

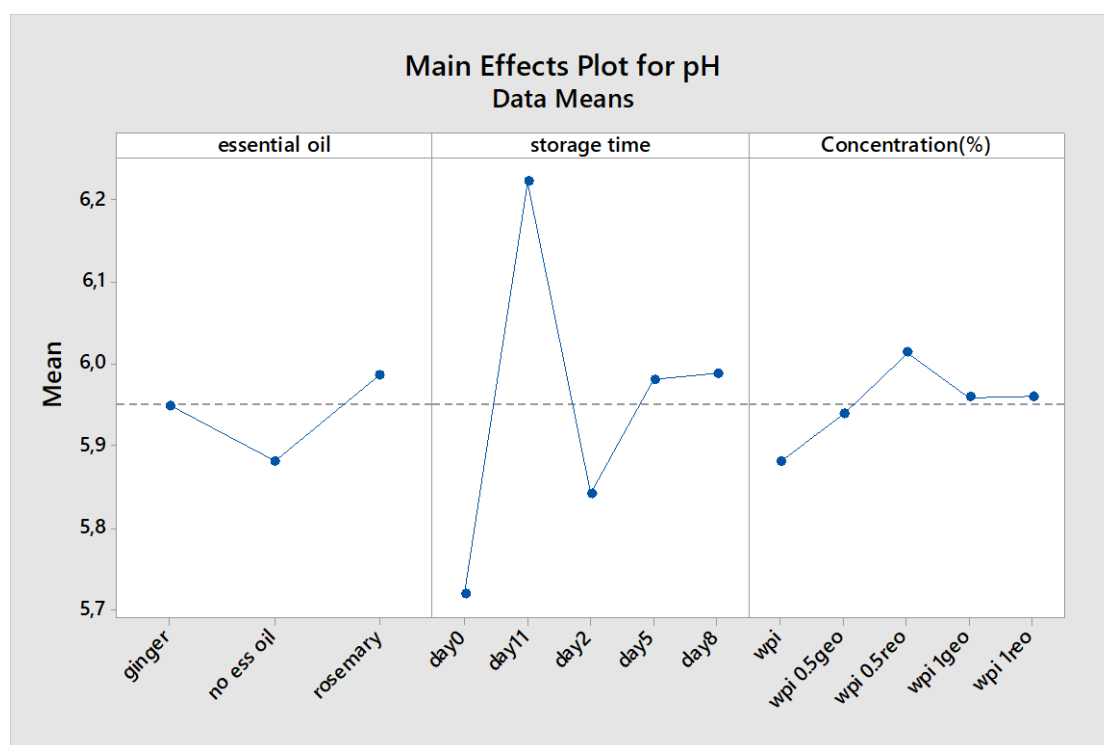
Supplementary material

# The Effect of Whey Protein Films with Ginger and Rosemary Essential Oils on Microbiological Quality and Physicochemical Properties of Minced Lamb Meat

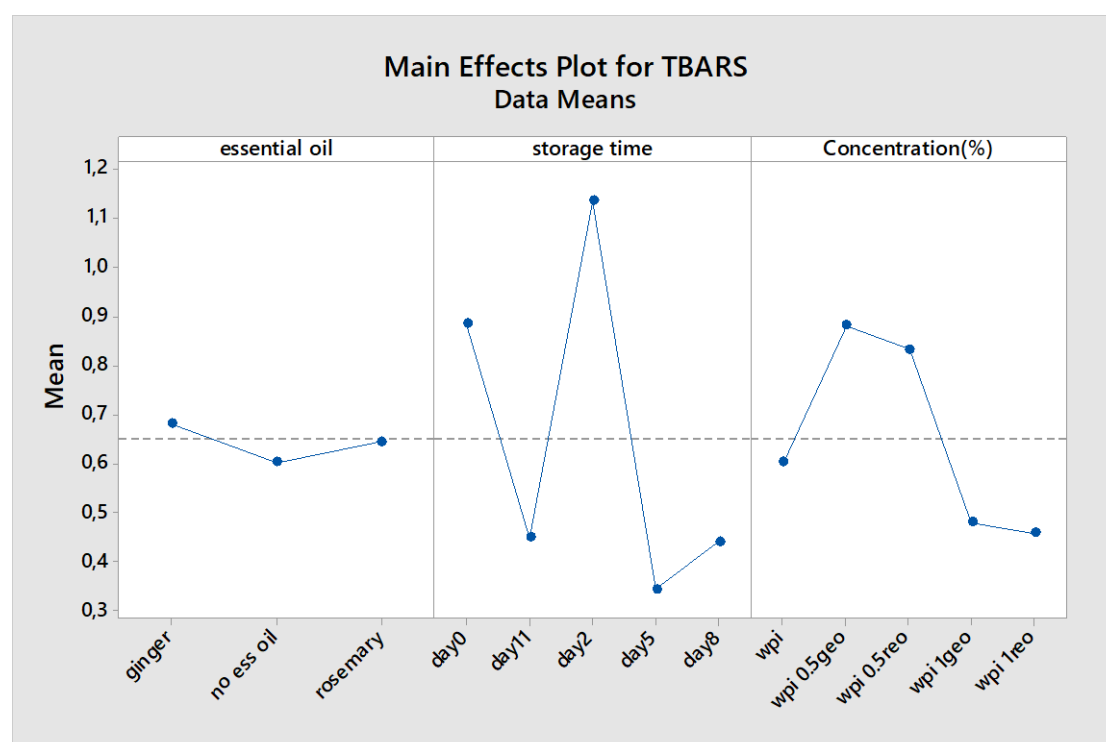
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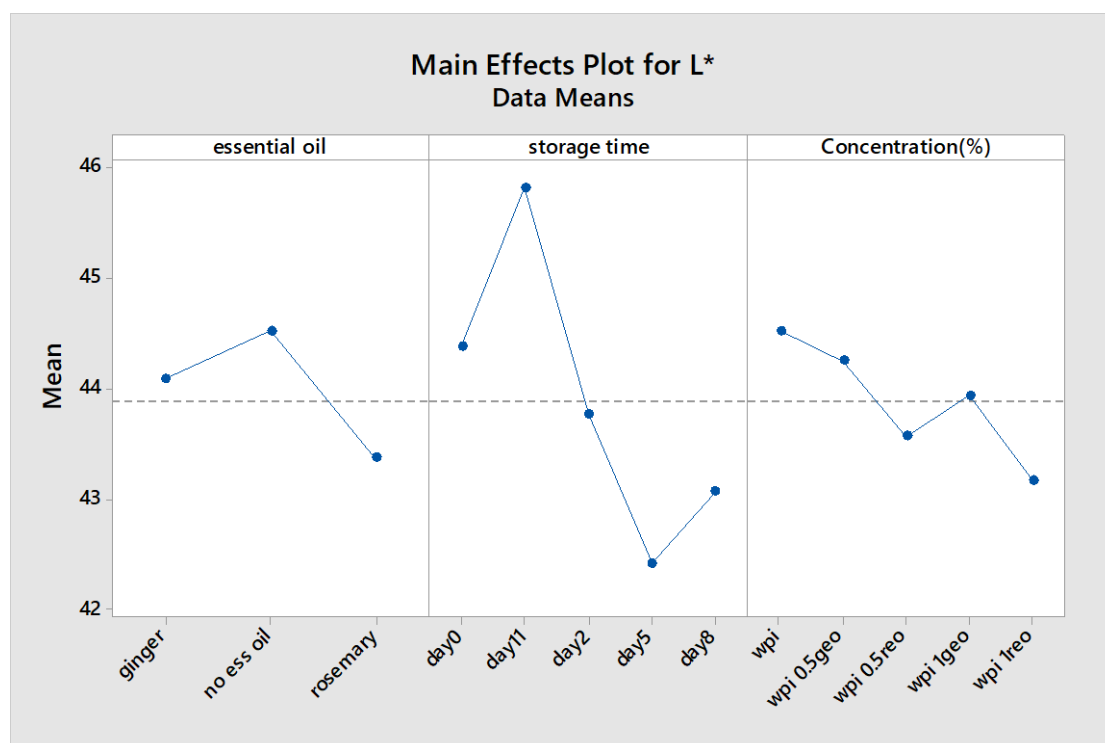
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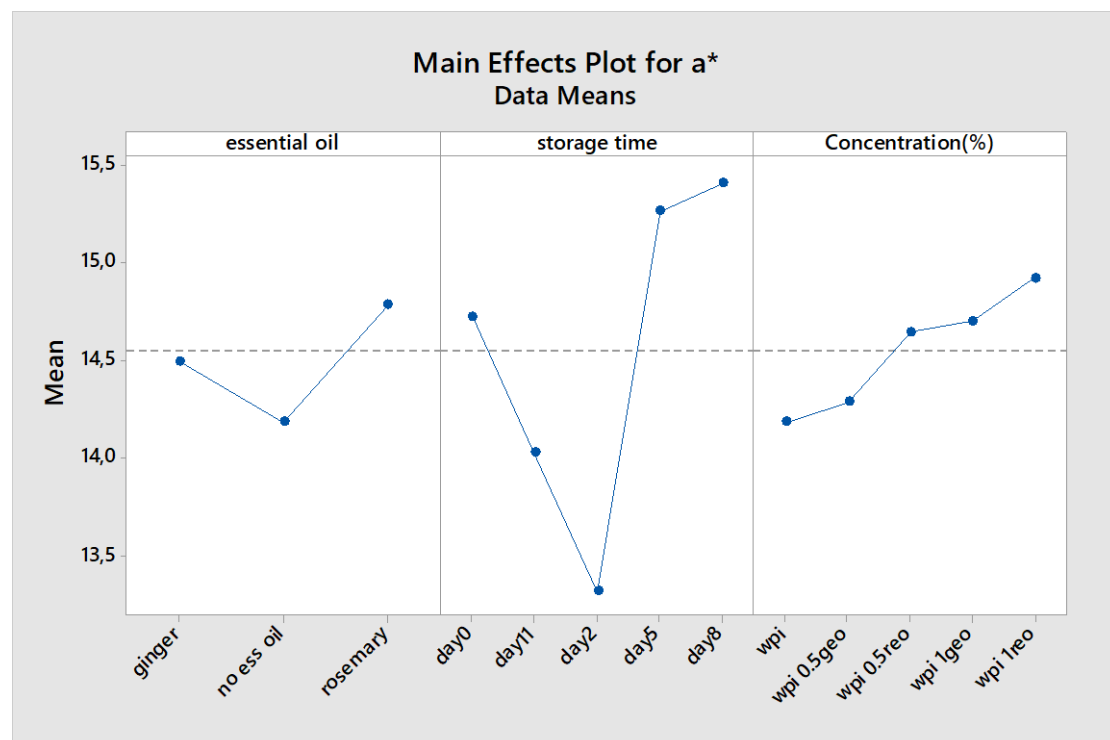
**Figure S1.** Main effects plot for essential oil, their concentration and storage time on the pH values of minced lamb meat samples packaged with different types of WPI films.



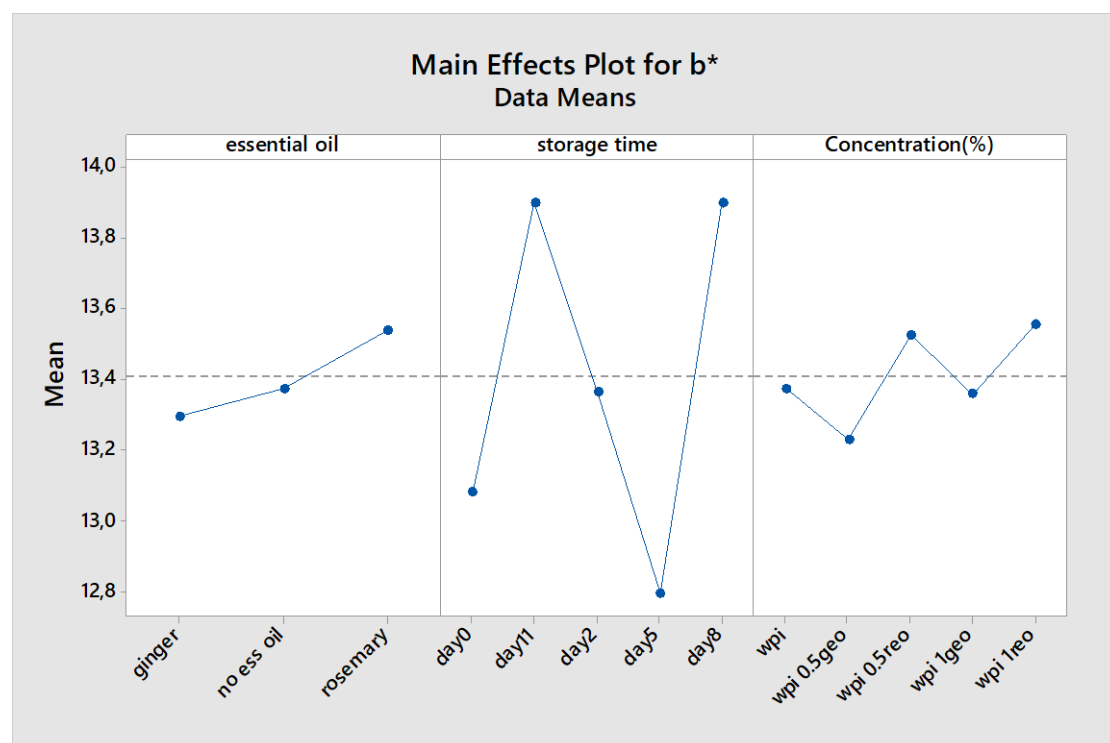
**Figure S2.** Main effects plot for essential oil, their concentration and storage time on TBARS values of minced lamb meat samples packaged with different types of WPI films.



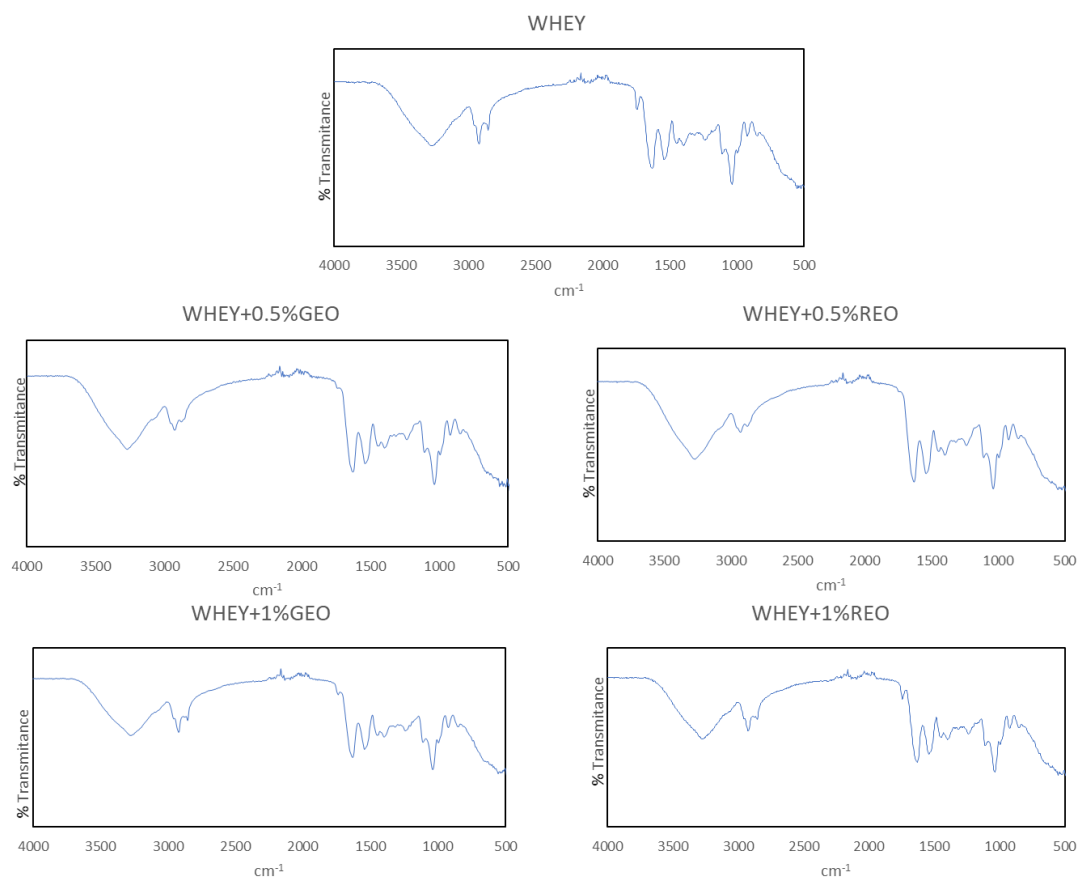
**Figure S3.** Main effects plot for essential oil, their concentration and storage time on L\* parameter (brightness) values of minced lamb meat samples packaged with different types of WPI films.



**Figure S4.** Main effects plot for essential oil, their concentration and storage time on a\* parameter (redness) values of minced lamb meat samples packaged with different types of WPI films.



**Figure S5.** Main effects plot for essential oil, their concentration and storage time on b\* parameter (yellowness) values of minced lamb meat samples packaged with different types of WPI films.



**Figure S6.** FTIR-ATR spectra of WPI films with and without EOs at different concentrations.

**Table S1.** Compositional analysis (%) of Ginger and Rosemary essential oils.

	Ginger	Rosemary
2-Hexen-1-ol		1.27
$\alpha$ -Thujene		0.60
$\alpha$ -Pinene	2.69	27.82
Camphene	8.01	8.56
1-Octen-3-ol		0.15
3-Octanone		0.88
$\beta$ -Myrcene	0.92	2.50
$\beta$ -Pinene	0.55	5.12
$\alpha$ -Phellandrene		0.31
$\beta$ -Phellandrene	11.52	
p-Cymene		0.13
Limonene		2.74
1,8-Cineole		8.33
Benzene acetaldehyde		0.25
Terpinolene	0.36	1.43
Linalool	0.87	1.68
Camphor	0.35	7.25
Borneol	2.55	4.41
$\alpha$ -(-)-Terpinen-4-ol	1.36	2.94
$\alpha$ -Terpineol	0.85	1.29
( E)-Citral	4.09	
( E)-Geraniol	0.67	
$\beta$ -Citral	7.32	
Verbenone		2.91
Bornyl acetate	0.36	15.37
Methyl nonyl ketone	0.55	
( E)-Caryophyllene		2.78
$\beta$ -Caryophyllene		0.53
Caryophyllene oxide		0.75
$\alpha$ -Copaene	0.75	
Geranyl acetate	0.25	
$\beta$ -Farnesene	0.75	
(-) Alloaromadendrene	0.68	
$\beta$ -Germacrene	0.59	
$\beta$ -Cedrenol	0.85	
Neral	0.78	
ar-Curcumene	11.38	
$\alpha$ -Zingiberene	18.64	
$\beta$ -Bisabolene	7.95	
$\beta$ -Sesquiphellandrene	8.39	
( E)- $\gamma$ -Bisabolene	0.75	
$\beta$ -Eudesmol	0.55	
Nerolidol	0.78	
(+)- $\alpha$ -Bisabolol	0.56	
(-)-Campherenone	1.56	
(Z,E)- Farnesal	0.75	
Thujopsene	1.02	