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$\mu$   $\mu$   
**Escherichia coli O157:H7**

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**2013**

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**Escherichia coli O157:H7**

**μ**

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**2013**

, μ μ  
μ . μ ,  
μ , μ μ μ  
μ μ μ μ . μ  
μ μ μ ,  
μ .  
μ μ , μ ,  
μ μ μ . μ ,  
μ μ μ μ , μ .  
μ μ μ μ μ μ .  
μ μ μ μ μ . μ μ μ μ μ .  
μ μ μ μ μ .  
μ μ μ μ μ .  
μ μ μ μ μ μ μ μ μ μ μ μ .



## Abstract

This study was conducted at the Agricultural University of Athens in the laboratory Quality Control and Hygiene of Food, in the department of Food Science and Technology. The aim of this study was to evaluate the effect of edible beads from alginate sodium with essential oil of oregano in developing *Escherichia coli* O157:H7 during the maintenance of beef burgers and evaluation of the operation of edible beads in the survival of the pathogen during heat treatment of the burgers.

Based on the specifications of the experiment, burgers (80g) were inoculated with 6 log CFU / g mixture of strains *E. coli* O157:H7. Sodium alginate beads were prepared (2.2 mm, 1.2 mm and lyophilized 0.9) with different concentrations of essential oregano oil (0.2% and 0.3%) and incorporated in burgers. Burgers without beads and essential oil and burgers with essential oil without beads were controls. Then, burgers were packed in modified atmosphere of 80% O<sub>2</sub>: 20% CO<sub>2</sub> and maintained at 4 °C. At regular time intervals, it became a heat treatment (baking pan) of the burgers until the temperature at the geometric center was 68 ° C, in order to evaluate the effect of maintenance antimicrobial edible beads in heat resistance of the pathogen.

Regarding the maintenance, the use of edible beads (2.2 mm and 1.2 mm) with oregano essential oil in a concentration 0.3% per burger positively impacted the inactivation of the pathogen population *E. coli* O157:H7. The lyophilized beads (0.9 mm) were not antimicrobial activity against the pathogen during maintenance at 4 °C. Regarding the heat treatment, the samples containing 0.2% and 0.3% oregano essential oil per burger with beads (2.2 mm, 1.2 mm and lyophilized 0.9), observed to had a significant role in the reduction of survival *E. coli* O157:H7 in comparison with the other methods.

Key words: *E. coli* O157:H7, burgers, beads.

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 $\mu$  ....

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## 1.1. $\mu$ $\mu$ *E. coli* O157: H7

### 1.1.1.

Theodor Escherich,  $\mu$  , 1885  $\mu$   
 $\mu$   $\mu$  coli. To 1888,  
 $\mu$   $\mu$  *Escherichia coli*.  
 $\mu$   $\mu$  *E. coli* Gram- ,  $\mu$   
*Enterobacteriaceae*.  
 $\mu$   $\mu$   $\mu$  ,  $\mu$   
 $\mu$  ,  $\mu$   $\mu$  .  
 $\mu$  37 C pH 6 8. ,  $\mu$   
 $\mu$  pH  $\mu$  4.3  
 $\mu$  9  $\mu$  10 (Mitscherlich and Marth,1984).  
( $a_w$ ) *E. coli* 0.95. ,  $\mu$   
 $\mu$   $\mu$  .  
 $\mu$   $\mu$   $\mu$   
 $\mu$   $\mu$  ,  $\mu$   $\mu$  ,  
 $\mu$   $\mu$   $\mu$   $\mu$  .  
*E. coli*  $\mu$  . ,  
 $\mu$   $\mu$  *E. coli*  $\mu$   
, ( )  $\mu$  ,  
 $\mu$   $\mu$   $\mu$   $\mu$   
 $\mu$   $\mu$  ( **1.1.**)

**1.1.**  $\mu$  ,  $\mu$   $\mu$   $\mu$   
 $\mu$   $\mu$   $\mu$  *E. coli* (Lee et al., 2009; Lin et al., 2009).

Όνομασία	Συντομογραφία	Συμπτώματα
Εντεροδιεισδυτικό <i>E. coli</i>	EIEC	Αιματώδη διάρροια
Εντεροπαθογόνο <i>E. coli</i>	EPEC	Διάρροια
Εντεροτοξινογόνο <i>E. coli</i>	ETEC	Διάρροια σε παιδιά, ταξιδιώτες
Εντεροαιμορραγικό <i>E. coli</i>	EHEC	Διάρροια, αιμορραγική κολίτιδα, HUS, TTP
Εντεροσυσσωματωμικό <i>E. coli</i>	EAEC	Διάρροια
Διάχυτα Προσκολλημένο <i>E. coli</i>	-	-

*E. coli* O157:H7, (Michael et al., 1997).

### 1.1.2.

### ***E. coli* O157:H7**

(Riley et al., 1983).

**1.2.** *E. coli* O157:H7

<b>1982</b>		μ	47 / 0	Riley et al., 1983
<b>1988</b>	H	μ	30 / 0	Rodrigue et al., 1995

<b>1991</b>		$\mu$ ,	521 / 2	Orr et al., 1994
<b>1992-1993</b>		$\mu$	>500 / 4	Winn et al., 2006
<b>1996</b>		$\mu$	71 / 1	CDC, 1996
<b>1996</b>			>9000 / 12	Sato et al., 2003
<b>1996</b>			501 / 20	Karch et al., 1999
<b>1999</b>	A		329 / 0	IDH, 1999
<b>2000</b>			2300 / 7	Ali, 2004
<b>2000</b>			788 / 1	Doyle et al., 2006
<b>2005</b>			120 / 0	Cowden et al., 2001
<b>2006</b>		,	204 / 3	Doyle et al., 2006

*E. coli* O157:H7

$\mu$        $\mu$        $\mu$        $\mu$        $\mu$

1982 (Riley et al., 1983; Welinder-Olsson and Kaijser, 2005; Mainil and Daube, 2005).

$\mu$  ,  $\mu$  26      19       $\mu$  ,

,      3  $\mu$       ,  $\mu$  21

, 14       $\mu$  .       $\mu$

$\mu$        $\mu$        $\mu$       .       $\mu$  '       $\mu$

$\mu$        $\mu$        $\mu$       .       $\mu$        $\mu$

Kassenborg et al., (2004)      *E. coli* O157:H7

μ μ , μ (Donnenberg and Whitam, 2001; Todar, 2002).

1988 (Rodrigue et al., 1995),

μ μ 30 μ . μ μ  
μ μ  
μ *E. coli* O157:H7 . μ

μ . μ , 1991, 23 μ  
μ (Meng et al., 2001), 1992

( ), μ μ μ μ  
μ μ μ . 15  
μ 1992 μ 28 1993 500 μ

μ ( , , , ) (Winn et al., 2006).

μ μ μ μ *E. coli* O157:H7.  
1996, 3 μ *E. coli* O157:H7 μ μ  
μ μ μ . μ μ μ μ μ  
μ μ 71 μ μ 1 (CDC,  
1996). μ , μ

( . . μ ). μ μ  
1996 9.000 μ ( ), μ  
μ 12 ( Sakai) (Sato et al., 2003). 106  
μ μ μ , 12 .

, μ μ μ ,  
μ .  
, μ μ μ *E. coli*  
O157:H7 1996, 501 μ μ  
μ 20  
(Karch et al., 1999). 5 μ 1998,

(Hatakka et al., 1998). 120

1995 (National Veterinary Institute, 2001). 1999 11 (National Veterinary Institute, 2001). 1999 4 (Norwegian Zoonosis Centre, 2000).

2000, 160 Walkerton, 500

*E. coli* O157:H7, *Campylobacter jejuni*. 2.300 7

*E. coli* O157:H7 (Ali, 2004).

2002, *E. coli* O157:H7 hot-dogs (Duffell et al., 2003). 2004, 7 *E. coli* O157:H7

*E. coli* O157:H7 (Ihekweazu et al., 2006).

38 *E. coli* O157:H7 2005, 1,10 100.000 (Anonymous, 2007).

12 (32%) 2006, 26 *E. coli*

O157:H7.  $\mu$  - 204  $\mu$  , 3 -  
 $\mu$  (Doyle et al., 2006). 2007,  
61  $\mu$  21  $\mu$   $\mu$   
 $\mu$  40  $\mu$   $\mu$   $\mu$   
 $\mu$  . , 2008, 49  $\mu$   $\mu$   $\mu$   $\mu$  .  
 $\mu$   $\mu$  , 73.480  
*E. coli* O157:H7, 2.168 61  
(Mead et al., 1999; Rangel et al., 2005).

### 1.1.3. *E. coli* O157:H7

$\mu$   $\mu$  *E. coli* O157:H7 Gram (-),  $\mu$  ,  
, (Paradis et al., 2005),  $\mu$  2  $\mu$ m  
 $\mu$  0.8  $\mu$ m  $\mu$  (Garrett and Grisham, 2009).  $\mu$   
,  $\mu$  "O"  $\mu$   $\mu$  , "H"  
 $\mu$  (Nataro and Kaper, 1998). *E. coli* O157:H7  
 $\mu$   $\mu$   
(Whitam, 1988).

, *E. coli* O157:H7  $\mu$   
/ Mac Conkey (SMAC),  $\mu$   $\mu$   $\mu$   
cefixime - rhamnose (CR- SMAC), cefixime- tellurite (CT- SMAC) 4- methylumbelliferyl- b-  
D- glucuronide (MSA- MUG).  $\mu$   
 $\mu$  SMAC.  $\mu$  , *E. coli* O157:H7  $\mu$   
 $\mu$  D- 24 ,  $\mu$  -  
,  $\mu$   $\mu$  (Manafi and Kremsmaier, 2001; Wu et al.,  
2003).

### 1.1.4. *E. coli* O157 :H7

$\mu$   $\mu$  *E. coli* O157:H7  
 $\mu$  .  $\mu$   $\mu$  (modified tryptone Soy Broth- TSB)

(11,5° C 18 – 21 h) (SMAC). SMAC  
 μ μ cefixime and tellurite (CT– SMAC)  
 , μ μ  
 , μ μ  
 , μ μ  
 (De Boer and Heuvelink, 2000; Kimura et al., 2000), μ  
 μ PCR ( μ )  
 (Kimura et al., 2000; Pilpott and Ebel, 2003).

**1.1.5. E. coli O157:H7**

, *E. coli* O157:H7  
 (intrinsic) (extrinsic) μ  
 μ , pH, ,  
 μ (Buchanan and Michael,  
 1997).

**1.1.5.1. μ**

μ μ μ μ μ μ  
 μ μ μ μ μ μ  
 μ . μ μ (Ben Yaghlene et al., 2009;  
 Ding et al., 2010).

μ , *E. coli* O157:H7 7°C,  
 μ μ μ  
 μ μ μ  
 μ μ . Tamplin et al. (2005)  
*E. coli* O157:H7 μ ( ) μ μ μ  
 μ 6°C. , *E. coli* O157:H7  
 , μ 51 °C (Szabo et al., 1986). *E.*

*E. coli* O157: H7 (Cheville et al., 1996; Buchanan and Michael, 1997).  
 121 C 15 160 170°C  
 Center for Food Security and Public Health (CFSPH) 2004,  
 71°C.  
*E. coli* O157: H7 (1.3).

**1.3.**  
*E. coli* O157:H7

	μ	μ (°C)	μ	
μ	54.5	39.8 min (D-value)*	μ	Doyle and Schoeni, 1984
μ	64.3	0.16 min (D-value)	μ	Doyle and Schoeni, 1984
μ	62.8	0.47 min (D-value)	μ	Line et al., 1991
μ	60	0.47 min (D-value)	μ	Ahmed et al., 1995
μ	57.2	2.8 min (D-value)	μ	Shipp et al., 1991
μ	62	1.97 min (D-value)	μ	Singh et al., 2006
	65	1.58 min (D-value)		
μ	72 ( )	7.0 log μ	μ	Guo et al 2006
μ	55	18.16 min (D-value)	μ	Vijay and Friedman, 2008
μ 1%	57.5	7.75 min (D-value)		
	60	1.53 min (D-value)		



$\mu$	55	23.76 min (D-value)	Vijay and Friedman,
$\mu$ 0.5%	57.5	15.79 min (D-value)	2008
	60	3.36 min (D-value)	
	60	2.38 min (D-value)	Murphy et al., 2004
	65	0.24 min (D-value)	
	70	0.03 min (D-value)	
	55	9.74 min (D-value)	Ahmed et al., 1995
	60	0.58 min (D-value)	Ahmed et al., 1995

\*D-value:  $\mu$  90%.  $\mu$   $\mu$   $\mu$   
 4- 45°C,  $\mu$   $\mu$   $\mu$  *E. coli* O157:H7  
 37°C (Strawn and Danyluk, 2010).

### 1.1.5.2. pH

*E. coli* O157: H7  $\mu$   $\mu$   
 $\mu$   $\mu$  pH 4. ,  $\mu$  pH  
 $\mu$  *E. coli* 4.4 (Gabriel and Nakano, 2010). ,  
 pH (6-7)  $\mu$   
 NaCl (Charimba et al., 2010).  $\mu$   $\mu$   $\mu$   
 pH (Ryu and Beuchat, 1998).  
 pH  $\mu$  *E. coli* O157:H7  
 (Abdul-Raouf, 1993; Presser et al., 1997). pka pH  
 $\mu$   
 $\mu$  . O *E. coli* O157:H7  
 $\mu$   $\mu$  pH (Yuk and Marshall, 2004; Samelis et al., 2005).  
*E. coli* O157:H7  
*E. coli* O157:H7

and Michael, 1997).

**1.1.5.3. (a<sub>w</sub>)**

μ ,  
μ μ . μ  
a<sub>w</sub> , μ μ , μ  
μ μ μ (Barbut and Griffiths, 2003).  
μ μ μ , a<sub>w</sub> *E. coli* O157:H7  
0.98 (Buchanan and Michael, 1997).

**1.1.5.4. μ**

μ ( . . , )  
μ μ μ  
(Barrera et al., 2007). μ μ  
μ μ (modified atmosphere packaging- MAP)  
( μ ), ( μ  
μ )  
( μ )  
(Smigic et al., 2009).

( μ ), *E. coli* O157:H7  
μ μ μ  
(Lactic Acid Bacteria- LAB).

μ , *Pseudomonas* spp. *Brochothrix thermosphacta* (Barrera et al., 2007).

*Pseudomonas* spp. μ , ,  
μ μ (0-15°C) (Barrera et al., 2007).

μ μ  
(Nychas et al., 2008) μ μ μ

μ  
μ . , Samelis Sofos (2002)

*Pseudomonas* spp.  $\mu$   $\mu$   $\mu$  ,  $\mu$   
*E. coli* O157:H7  
 $\mu$  (Barrera et al., 2007).

**1.1.6. *E. coli* O157: H7**

*E. coli* O157:H7  $\mu$   $\mu$   
 (Nataro and Kaper, 1998).  $\mu$  shiga - .  
 shiga - ,  $\mu$   $\mu$   
 $\mu$  *Shigella* (Reisberg et al., 1981). shiga -  
*E. coli* O157:H7  $\mu$   $\mu$   
 $\mu$  .  
 shiga - ,  $\mu$   $\mu$   
 $\mu$  shiga - (Strockbine et al., 1986).

**1.1.7.  $\mu$   $\mu$  *E. coli* O157: H7**

$\mu$   $\mu$  *E. coli* O157:H7  $\mu$   $\mu$   
 (Mead and Griffin, 1998, Müller et al., 2003).  $\mu$   
 $\mu$   $\mu$   $\mu$  10-100 cfu/ g  $\mu$  (Feng, 2000).  
 $\mu$   $\mu$   $\mu$   
 (Mead and Griffin, 1998; Hawker et al., 2001).

**1.1.8. *E. coli* O157: H7**

$\mu$  *E. coli* O157: H7  
 $\mu$   $\mu$  ,  $\mu$   $\mu$   $\mu$   
 , (  $\mu\mu$  ),  $\mu$   $\mu$  -  
 (Sánchez et al., 2010). ,  $\mu$  ,  
*E. coli* O157:H7,  $\mu$   
 $\mu$   $\mu$   $\mu$  ,

μ μ μ (Varela - Hernández et al., 2007). ,  
 μ μ μ μ , μ μ μ  
 , , ( μ )  
 μ (Grauke et al., 2003). , μ μ  
 μ μ μμ μ  
 (Yilmaz et al., 2006).

**1.1.9. μ μ μ (HUS) μ (HC)**

μ *E. coli* O157:H7  
 shiga - (Wells et al., 1991). shiga - μ  
 μ μ μ (HUS). , , μ (HC)  
 , , ,  
 (Donnenberg and Whittam, 2001).  
 μ *E. coli* O157:H7 μ  
 μ - μ μ (HUS).  
 μ μ , μ μ  
 (Cray and Moon, 1995). H μ μ  
 , μ o *E. coli* O157:H7, μ  
 μ μ .  
 , μ  
 μ ( ) (Nataro and  
 Kaper, 1998; Paton and Paton, 1998).

μ μ μ ,  
 2 - 3 μ μ (Mead et al., 1999; CFSPH, 2004).  
 , 15% μ μ HUS  
 (Donnenberg and Whittam, 2001).  
 μ μ 8 μ (CFSPH, 2004).

**1.2. μ**





(Martín-Belloso et al., 2009; Zhao, 2010; Tapia, 2007).  
 (Zuidam and Shimoni, 2010; Parra-Huerta, 2011).  
 (60°C) (Krasaekoopt et al., 2003; Gouin, 2004).

(Zhang et al., 2007).  
 0,2 5 mm  
 3% . . .  
 (Prusse et al., 2008).

#### 1.4.

(Burt, 2004).  
 (Amrik and Bilkei, 2004; Mauch and Bilkei, 2004).  
 (Yesil Celiktas et al. 2007), (McGimpsey and Douglas, 1994)  
 (Juliano et al., 2000).

μ μ . Dorman and Deans (2000) *in vitro* μ ,  
 μ μ  
*B. subtilis, C. sporogenes, B. thermosphacta S. pullorum.*  
 Marino et al. (2001) μ *in vitro*  
 μ μ μ , *E. coli* O157:H7, *S. aureus*, *S.*  
*typhimurium, Y. enterocolitica, Micrococcus spp., P. vulgaris.*  
 μ  
 μ μ 100 % 800 ppm, μ μ μ 70 % - 100  
 % 400 ppm μ *E. coli* O157 :H7 200 ppm.  
 μ μ , Hammer et al., (1999)  
*E. coli, S.*  
*typhimurium, S. aureus, P. aeruginosa* 0,25 %, 0,12 %, 0,12 % 2 % .  
 μ *E. coli*  
 O157:H7 μ . μ μ Sagdic et el., (2002)  
 1 %, 1.5 %, 2 %  
 μ μ 10<sup>8</sup> cfu/ml μ 37  
 C. μ μ  
 μ *E. coli* O157:H7. μ μ Caillet et al., (2005),  
 0.025  
 % . μ μ Skandamis et al., (2001) 0.05 %  
 μ  
 μ 5 log cfu/ml μ 37 C. μ ,  
 0.03% . Burt and  
 Reinders (2003) μ *E. coli* O157:H7 (10<sup>6</sup> cfu/ml) μ  
 625 μ/l  
 10, 20 37 C. Skandamis and  
 Nychas (2000) μ μ μ pH  
 0.1 - 0.7 %, μ *E. coli* O157:H7 μ  
 . *E. coli* O157:H7 μ pH, μ





<b>Μεμβράνη</b>	Βόειο Φιλέτο	Αιθέριο Έλαιο Ρίγανης, Κανέλας	Oussalah et al., 2006
<b>Μεμβράνη</b>	Φέτες Ζαμπόν και λουκάνικο	Αιθέριο Έλαιο Ρίγανης, Κανέλας	Oussalah et al., 2007
<b>Επικάλυψη</b>	Καπνιστός Σολωμός	Γαλακτικό νάτριο και Διοξικό οξύ	Neetoo et al., 2010
<b>Επικάλυψη</b>	Φέτες Μήλων	Βανιλίνη και Αιθέριο Έλαιο ρίγανης, λεμονόχορτο	Rojas-Grau et al., 2007
<b>Επικάλυψη</b>	Φέτες Πεπονιού	Μηλικό οξύ, Αιθέριο Έλαιο λεμονόχορτο, κανέλας και ευγενόλη, κιτράλη, γερανιόλη	Raybaudi-Massilia et al., 2008a
<b>Επικάλυψη</b>	Φέτες Μήλων	Μηλικό οξύ, Αιθέριο Έλαιο λεμονόχορτο, κανέλας, γαρύφαλλο και ευγενόλη, κιτράλη, κινναμαλδευδη	Raybaudi-Massilia et al., 2008b
<b>Επικάλυψη</b>	Φέτες Μήλων	Σορβικό κάλιο	Olivas et al., 2007
<b>Επικάλυψη</b>	Γαλοπούλα	Γαλακτικό νάτριο και Διοξικό οξύ	Jiang et al., 2011
<b>Μικροσφαιρίδια</b>	Βόειο Φιλέτο	Νισίνη	Milette et al., 2007





•  
μ μ μ μ (edible film)  
(coating). μ μ μ μ  
μ μ μ μ (beads).  
μ μ μ μ . . .  
, μ μ μ μ μ μ  
μ μ μ μ μ μ μ μ μ μ  
μ μ μ μ .

**2.** μ  
μ μ μ μ μ  
μ μ μ *E. coli*  
O157:H7 μ  
μ μ μ ( μ  
) μ .

**2.1.** μ

**2.1.1.**

μ μ μ  
2.1..

**2.1.** *Escherichia coli* O157:H7 μ μ .

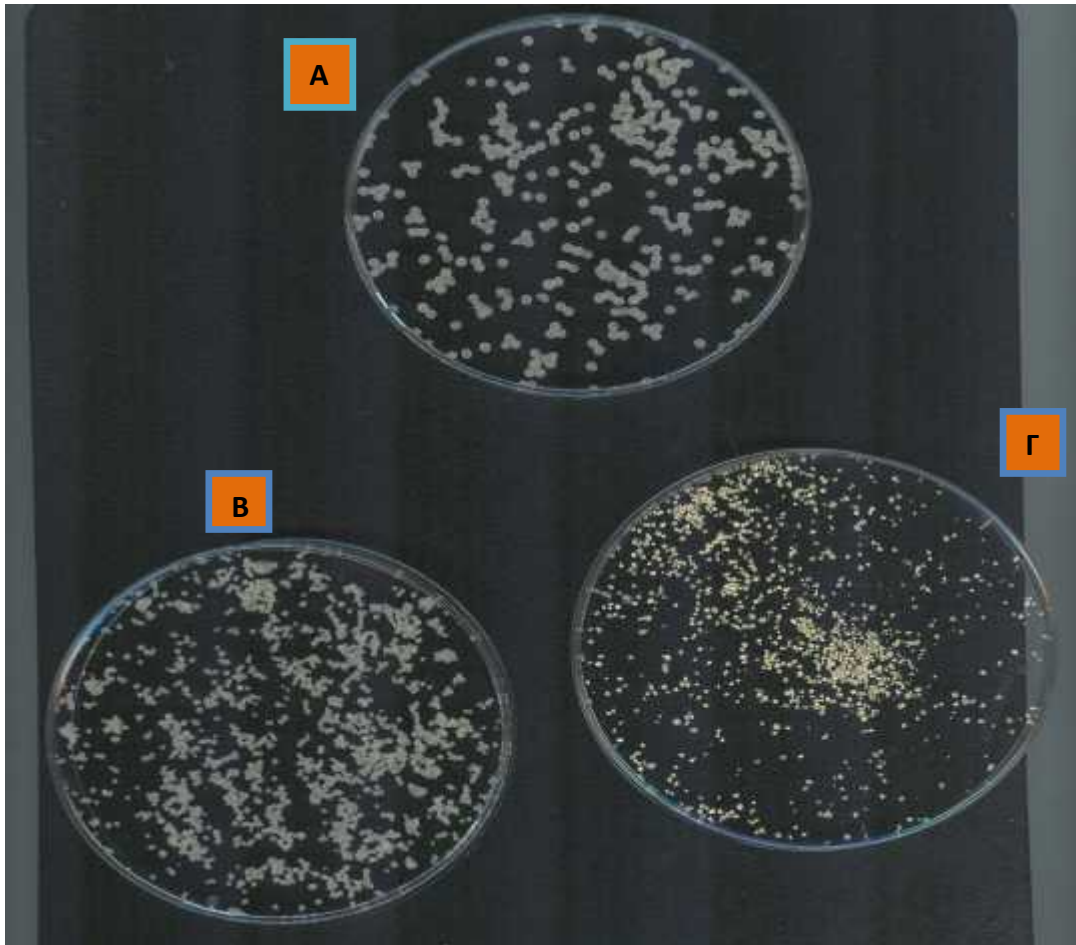
<b>Escherichia coli O157:H7</b>					VT1	VT2
<b>NCTC 12079</b>						
<b>Escherichia coli O157:H7</b>	E	M				-----
<b>NCTC 13125</b>	B		T	μ		
<b>Escherichia coli O157:H7</b>	E	M				-----
<b>NCTC 13127</b>	B		T	μ		

### 2.1.2.

- μ μ  
 μ 3  
 μ μ μ  
 . μ , μ - ,  
 μ Tryptone Soy Broth (TSB) (LAMB, United Kingdom) μ 20% -  
 20°C 6 μ . μ  
 μ μ μ 4°C  
 20 μ . μ  
 μ μ μ  
 (streaking) μ Tryptone Soy Agar (TSA) (37 C 24 ) (LAMB,  
 United Kingdom). μ μ μ  
 μ μ μ , 10 mL  
 μ μ TSB. μ μ μ  
 37°C 24 (1 ). 24 , 100 μl  
 μ μ μ 10 ml TSB  
 37 C 18 (early stationary phase) (2 ).  
 μ 10<sup>8</sup> - 10<sup>9</sup> cfu/ ml.  
 (3000g, 4°C, 15 ) (Megafure 1.0R, Germany).  
 μ μ ( μ )  
 μ μ μ ¼ Ringer (LAMB, United Kingdom).  
 μ . , μ



4 C,  $\mu$  0.9 mm  
 $\mu$  silica gel  $\mu$  ( 1.).  
 1.  $\mu$   $\mu$   $\mu$  ) 2.2 mm, B)  
 1.1 mm )  $\mu$  0.9 mm.



2.1.4.  $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   
 (12 ) «  $\mu$  »  $\mu$   
 $\mu$   $\mu$   $\mu$   $\mu$  1 C.  
 $\mu$   $\mu$   $\mu$   
 (Kenwood, China).  $\mu$  400 g  
 (Inauen Maschinen AG VC999, Switzerland).  
 400 g  $\mu$   $\mu$   $\mu$   $\mu$  *E. coli*  
 O157:H7,  $\mu$   $10^6$  cfu/ g  $\mu$  .  $\mu$   $\mu$



1 μ 4 C 15 μ μ μ . , μ .

15 μ μ , μ (80 g), μ μ (1 2 mm μ ( )) μ μ 80 g μ 0.2 0.3% μ . , μ μ μ μ ( ) μ μ μ μ ( μ 6.9 cm 2.4 cm) μ . μ μ μ μ μ μ μ . , μ μ μ 0.2 0.3% μ μ . μ (Flexopack S.A., Athens) μ μ 80% 2: 20% CO<sub>2</sub> 4 C. μ 12 μ . 4 μ : 0 , 5 , 9 12 μ .

## 2.1.5.

### 2.1.5.1.

μ μ μ μ . coli O157:H7 μ 4 C μ μ μ . μ μ stomacher. 320 ml Ringer μ 60 sec stomacher (BagMixer400, France). 0.1 ml μ μ μ μ CT- SMAC (cefixime - tellurite - Sorbitol MackConey Agar) (LAMB, United Kingdom) μ μ TSA μ E. coli

O157:H7 ( 37°C 24 ) μ μ ( ) ( 30 C 72 ), .

**2.1.5.2. μ μ**

μ μ μ  
*E. coli* O157:H7 μ μ μ  
 μ , 200 ml Ringer stomacher  
 4 C 30 μ .  
 μ 250 C  
 ( μ μ ) (Hanna Instruments). , μ  
 μ (μ μ )  
 μ (Pico Technology, United Kingdom) μ  
 , μ . 2 μ  
 μ μ μ μ μ .  
 μ μ μ μ μ 68 C,  
 μ μ stomacher μ μ  
 Ringer μ μ ,  
 μ μ Ringer μ 1:5.  
 μ stomacher. 0.1 ml  
 μ μ μ  
 μ CT- SMAC μ TSA  
 μ *E. coli* O157:H7 ( 37°C 24 ) μ  
 μ ( ) ( 30 C 72 ), .

**2.1.5.3. μ μ μ**

μ μ μ μ μ  
 μ μ μ , *D*,  
 μ μ μ , *z*.  
 , μ μ μ , *F*, :

$$F = 0 \quad t \quad 10^{(T(t) - T(\text{ref}))/z} \quad d_t,$$

$T(t)$   $\mu$   $\mu$   $t$  (ref)  
 $\mu$  (Toledo, 1991).

**2.1.6. pH**

pH  $\mu$   $\mu$   $\mu$  pH $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   
 $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   $\mu$

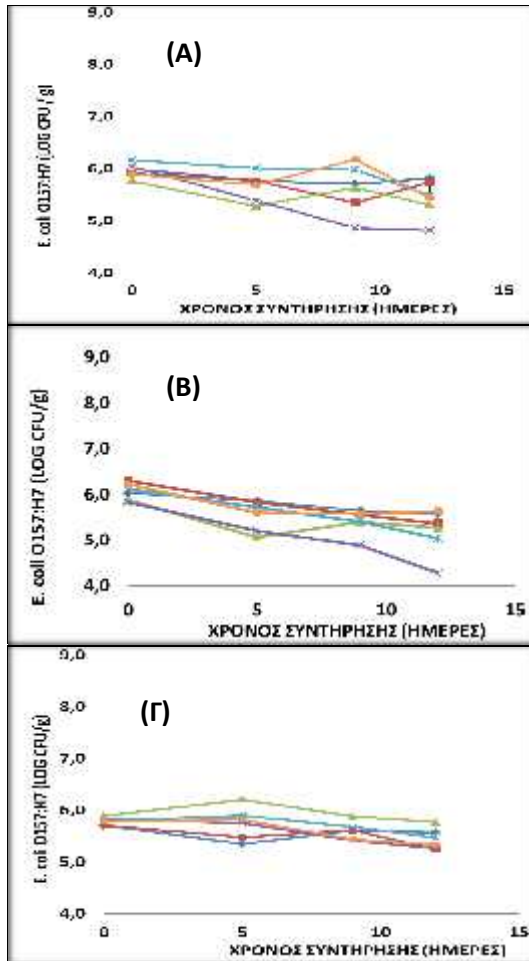
**2.1.7.**

$\mu$   $\mu$   $\mu$   $\mu$   
 (ANOVA)  $\mu$  Tukey- test  $\mu$   $\mu$   $\mu$  5%,  $\mu$   
 $\mu$   $\mu$   $\mu$   $\mu$   $\mu$  (ANOVA)  $\mu$   
 LCD- test  $\mu$   $\mu$   $\mu$  5%. T  $\mu$   $\mu$   
 $\mu$  STATISTICA 7 (StatSoft International Company).

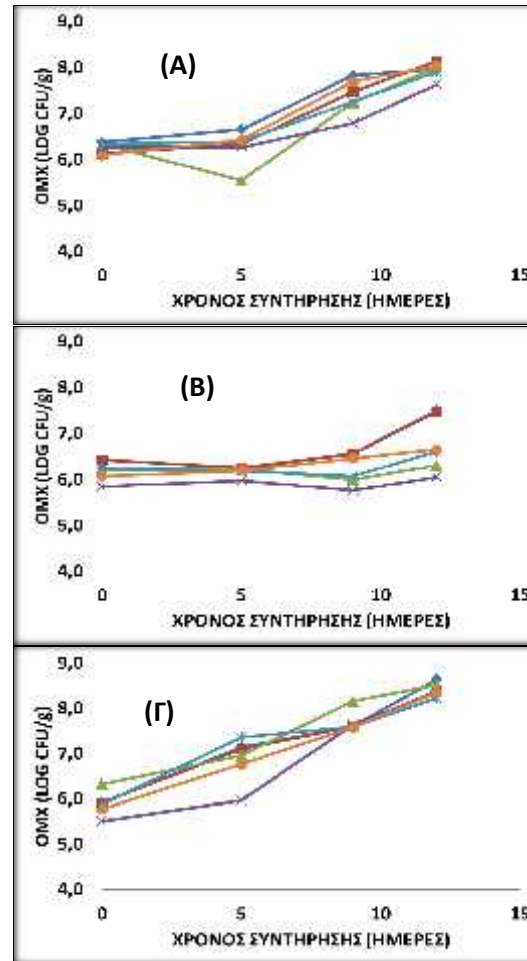
. —  
**3.1. E. coli O157:H7**

μ	2.2 mm, 1.2 mm	μ	0.9 mm	μ μ	μ
μ	4 C	μ			
o	μμ 3.1	μ			μ
μ	μ		<i>E. coli</i> O157:H7		
μ	( )	μ	.	μ	μ
μ	μ	μ	2.2 mm, 1.2 mm		
μ	0.9.		0,2%	0,3%	
μ	.				

### 1. E. coli O157:H7



### 2. OMX



- ΜΑΡΤΥΡΑΣ
- ΜΙΚΡΟΣΦΑΙΡΙΔΙΑ
- ΜΙΚΡΟΣΦΑΙΡΙΔΙΑ (0.2% Ε.Ο.)
- ΜΙΚΡΟΣΦΑΙΡΙΔΙΑ (0.3% Ε.Ο.)
- 0.2% Ε.Ο.
- 0.3% Ε.Ο.

μ 3.1. (0.2 0.3% μ ),  
 μ μ (A) 2.2 mm, (B) 1.2 mm ( ) μ 0.9 mm  
 2) μ 4 C.

1) *E. coli* O157:H7

μ μ μ μ 0.2%  
 μ μ μ 2.2 mm μ μ μ  
*E. coli* O157:H7 ( μμ 3.1. ). μ , μ 12 μ  
 4°C, μ μ 0.2%  
 μ μ μ , 0.5 log cfu / g. μ 9  
 μ , μ 0.2% μ μ  
 μ μ (0.9 log cfu / g) μ  
 μ μ  
 0.2% μ μ 1.4 1.2 log cfu / g  
 ( μμ 3.2. ). 12 μ μ μ  
 μ , 0.2% μ μ μ  
 0.2% μ μ (8 log cfu / g).  
 0.3% ( μμ 3.1. ),  
 μ 9 μ μ 0.6 1.1 log cfu / g μ  
 μ μ μ 0.3%  
 μ . 12 μ μ μ 1.3 0.5 log  
 cfu / g μ 0.3%  
 μ μ μ 0.3% μ .  
 ( μμ 3.2. ) 0 9 μ μ μ 0.3%  
 μ μ μ μ (0.5 log cfu / g)  
 μ μ μ  
 0.3% μ μ 1.4 1.6 log cfu / g  
 . 1.3 log cfu / g  
 μ 12 μ μ 0.3% μ μ  
 μ μ μ μ  
 0.3% μ μ 2.0 log cfu / g  
 .  
 , *E. coli* O157: H7 μ  
 0.2% 0.3% μ μ μ μ  
 μ 1.2 mm ( μμ 3.1. ). μ ,  
 0.2% , μ 5

μ μ μ 0.2%  
 μ μ μ 0.5, 0.8 log  
 cfu / g . 12 μ μ 0.9, 0.6 1.0  
 log cfu / g μ μ , 0.2%  
 μ μ μ 0.2% μ , .  
 ( μμ 3.2. ) 0 μ  
 12 μ , μ μ 0.2% μ μ μ  
 μ (6.2 log cfu / g) μ μ  
 μ μ 1.1 log  
 cfu / g. 0.3%  
*E. coli* O157:H7 ( μμ 3.2. ), μ 9 μ  
 μ μ 0.7, 0.9 0.6 log cfu / g μ  
 μ , 0.3% μ μ μ  
 0.3% μ . 12 μ μ μ  
 μ 9 μ 0.6 log cfu / g μ 0.3%  
 μ μ μ , μ μ *E. coli*  
 O157:H7 μ μ 0.3% (5.6 log cfu / g).  
 0.3% ( μμ 3.2. ),  
 12 μ μ μ 0.3%  
 μ μ μ μ μ  
 μ 0.3% μ  
 1.1 0.5 log cfu / g .  
 μ *E. coli* O157: H7  
 μ 0.2% 0.3% μ μ μ  
 μ μ 0.9 mm ( μμ 3.1. ) μ  
 μ μ μ μ μ  
 μ . μ , 0.2% μ  
 μ μ μ μ μ  
 0.2% μ μ μ 0.2%  
 μ . 0.3%  
 μ μ μ

(  $\mu\mu$  3.2. )  
 0.2%, 0 12  $\mu$   
 $\mu$   $\mu$   $\mu$  0.2%  $\mu$   
 $\mu$   $\mu$   $\mu$  0.2%  $\mu$   
 $\mu$   $\mu$  0.3%  
 $\mu$   $\mu$   $\mu$  0.3%  
 $\mu$   $\mu$  0.3%  $\mu$   
 (  $\mu$  ) 51  $\mu$   $\mu$   
 $\mu$   $\mu$   $\mu$   
 0.3%  $\mu$   $\mu$  2.2 mm 1.2 mm  
 $\mu$   $\mu$   $\mu$  *E. coli* O157:H7 12  
 $\mu$  , 1.5 1.3 log cfu / g  $\mu$   
 $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   
 $\mu$  .  $\mu$  , Milette et al. (2007)  $\mu$   $\mu$   
 $\mu$   $\mu$  *Staphylococcus aureus* 1.93 1.77 log cfu / g  $\mu$   $\mu$   
 $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   
 1000 500 IU / g . O  $\mu$   
 $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   
 $\mu$  , Oussalah et al. (2006)  $\mu$   
 1%  $\mu$  *E. coli* O157: H7  $\mu$   $\mu$   
 $\mu$   $\mu$   $\mu$   $\mu$   $\mu$  >2 log cfu / g.  
 $\mu$   $\mu$   $\mu$  , Oussalah et al. (2007)  $\mu$   
 1% *Salmonella enterica ser.*  
*Typhimurium*  $\mu$   $\mu$   $\mu$   $\mu$   
 1.85 log cfu / cm<sup>2</sup> 5  $\mu$   $\mu$   
 $\mu$   $\mu$  ,  $\mu$   $\mu$   
 $\mu$   $\mu$  1.2 mm.  $\mu$  ,  
 $\mu$   $\mu$   $\mu$  1,5 log cfu/g 1.2 mm  $\mu$  0,3%  
 $\mu$  , 2.2 mm  $\mu$  0,3%  $\mu$  1 log



cfu/g,

μ 0.9 mm

μ μ . μ μ μ

μ μ μ μ μ

μ μμ .

μ μ μ

μ

μ . ,

μ μ μ

μ μ μ

μ μ 2.2 mm 1.2 mm μ

μ μ μ ,

μ .

, μ μ μ

( ) μ μ μ μ μ

μ μ (0.9 mm) μ

μ

μ μ μ

μ *E. coli* O157:H7.

### 3.2. *E. coli* O157: H7

μ

μ μ 2.2 mm, 1.2 mm μ μ μ

μ μ μ (68°C 0.9 mm, μ μ)

μμ 3.3 3.4 μ

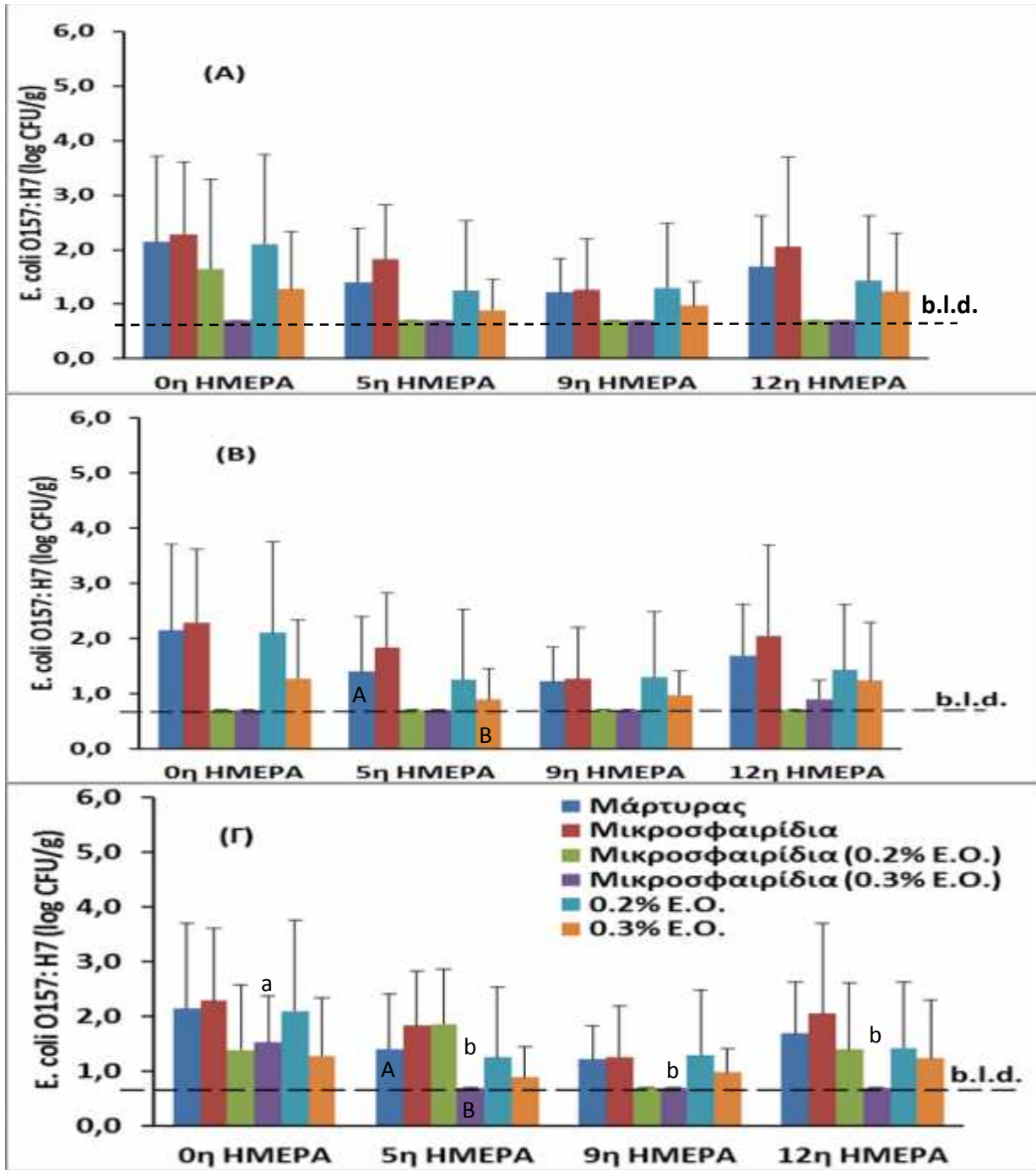
*E. coli* O157:H7

μ μ ( ) μ μ . μ

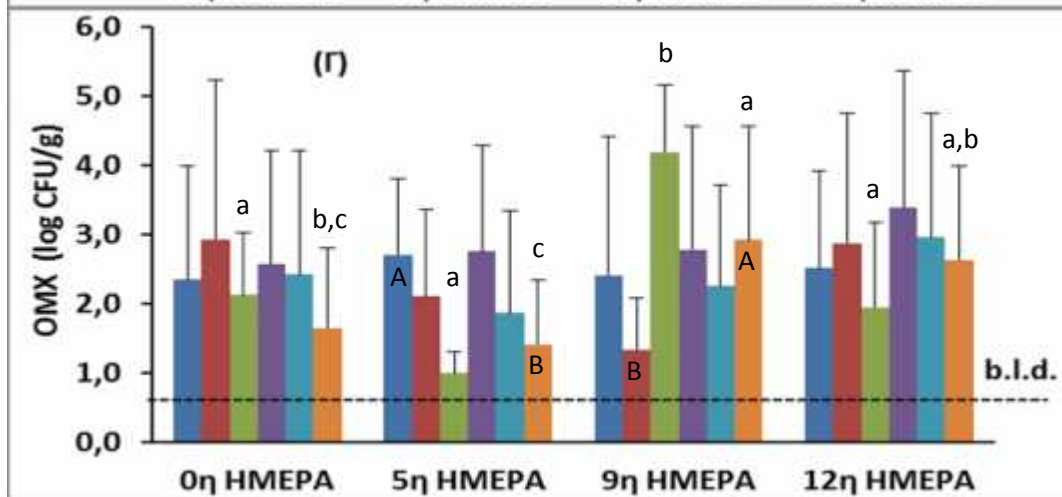
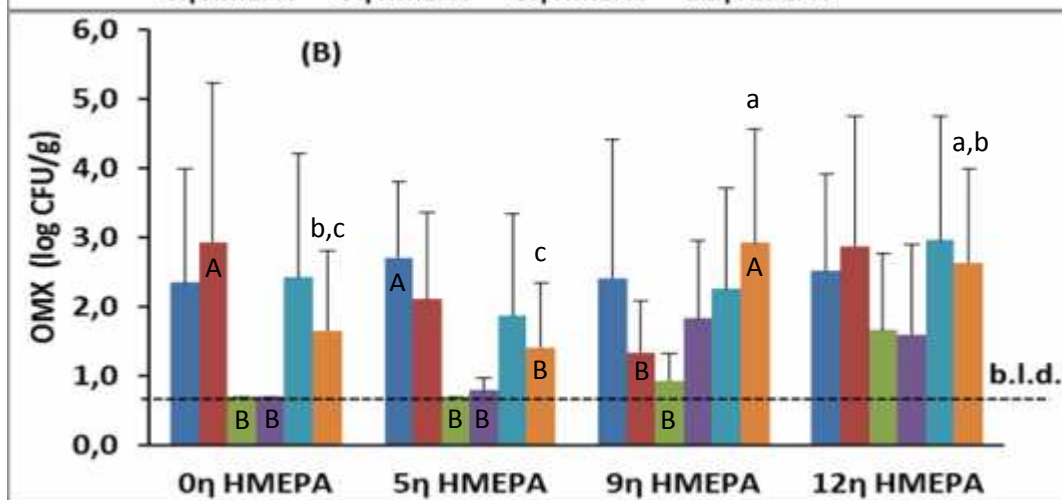
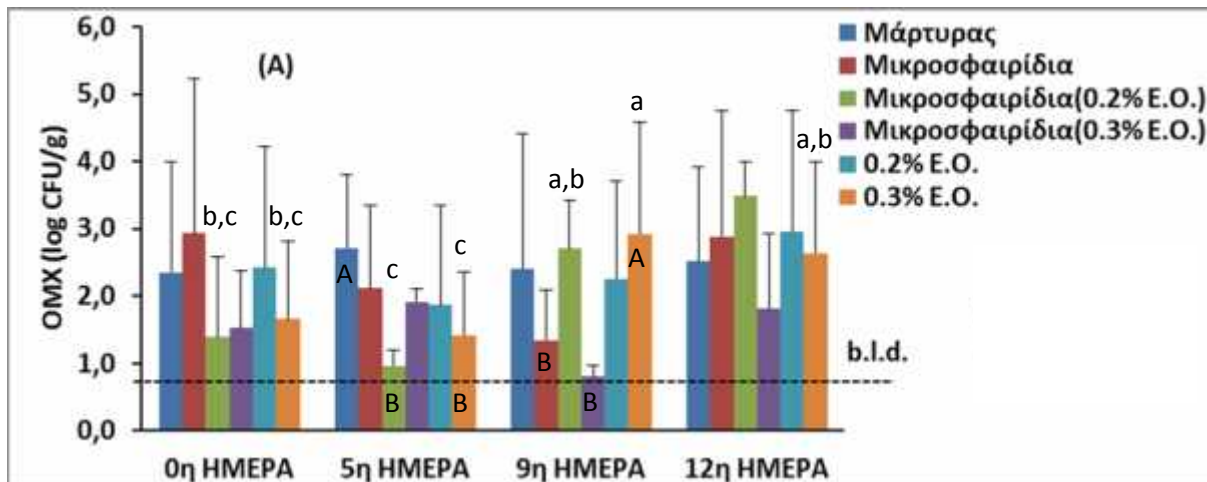
μ μ μ μ 2.2 mm, 1.2 mm

μ μ 0.9 mm. 0,2%

0,3% μ .



$\mu\text{m}$  3.3.  
 $\mu\text{m}$   $\mu\text{m}$   $\mu\text{m}$  (A) 2.2 mm, (B) 1.2 mm ( )  $\mu\text{m}$  0.9 mm  
*E. coli* O157:H7  $\mu\text{m}$  (68 C  
 )). \*b.l.d.: (0.7 log cfu / g),  $\mu\text{m}$   
 (  $\mu\text{m}$  ) :  $\mu\text{m}$   $\mu\text{m}$   $\mu\text{m}$   $\mu\text{m}$



μμ 3.4.

μ μ

μ (A) 2 mm, (B) 1 mm ( )

μ 0.9 mm

μ (68 C μ

μ μ

). \*b.l.d.:

(0.7 log cfu / g),

μ μ (

μ ):

μ

μ

μ

μ

μ μ :

μ

μ

μ

μ

μ

μ

0.2%  
 2.2 mm 1.2 mm  
 ( 3.3. 3.3. )  
 0.2%  
 0.2%  
 / g ( 2.2 mm) (> 0.7 log cfu / g) ( 1.2 mm),  
 2.3 log cfu / g (2.2 mm 1.2 mm).  
 , 5 , 9 12 ,  
 (> 0.7 log cfu / g) (2.2 mm 1.2 mm)  
 1.8, 1.3 2 log cfu / g  
 0.2% 1.2, 1.3 1.4 log cfu / g  
 0.3%  
*E. coli* O157:H7  
 0.3% (2.2 mm 1.2 mm)  
 (> 0.7 log cfu / g) (2.2 mm 1.2 mm)  
 0.3% 1.3, 0.9, 1.0 1.2  
 log cfu / g 0 , 5 , 9 12  
 0.2% 2.2 mm ( 3.4. )  
 5 1.9 log cfu / g  
 9 12 (2.2 mm) 0.3% (0.8 1.8 log  
 cfu / g ) 0.3%  
 (2.9 2.6 log cfu / g ). 0.2%  
 0.3% (1.2 mm) ,

$\mu$  (  $\mu\mu$  3.4. . 3.4. . )  $\mu$   $\mu$  0.2% 0.3%  $\mu$   
 $\mu$   $\mu$  .  $\mu$  , 0 5  $\mu$   $\mu$   
 $\mu$   $\mu$  0.2% 0.3%  $\mu$   $\mu$   
(0.7 log cfu / g)  $\mu$  0.2%  
 $\mu$  2.4 1.9 log cfu / g  $\mu$   
0.3%  $\mu$  1.7 1.4 log cfu / g. 12  $\mu$   $\mu$   
1.7 1.6 log cfu / g  $\mu$  0.2% 0.3%  
 $\mu$   $\mu$   $\mu$  (1.2 mm) ,  
 $\mu$  0.2% 0.3%  $\mu$  3.0 2.6  
log cfu / g .  
 $\mu$   $\mu$  *E. coli* O157:H7  
 $\mu$   $\mu$   $\mu$   
 $\mu$  0.9 mm (  $\mu\mu$  3.3. . )  $\mu$  ,  
 $\mu$  9  $\mu$   $\mu$  (0.7 log cfu / g)  
 $\mu$  0.2%  $\mu$   $\mu$   $\mu$  ,  
 $\mu$   $\mu$  0.2%  $\mu$  1.3 log cfu / g. 5 , 9 12  
 $\mu$   $\mu$   $\mu$  0.3%  $\mu$   $\mu$   
 $\mu$   $\mu$  *E. coli* O157:H7 (>  
0.7 log cfu / g),  $\mu$   $\mu$  0.3%  
 $\mu$  0.9, 1.0 1.2 log cfu / g .  
(  $\mu\mu$  3.4. . ),  $\mu$  12  $\mu$   $\mu$   $\mu$  0.2%  
 $\mu$   $\mu$   $\mu$   $\mu$  1,9 log cfu / g  $\mu$   
 $\mu$  0.2%  $\mu$  3.0 log cfu / g.  
 $\mu$   $\mu$   $\mu$   
0.2% 0.3%  $\mu$   $\mu$   $\mu$   
0.2% 0.3%  $\mu$   $\mu$   $\mu$   $\mu$   
 $\mu$  .  $\mu$   $\mu$   $\mu$   $\mu$   
 $\mu$   $\mu$  , Hoque et al., 2007  $\mu$  100 C

*E. coli*

O157:H7                      μ                      μ                      .                      μ

μ                      0.2%                      0.3%                      μ                      μ μ

                    μ                      μ                      *E. coli* O157:H7                      μ

                    μ                      μ                      0.2%

0.3%                      μ                      .                      μ                      Friedman et al., 2009,

                    μ 1%                      μ                      *E. coli*

O157:H7                      μ                      o control                      2.5 log cfu / g                      μ                      μ

                    μ                      μ                      .

                    μ                      μ

(                      μ )                      51                      μ                      μ                      .

                    μ                      μ                      (F-value)                      μ                      .

                    μ                      .

**3.1.**                      μ                      μ                      μ                      μ                      μ                      *E. coli* O157:H7

                    μ                      (                      )                      μ                      μ                      (68°C                      ) μ

                    μ                      μ                      μ                      μ                      μ                      2.2 mm

                    4°C.

		F- value (min)			
		0 μ	5 μ	9 μ	12 μ
		5,71 ± 1,6 <sup>Aa</sup>	6,23 ± 0,7 <sup>Aa</sup>	6,14 ± 0,1 <sup>Aa</sup>	6,68 ± 1,3 <sup>Aa</sup>
		5,65 ± 1,5 <sup>Aa</sup>	6,18 ± 1,7 <sup>Aa</sup>	5,52 ± 0,6 <sup>Aa</sup>	4,30 ± 1,7 <sup>Aa</sup>
	(0.2% . .)	6,56 ± 0,4 <sup>Aa</sup>	6,46 ± 0,4 <sup>Aa</sup>	6,00 ± 0,5 <sup>Aa</sup>	6,17 ± 1,2 <sup>Aa</sup>
	(0.3% . .)	6,15 ± 0,7 <sup>Aa</sup>	6,08 ± 0,5 <sup>Aa</sup>	6,17 ± 0,6 <sup>Aa</sup>	6,14 ± 0,7 <sup>Aa</sup>
. .	0.2%	7,20 ± 0,9 <sup>Aa</sup>	4,38 ± 0,9 <sup>Ab</sup>	6,01 ± 1,2 <sup>Aab</sup>	5,19 ± 1,1 <sup>Aab</sup>
. .	0.3%	6,62 ± 0,2 <sup>Aa</sup>	5,97 ± 0,4 <sup>Aa</sup>	5,89 ± 0,1 <sup>Aa</sup>	5,90 ± 1,00 <sup>Aa</sup>

\_\_\_\_\_ μμ :                      μ                      μ                      .

\_\_\_\_\_ μμ :                      μ                      μ                      .

**3.2.**  $\mu$   $E. coli$  O157:H7 ( )  $\mu$  (68°C)  $\mu$   
 $\mu$  )  $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   $\mu$  2.2 mm  
 $\mu$   $\mu$  4°C.

		$\mu$ (min)			
		0 $\mu$	5 $\mu$	9 $\mu$	12 $\mu$
		11,0 ± 0,8 <sup>Aa</sup>	11,6 ± 0,1 <sup>Aa</sup>	11,7 ± 0,4 <sup>Aa</sup>	11,6 ± 0,5 <sup>Aa</sup>
		11,0 ± 2,2 <sup>Aa</sup>	12,5 ± 1,1 <sup>Aa</sup>	11,8 ± 0,8 <sup>Aa</sup>	10,2 ± 2,4 <sup>Aa</sup>
	(0.2% . .)	11,7 ± 0,7 <sup>Aa</sup>	11,2 ± 0,8 <sup>Aa</sup>	12,0 ± 1,1 <sup>Aa</sup>	9,7 ± 2,0 <sup>Aa</sup>
	(0.3% . .)	11,8 ± 0,3 <sup>Aa</sup>	11,4 ± 1,4 <sup>Aa</sup>	12,2 ± 0,9 <sup>Aa</sup>	12,1 ± 0,6 <sup>Aa</sup>
. . 0.2%		12,7 ± 0,8 <sup>Aa</sup>	10,8 ± 2,3 <sup>Aa</sup>	11,7 ± 1,2 <sup>Aa</sup>	10,7 ± 2,7 <sup>Aa</sup>
. . 0.3%		12,5 ± 1,3 <sup>Aa</sup>	12,1 ± 0,2 <sup>Aa</sup>	12,5 ± 0,7 <sup>Aa</sup>	12,4 ± 1,1 <sup>Aa</sup>

...:  
 \_\_\_\_\_  $\mu\mu$  :  $\mu$   $\mu$  .  
 \_\_\_\_\_  $\mu\mu$  :  $\mu$   $\mu$  .

**3.3.**  $\mu$   $E. coli$  O157:H7 ( )  $\mu$  (68°C)  $\mu$   $\mu$   
 $\mu$   $\mu$  ( )  $\mu$   $\mu$   $\mu$   $\mu$   $\mu$  1.2 mm  
 $\mu$   $\mu$  4°C.

		F- value (min)			
		0 $\mu$	5 $\mu$	9 $\mu$	12 $\mu$
		3,40 ± 2,0 <sup>Aa</sup>	5,44 ± 0,9 <sup>Aa</sup>	5,56 ± 1,2 <sup>Aa</sup>	5,40 ± 0,9 <sup>Aa</sup>
		4,17 ± 0,9 <sup>Ab</sup>	5,44 ± 0,9 <sup>Aab</sup>	5,81 ± 0,4 <sup>Aa</sup>	4,72 ± 0,2 <sup>Aab</sup>
	(0.2% . .)	4,64 ± 0,9 <sup>Aa</sup>	4,86 ± 0,8 <sup>Aa</sup>	4,56 ± 1,5 <sup>Aa</sup>	5,16 ± 0,4 <sup>Aa</sup>
	(0.3% . .)	5,93 ± 1,1 <sup>Aa</sup>	5,61 ± 0,5 <sup>Aa</sup>	4,61 ± 0,3 <sup>Aa</sup>	7,02 ± 3,9 <sup>Aa</sup>
. . 0.2%		4,21 ± 1,4 <sup>Aa</sup>	4,11 ± 0,6 <sup>Aa</sup>	4,73 ± 0,8 <sup>Aa</sup>	4,64 ± 1,3 <sup>Aa</sup>
. . 0.3%		5,38 ± 1,0 <sup>Aa</sup>	4,20 ± 0,3 <sup>Aa</sup>	5,27 ± 1,0 <sup>Aa</sup>	4,57 ± 0,3 <sup>Aa</sup>

...:  
 \_\_\_\_\_  $\mu\mu$  :  $\mu$   $\mu$  .  
 \_\_\_\_\_  $\mu\mu$  :  $\mu$   $\mu$  .

3.4.  $\mu$   $E. coli$  O157:H7 (  $\mu$  )  $\mu$  (68°C  $\mu$  )  $\mu$  4°C.  $\mu$   $\mu$  1.2 mm

		$\mu$ (min)			
		0 $\mu$	5 $\mu$	9 $\mu$	12 $\mu$
. . . 0.2% . . . 0.3%	(0.2% . .)	$8,7 \pm 2,8^{Aa}$	$11,4 \pm 1,5^{Aa}$	$11,0 \pm 0,8^{Aa}$	$10,2 \pm 1,0^{Aa}$
		$10,0 \pm 1,6^{Aa}$	$11,5 \pm 0,2^{Aa}$	$11,2 \pm 0,6^{Aa}$	$10,2 \pm 0,4^{Aa}$
	(0.3% . .)	$10,9 \pm 0,7^{Aa}$	$11,7 \pm 1,3^{Aa}$	$10,9 \pm 2,5^{Aa}$	$10,7 \pm 0,6^{Aa}$
		$11,9 \pm 1,2^{Aa}$	$11,8 \pm 1,1^{Aa}$	$10,8 \pm 0,5^{Aa}$	$10,7 \pm 1,2^{Aa}$
		$10,3 \pm 1,5^{Aa}$	$10,6 \pm 0,6^{Aa}$	$11,1 \pm 1,1^{Aa}$	$10,3 \pm 0,9^{Aa}$
		$10,4 \pm 1,1^{Aa}$	$10,9 \pm 0,2^{Aa}$	$10,7 \pm 1,1^{Aa}$	$10,1 \pm 0,8^{Aa}$

...:

\_\_\_\_\_  $\mu\mu$  :

$\mu$   $\mu$  .

\_\_\_\_\_  $\mu\mu$  :

$\mu$   $\mu$  .

3.5.  $\mu$   $E. coli$  O157:H7 (  $\mu$  )  $\mu$  (68°C  $\mu$  )  $\mu$  4°C.  $\mu$   $\mu$  0.9 mm

		F – value (min)			
		0 $\mu$	5 $\mu$	9 $\mu$	12 $\mu$
. . . 0.2% . . . 0.3%	(0.2% . .)	$4,85 \pm 1,3^{Aab}$	$4,09 \pm 0,5^{Aab}$	$6,12 \pm 1,1^{Aa}$	$3,25 \pm 1,1^{Ab}$
		-	-	-	-
	(0.3% . .)	$6,10 \pm 1,1^{Aa}$	$5,38 \pm 0,7^{Aa}$	$5,32 \pm 1,4^{Aa}$	$5,73 \pm 0,4^{Aa}$
		$5,03 \pm 1,9^{Aa}$	$4,49 \pm 0,4^{Aa}$	$4,86 \pm 1,2^{Aa}$	$5,09 \pm 1,1^{Aa}$
		$5,18 \pm 1,5^{Aa}$	$4,47 \pm 0,7^{Aa}$	$2,94 \pm 0,3^{Aa}$	$3,87 \pm 1,4^{Aa}$
		$5,03 \pm 1,9^{Aa}$	$4,49 \pm 0,4^{Aa}$	$4,86 \pm 1,2^{Aa}$	$5,09 \pm 1,1^{Aa}$

...:

\_\_\_\_\_  $\mu\mu$  :

$\mu$   $\mu$  .

\_\_\_\_\_  $\mu\mu$  :

$\mu$   $\mu$  .



3.6.  $\mu$  ( )  $\mu$  (68°C  $\mu$ )  
 )  $\mu$   $\mu$   $\mu$   $E. coli$  O157:H7  $\mu$   $\mu$  0.9 mm  
 $\mu$   $\mu$  4°C.

	$\mu$ (min)			
	0 $\mu$	5 $\mu$	9 $\mu$	12 $\mu$
	$10,7 \pm 0,6^{Aa}$	$9,9 \pm 0,7^{Aa}$	$11,2 \pm 0,2^{Aa}$	$9,0 \pm 1,6^{Aa}$
	-	-	-	-
(0.2% . .)	$11,6 \pm 0,2^{Aa}$	$11,2 \pm 0,2^{Aa}$	$10,8 \pm 1,1^{Aa}$	$11,2 \pm 0,8^{Aa}$
(0.3% . .)	$10,8 \pm 0,1^{Aa}$	$10,1 \pm 0,8^{Aa}$	$9,1 \pm 1,8^{Aa}$	$9,1 \pm 1,4^{Aa}$
. . 0.2%	$10,0 \pm 2,0^{Aa}$	$10,3 \pm 0,7^{Aa}$	$10,0 \pm 2,2^{Aa}$	$9,7 \pm 0,6^{Aa}$
. . 0.3%	$10,0 \pm 1,8^{Aa}$	$11,0 \pm 0,6^{Aa}$	$8,1 \pm 0,5^{Aa}$	$9,2 \pm 1,3^{Aa}$

..: .

\_\_\_\_\_  $\mu\mu$  :

$\mu$   $\mu$  .

\_\_\_\_\_  $\mu\mu$  :

$\mu$   $\mu$  .

( $p < 0.05$  )  $\mu$   $\mu$   
 $\mu$  .  $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   
 $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   
 $\mu$   $\mu$   $\mu$   $\mu$   $\mu$   $\mu$  ,  
 $\mu$   $E. coli$  O157:H7

•  
 (1.2 mm 2.2 mm)  $\mu$   
 0.3%  $\mu$   
*E. coli* O157:H7.  $\mu$   $\mu$   
 0.9 mm  $\mu$  4  
 °C.  
 $\mu$   $\mu$   $\mu$  ,  $\mu$  0.2% 0.3%  
 $\mu$   $\mu$   $\mu$  ,  $\mu$  ,  
*E. coli* O157:H7  $\mu$   $\mu$  .  
 ,  $\mu$   $\mu$  ,  $\mu$   $\mu$  71 C  
 $\mu$   $\mu$  (CFSPH, 2004),  $\mu$   $\mu$   $\mu$   
 $\mu$   $\mu$   $\mu$   
 $\mu$  .  
 $\mu$   $\mu$   $\mu$  ( , ,  $\mu$  )  $\mu$   $\mu$   
 $\mu$   $\mu$   
 $\mu$  .

•

5.1.  $\mu$  *E. coli* O157:H7 (log CFU/g)  $\mu$   $\mu$  ( )  $\mu$  (68°C  
 $\mu$  )  $\mu$   $\mu$   $\mu$   $\mu$   $\mu$  2.2 mm  
 4°C.

	0 <sup>η</sup> Ημέρα		5 <sup>η</sup> Ημέρα		9 <sup>η</sup> Ημέρα		12 <sup>η</sup> Ημέρα	
	Πριν	Μετά	Πριν	Μετά	Πριν	Μετά	Πριν	Μετά
<i>Μάρτυρας</i>	6.0 ± 0.0 <sup>Aa*</sup>	2.1 ± 1.6 <sup>Aa</sup>	5.8 ± 0.1 <sup>ABa*</sup>	1.4 ± 1.0 <sup>Aa</sup>	5.7 ± 0.2 <sup>Aa*</sup>	1.2 ± 0.6 <sup>Aa</sup>	5.8 ± 0.6 <sup>Aa*</sup>	1.7 ± 0.9 <sup>Aa</sup>
<i>Μικροσφαιρίδια</i>	5.9 ± 0.1 <sup>Aa*</sup>	2.3 ± 1.3 <sup>Aa</sup>	5.8 ± 0.1 <sup>ABa*</sup>	1.8 ± 1.0 <sup>Aa</sup>	5.3 ± 0.3 <sup>Aa*</sup>	1.3 ± 0.9 <sup>Aa</sup>	5.7 ± 0.3 <sup>Aa*</sup>	2.0 ± 1.6 <sup>Aa</sup>
<i>Μικροσφαιρίδια (0.2% E.O.)</i>	5.8 ± 0.6 <sup>Aa*</sup>	1.6 ± 1.6 <sup>Aa</sup>	5.3 ± 0.2 <sup>Aa*</sup>	0.7 ± 0.0 <sup>Aa</sup>	5.6 ± 0.2 <sup>Aa*</sup>	0.7 ± 0.0 <sup>Aa</sup>	5.3 ± 0.1 <sup>Aa*</sup>	0.7 ± 0.0 <sup>Aa</sup>
<i>Μικροσφαιρίδια (0.3% E.O.)</i>	6.0 ± 0.1 <sup>Aa*</sup>	0.7 ± 0.0 <sup>Aa</sup>	5.4 ± 0.1 <sup>Aab*</sup>	0.7 ± 0.0 <sup>Aa</sup>	4.9 ± 0.6 <sup>Aab*</sup>	0.7 ± 0.0 <sup>Aa</sup>	4.7 ± 0.0 <sup>Ab*</sup>	0.7 ± 0.0 <sup>Aa</sup>
<i>0.2% E.O.</i>	6.2 ± 0.0 <sup>Aa*</sup>	2.1 ± 1.6 <sup>Aa</sup>	6.0 ± 0.1 <sup>Bab*</sup>	1.2 ± 1.3 <sup>Aa</sup>	6.0 ± 0.1 <sup>Aa*</sup>	1.3 ± 1.2 <sup>Aa</sup>	5.5 ± 0.3 <sup>Aa*</sup>	1.4 ± 1.2 <sup>Aa</sup>
<i>0.3% E.O.</i>	5.9 ± 0.4 <sup>Aa*</sup>	1.3 ± 1.1 <sup>Aa</sup>	5.7 ± 0.2 <sup>ABa*</sup>	0.9 ± 0.6 <sup>Aa</sup>	6.2 ± 0.3 <sup>Aa*</sup>	1.0 ± 0.4 <sup>Aa</sup>	5.4 ± 0.1 <sup>Aa*</sup>	1.2 ± 1.1 <sup>Aa</sup>

...:

\_\_\_\_\_  $\mu\mu$  :

\_\_\_\_\_  $\mu\mu$  :

\*:

0.7 log cfu /g:

5.2. μ (log CFU / g) μ μ ( ) μ (68°C  
 μ ) μ μ μ μ μ μ 2.2 mm  
 4°C.

	0 <sup>η</sup> Ημέρα		5 <sup>η</sup> Ημέρα		9 <sup>η</sup> Ημέρα		12 <sup>η</sup> Ημέρα	
	Πριν	Μετά	Πριν	Μετά	Πριν	Μετά	Πριν	Μετά
<i>Μάρτυρας</i>	6.4 ± 0.1 <sup>Ab*</sup>	2.4 ± 1.6 <sup>Aa</sup>	6.6 ± 0.2 <sup>Ab*</sup>	2.7 ± 1.1 <sup>Aa</sup>	7.8 ± 0.2 <sup>Aa*</sup>	2.4 ± 2.0 <sup>ABa</sup>	8.0 ± 0.2 <sup>Aa*</sup>	2.5 ± 0.4 <sup>Aa</sup>
<i>Μικροσφαιρίδια</i>	6.1 ± 0.4 <sup>Ab*</sup>	2.9 ± 2.3 <sup>Aa</sup>	6.3 ± 0.2 <sup>ABb*</sup>	2.1 ± 1.2 <sup>ABa</sup>	7.5 ± 0.2 <sup>Aa*</sup>	1.3 ± 0.7 <sup>Ba</sup>	8.1 ± 0.0 <sup>Aa*</sup>	2.9 ± 1.9 <sup>Aa</sup>
<i>Μικροσφαιρίδια (0.2% E.O.)</i>	6.3 ± 0.4 <sup>Abc*</sup>	2.3 ± 1.9 <sup>Abc</sup>	5.5 ± 0.3 <sup>Bc*</sup>	1.0 ± 0.2 <sup>Bc</sup>	7.2 ± 0.1 <sup>ABab*</sup>	2.7 ± 0.7 <sup>ABab</sup>	8.0 ± 0.1 <sup>Aa*</sup>	3.3 ± 0.5 <sup>Aa</sup>
<i>Μικροσφαιρίδια (0.3% E.O.)</i>	6.3 ± 0.2 <sup>Ab*</sup>	1.7 ± 0.7 <sup>Aa</sup>	6.3 ± 0.2 <sup>ABb*</sup>	1.9 ± 0.2 <sup>ABa</sup>	6.8 ± 0.1 <sup>Bb*</sup>	0.8 ± 0.2 <sup>Ba</sup>	7.6 ± 0.0 <sup>Aa*</sup>	1.8 ± 1.1 <sup>Aa</sup>
<i>0.2% E.O.</i>	6.3 ± 0.0 <sup>Ab*</sup>	2.4 ± 1.8 <sup>Aa</sup>	6.4 ± 0.0 <sup>Ab*</sup>	1.9 ± 1.5 <sup>ABa</sup>	7.5 ± 0.0 <sup>ABa*</sup>	2.3 ± 1.5 <sup>ABa</sup>	7.9 ± 0.2 <sup>Aa*</sup>	3.0 ± 1.8 <sup>Aa</sup>
<i>0.3% E.O.</i>	6.1 ± 0.4 <sup>Ab*</sup>	1.7 ± 1.2 <sup>Abc</sup>	6.4 ± 0.0 <sup>Ab*</sup>	1.4 ± 0.9 <sup>Bc</sup>	7.7 ± 0.1 <sup>Aa*</sup>	2.9 ± 1.6 <sup>Aa</sup>	8.1 ± 0.2 <sup>Aa*</sup>	2.6 ± 1.4 <sup>Aab</sup>

.....:

\_\_\_\_\_ μμ \_\_\_\_\_ :

\_\_\_\_\_ μμ \_\_\_\_\_ :

\*: \_\_\_\_\_

0.7 log cfu /g: \_\_\_\_\_

5.3.  $\mu$  *E. coli* O157:H7 (log CFU/g)  $\mu$   $\mu$  ( )  $\mu$  (68°C  
 $\mu$  )  $\mu$   $\mu$   $\mu$   $\mu$   $\mu$  1.2 mm  
 4°C.

	0 <sup>η</sup> Ημέρα		5 <sup>η</sup> Ημέρα		9 <sup>η</sup> Ημέρα		12 <sup>η</sup> Ημέρα	
	Πριν	Μετά	Πριν	Μετά	Πριν	Μετά	Πριν	Μετά
<i>Μάρτυρας</i>	6.0 ± 0.5 <sup>Aa*</sup>	2.1 ± 1.6 <sup>Aa</sup>	5.8 ± 0.3 <sup>Aa*</sup>	1.4 ± 1.0 <sup>ABa</sup>	5.6 ± 0.1 <sup>Aa*</sup>	1.2 ± 0.6 <sup>Aa</sup>	5.6 ± 0.2 <sup>Aa*</sup>	1.7 ± 0.9 <sup>Aa</sup>
<i>Μικροσφαιρίδια</i>	6.3 ± 0.2 <sup>Aa*</sup>	2.3 ± 1.3 <sup>Aa</sup>	5.8 ± 0.0 <sup>Aab*</sup>	1.8 ± 1.0 <sup>Aa</sup>	5.6 ± 0.2 <sup>Ab*</sup>	1.3 ± 0.9 <sup>Aa</sup>	5.4 ± 0.1 <sup>ABb*</sup>	2.0 ± 1.6 <sup>Aa</sup>
<i>Μικροσφαιρίδια (0.2% E.O.)</i>	5.9 ± 0.2 <sup>Aa*</sup>	0.7 ± 0.0 <sup>Aa</sup>	5.1 ± 0.8 <sup>Aa*</sup>	0.7 ± 0.0 <sup>ABa</sup>	5.4 ± 0.2 <sup>Aa*</sup>	0.7 ± 0.0 <sup>Aa</sup>	5.3 ± 0.1 <sup>ABa*</sup>	0.7 ± 0.0 <sup>Aa</sup>
<i>Μικροσφαιρίδια (0.3% E.O.)</i>	5.8 ± 0.2 <sup>Aa*</sup>	0.7 ± 0.0 <sup>Aa</sup>	5.2 ± 0.2 <sup>Ab*</sup>	0.7 ± 0.0 <sup>ABa</sup>	4.9 ± 0.0 <sup>Abc*</sup>	0.7 ± 0.0 <sup>Aa</sup>	4.3 ± 0.1 <sup>Bc*</sup>	0.9 ± 0.3 <sup>Aa</sup>
<i>0.2% E.O.</i>	6.0 ± 0.3 <sup>Aa*</sup>	2.1 ± 1.6 <sup>Aa</sup>	5.7 ± 0.3 <sup>Aa*</sup>	1.2 ± 1.3 <sup>ABa</sup>	5.4 ± 0.4 <sup>Aa*</sup>	1.3 ± 1.2 <sup>Aa</sup>	5.0 ± 0.6 <sup>ABa*</sup>	1.4 ± 1.2 <sup>Aa</sup>
<i>0.3% E.O.</i>	6.2 ± 0.2 <sup>Aa*</sup>	1.3 ± 1.1 <sup>Aa</sup>	5.6 ± 0.0 <sup>Ab*</sup>	0.9 ± 0.6 <sup>Ba</sup>	5.6 ± 0.0 <sup>Ab*</sup>	1.0 ± 0.4 <sup>Aa</sup>	5.6 ± 0.2 <sup>Ab*</sup>	1.2 ± 1.1 <sup>Aa</sup>

...:

\_\_\_\_\_  $\mu\mu$  :

\_\_\_\_\_  $\mu\mu$  :

\*:

0.7 log cfu /g:

5.4. μ (log CFU / g) μ μ ( ) μ (68°C  
 μ ) μ μ μ μ μ μ 1.2 mm  
 4°C.

	0 <sup>η</sup> Ημέρα		5 <sup>η</sup> Ημέρα		9 <sup>η</sup> Ημέρα		12 <sup>η</sup> Ημέρα	
	Πριν	Μετά	Πριν	Μετά	Πριν	Μετά	Πριν	Μετά
<i>Μάρτυρας</i>	6.3 ± 0.2 <sup>Ab*</sup>	2.4 ± 1.6 <sup>ABa</sup>	6.2 ± 0.0 <sup>Ab*</sup>	2.7 ± 1.1 <sup>Aa</sup>	6.6 ± 0.3 <sup>Ab*</sup>	2.4 ± 2.0 <sup>ABa</sup>	7.5 ± 0.1 <sup>Aa*</sup>	2.5 ± 0.4 <sup>Aa</sup>
<i>Μικροσφαιρίδια</i>	6.4 ± 0.0 <sup>Aab*</sup>	2.9 ± 2.3 <sup>Aa</sup>	6.3 ± 0.1 <sup>Ab*</sup>	2.1 ± 1.2 <sup>ABa</sup>	6.5 ± 0.3 <sup>Aab*</sup>	1.3 ± 0.7 <sup>Ba</sup>	7.5 ± 0.3 <sup>Aa*</sup>	2.9 ± 1.9 <sup>Aa</sup>
<i>Μικροσφαιρίδια (0.2% E.O.)</i>	6.2 ± 0.2 <sup>Aa*</sup>	0.7 ± 0.0 <sup>Ba</sup>	6.2 ± 0.2 <sup>Aa*</sup>	0.7 ± 0.0 <sup>Ba</sup>	6.0 ± 0.2 <sup>ABa*</sup>	0.9 ± 0.4 <sup>Ba</sup>	6.3 ± 1.0 <sup>Aa*</sup>	2.1 ± 1.1 <sup>Aa</sup>
<i>Μικροσφαιρίδια (0.3% E.O.)</i>	5.8 ± 0.2 <sup>Aa*</sup>	0.7 ± 0.0 <sup>Ba</sup>	6.0 ± 0.3 <sup>Aa*</sup>	0.8 ± 0.2 <sup>Ba</sup>	5.8 ± 0.0 <sup>Ba*</sup>	1.8 ± 1.1 <sup>ABa</sup>	6.1 ± 0.6 <sup>Aa*</sup>	1.6 ± 1.3 <sup>Aa</sup>
<i>0.2% E.O.</i>	6.2 ± 0.0 <sup>Aa*</sup>	2.4 ± 1.8 <sup>ABa</sup>	6.2 ± 0.0 <sup>Aa*</sup>	1.9 ± 1.5 <sup>ABa</sup>	6.2 ± 0.0 <sup>ABa*</sup>	2.3 ± 1.5 <sup>ABa</sup>	6.6 ± 0.4 <sup>Aa*</sup>	3.0 ± 1.8 <sup>Aa</sup>
<i>0.3% E.O.</i>	6.1 ± 0.2 <sup>Aa*</sup>	1.7 ± 1.2 <sup>ABbc</sup>	6.2 ± 0.0 <sup>Aa*</sup>	1.4 ± 0.9 <sup>Bc</sup>	6.5 ± 0.1 <sup>ABa*</sup>	2.9 ± 1.6 <sup>Aa</sup>	6.6 ± 0.2 <sup>Aa*</sup>	2.6 ± 1.4 <sup>Aab</sup>

...:

\_\_\_\_\_ μμ \_\_\_\_\_ :

\_\_\_\_\_ μμ \_\_\_\_\_ :

\*:

0.7 log cfu /g:

5.5.  $\mu$  *E. coli* O157:H7 (log CFU/g)  $\mu$   $\mu$  ( )  $\mu$  (68°C  
 $\mu$  )  $\mu$   $\mu$   $\mu$   $\mu$   $\mu$  0.9 mm  
 4°C.

	0 <sup>η</sup> Ημέρα		5 <sup>η</sup> Ημέρα		9 <sup>η</sup> Ημέρα		12 <sup>η</sup> Ημέρα	
	Πριν	Μετά	Πριν	Μετά	Πριν	Μετά	Πριν	Μετά
<i>Μάρτυρας</i>	5.7 ± 0.1 <sup>Aa*</sup>	2.1 ± 1.6 <sup>Aa</sup>	5.3 ± 0.1 <sup>Aa*</sup>	1.4 ± 1.0 <sup>ABa</sup>	5.6 ± 0.2 <sup>Aa*</sup>	1.2 ± 0.6 <sup>Aa</sup>	5.6 ± 0.1 <sup>Aa*</sup>	1.7 ± 0.9 <sup>Aa</sup>
<i>Μικροσφαιρίδια</i>	5.7 ± 0.1 <sup>Aa*</sup>	2.3 ± 1.3 <sup>Aa</sup>	5.5 ± 0.0 <sup>ABa*</sup>	1.8 ± 1.0 <sup>Aa</sup>	5.6 ± 0.2 <sup>Aa*</sup>	1.3 ± 0.9 <sup>Aa</sup>	5.2 ± 0.1 <sup>Aa*</sup>	2.0 ± 1.6 <sup>Aa</sup>
<i>Μικροσφαιρίδια</i> (0.2% E.O.)	5.9 ± 0.0 <sup>Aa*</sup>	1.4 ± 1.2 <sup>Aa</sup>	6.2 ± 0.3 <sup>Ba*</sup>	1.9 ± 1.0 <sup>ABa</sup>	5.9 ± 0.5 <sup>Aa*</sup>	0.7 ± 0.0 <sup>Aa</sup>	5.8 ± 0.2 <sup>Aa*</sup>	1.4 ± 0.0 <sup>Aa</sup>
<i>Μικροσφαιρίδια</i> (0.3% E.O.)	5.8 ± 0.1 <sup>Aa*</sup>	1.5 ± 0.8 <sup>Aa</sup>	5.8 ± 0.2 <sup>ABa*</sup>	0.7 ± 0.0 <sup>Bb</sup>	5.4 ± 0.2 <sup>Aa*</sup>	0.7 ± 0.0 <sup>Ab</sup>	5.3 ± 0.2 <sup>Aa*</sup>	0.7 ± 0.0 <sup>Ab</sup>
<i>0.2% E.O.</i>	5.8 ± 0.0 <sup>Aa*</sup>	2.1 ± 1.6 <sup>Aa</sup>	6.0 ± 0.3 <sup>ABa*</sup>	1.2 ± 1.3 <sup>ABa</sup>	5.7 ± 0.0 <sup>Aa*</sup>	1.3 ± 1.2 <sup>Aa</sup>	5.5 ± 0.2 <sup>Aa*</sup>	1.4 ± 1.2 <sup>Aa</sup>
<i>0.3% E.O.</i>	5.8 ± 0.0 <sup>Aa*</sup>	1.3 ± 1.1 <sup>Aa</sup>	5.8 ± 0.0 <sup>ABa*</sup>	0.9 ± 0.6 <sup>Ba</sup>	5.4 ± 0.3 <sup>Aa*</sup>	1.0 ± 0.4 <sup>Aa</sup>	5.3 ± 0.1 <sup>Aa*</sup>	1.2 ± 1.1 <sup>Aa</sup>

...:

\_\_\_\_\_  $\mu\mu$  :

\_\_\_\_\_  $\mu\mu$  :

\*:

0.7 log cfu /g:



5.6. μ (log CFU / g) μ μ ( ) μ (68°C  
 μ ) μ μ μ μ μ μ 0.9 mm  
 4°C.

	0 <sup>η</sup> Ημέρα		5 <sup>η</sup> Ημέρα		9 <sup>η</sup> Ημέρα		12 <sup>η</sup> Ημέρα	
	Πριν	Μετά	Πριν	Μετά	Πριν	Μετά	Πριν	Μετά
<i>Μάρτυρας</i>	5.9 ± 0.1 <sup>Ba*</sup>	2.4 ± 1.6 <sup>Aa</sup>	7.1 ± 0.3 <sup>ABb*</sup>	2.7 ± 1.1 <sup>Aa</sup>	7.6 ± 0.0 <sup>Ab*</sup>	2.4 ± 2.0 <sup>ABa</sup>	8.6 ± 0.2 <sup>Aa*</sup>	2.5 ± 0.4 <sup>Aa</sup>
<i>Μικροσφαιρίδια</i>	5.9 ± 0.1 <sup>Bd*</sup>	2.9 ± 2.3 <sup>Aa</sup>	7.1 ± 0.0 <sup>ABc*</sup>	2.1 ± 1.2 <sup>ABa</sup>	7.6 ± 0.0 <sup>Ab*</sup>	1.3 ± 0.7 <sup>Ba</sup>	8.4 ± 0.0 <sup>Aa*</sup>	2.9 ± 1.9 <sup>Aa</sup>
<i>Μικροσφαιρίδια (0.2% E.O.)</i>	6.3 ± 0.0 <sup>Ac*</sup>	2.1 ± 0.9 <sup>Aa</sup>	7.0 ± 0.7 <sup>ABbc*</sup>	1.0 ± 0.3 <sup>ABa</sup>	8.2 ± 0.0 <sup>Aab*</sup>	4.2 ± 1.0 <sup>Ab</sup>	8.5 ± 0.2 <sup>Aa*</sup>	1.9 ± 0.9 <sup>Aa</sup>
<i>Μικροσφαιρίδια (0.3% E.O.)</i>	5.5 ± 0.0 <sup>Cb*</sup>	2.6 ± 1.6 <sup>Aa</sup>	6.0 ± 0.1 <sup>Bb*</sup>	2.8 ± 1.5 <sup>ABa</sup>	7.6 ± 0.5 <sup>Aa*</sup>	2.8 ± 1.8 <sup>ABa</sup>	8.3 ± 0.1 <sup>Aa*</sup>	3.4 ± 2.0 <sup>Aa</sup>
<i>0.2% E.O.</i>	5.9 ± 0.1 <sup>Bb*</sup>	2.4 ± 1.8 <sup>Aa</sup>	7.4 ± 0.0 <sup>Aa*</sup>	1.9 ± 1.5 <sup>ABa</sup>	7.6 ± 0.0 <sup>Aa*</sup>	2.3 ± 1.5 <sup>ABa</sup>	8.2 ± 0.0 <sup>Aa*</sup>	3.0 ± 1.8 <sup>Aa</sup>
<i>0.3% E.O.</i>	5.7 ± 0.1 <sup>BCb*</sup>	1.7 ± 1.2 <sup>Abc</sup>	6.8 ± 0.3 <sup>ABb*</sup>	1.4 ± 0.9 <sup>Bc</sup>	7.6 ± 0.1 <sup>Aa*</sup>	2.9 ± 1.6 <sup>Aa</sup>	8.3 ± 0.1 <sup>Aa*</sup>	2.6 ± 1.4 <sup>Aab</sup>

...:

\_\_\_\_\_ μμ :

\_\_\_\_\_ μμ :

\*:

0.7 log cfu /g:

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