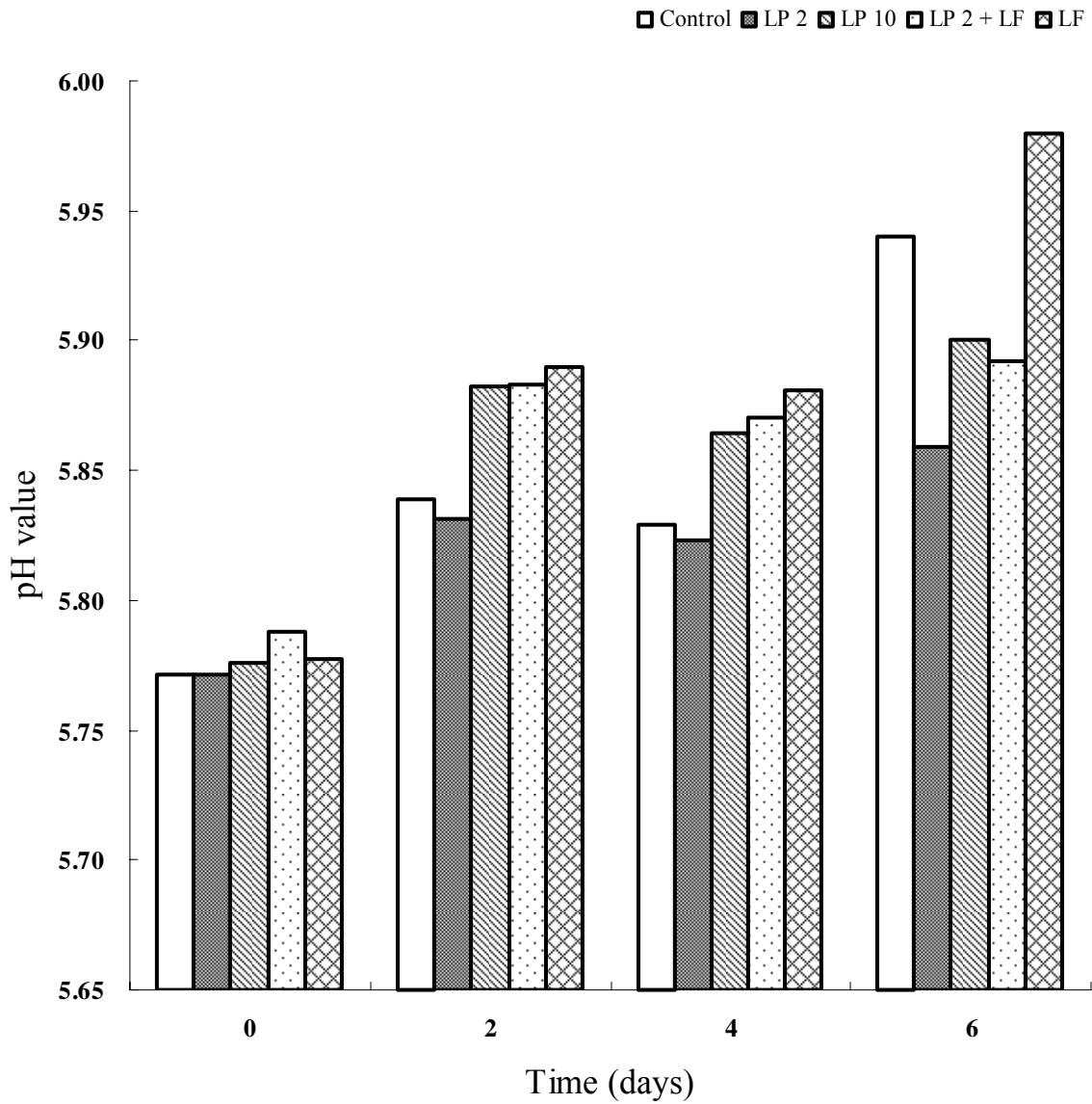
行政院衛生署公佈過氧化氫 (H_2O_2) 為第二類殺菌劑：「過氧化氫可使用於魚肉煉製品、除麵粉及其製品以外之其他食品；用量以 H_2O_2 殘留量計：食品中不得殘留。」本試驗使用衛生署所測試之兩種定性試劑 (5% Titanium sulfate solution 及 0.1% Vanadium sulfate solution)，發現各處理組皆無 H_2O_2 殘留。



附錄十、 貯藏時間 (4) 乳過氧化酵素系統及乳鐵蛋白對絞碎豬肉總生菌數之影響。

Appendix 10. Effect of lactoperoxidase system and lactoferrin on total plate counts of ground pork during storage at 4 (n = 9).

^{a-b} Means within a storage period having different letters are significantly differently ($P < 0.05$).



附錄十一、 貯藏時間 (4) 乳過氧化酵素系統及乳鐵蛋白對絞碎豬肉酸鹼值之影響。

Appendix 11. Effect of lactoperoxidase system and lactoferrin on pH value of ground pork during storage at 4 (n = 9).

```

title "tpc";
data crd;
input trt day rep tpc pH tba Fe @@;
cards;
1 0 1 4.08 5.77 0.17 1.95
1 0 1 4.15 5.78 0.15 1.87
1 0 1 4.11 5.78 0.18 1.60
...
...
...
;
proc sort;
    by trt;
proc print;
proc glm;
    class trt day;
    model tpc = trt day trt*day;
    means trt day trt*day/duncan;
    lsmeans trt day trt*day/stderr tdiff;
proc corr;
run;

```

附錄十二、 SAS 電腦程式設計。

Appendix 12. The design for SAS computer program.