



**SURVIVAL AND PENETRATION OF *Salmonella* spp.
INOCULATED ON WASHED AND UNWASHED
EGGSHELL STORED AT DIFFERENT TEMPERATURES**

by

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Sekian, terima kasih.

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This dissertation is composed of my original work and contains no material previously text. The content of my dissertation is the result of work I have carried out since the commencement of my research project and does not include a substantial part of work that has been submitted to qualify for the award of any other degree or diploma in any university or other tertiary institution.



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LIST OF ABBREVIATIONS

Abbreviation	Caption
°C	Degree Celsius
L	Litre
µm	Micrometre
mL	Millilitre
nm	Nanometre
ppm	Part per million
%	Percentage
v/v	Volume per volume
ANOVA	Analysis of variance
BPW	Buffer peptone water
CDC	Centers for Disease Control and Prevention
CFU	Colony forming unit
DNA	Deoxyribonucleic acid
EFSA	European Food Safety Authority
FDA	Food and Drug Administration
FERG	Foodborne Disease Burden Epidemiology Reference Group
FTIR	Fourier-transform infrared spectroscopy
LPS	Lipopolysaccharide
NA	Nutrient agar
NTS	Non-typhoidal <i>Salmonella</i>
PCA	Plate count agar

RNA	Ribonucleic acid
SEM	Scanning electron microscopy
SFA	Singapore Food Agency
TSB	Tryptic soy broth
XLD	Xylose-lysine deoxycholate agar

KELANGSUNGAN HIDUP DAN PENEMBUSAN *Salmonella* spp. YANG DIINOKULASI ATAS TELUR YANG DICUCI DAN TIDAK DICUCI DENGAN PENYIMPANAN PADA SUHU YANG BERBEZA

ABSTRAK

Pencucian dan suhu penyimpanan telur merupakan faktor penting yang mempengaruhi pencemaran *Salmonella* atas permukaan telur dan kandungannya sepanjang masa penyimpanan. Objektif kajian ini adalah untuk mengkaji kesan pencucian dan suhu penyimpanan terhadap kelangsungan hidup dan penetrasi *Salmonella* atas permukaan dan kandungan telur sepanjang tempoh masa penyimpanan 1, 5, 7, 15, 22 dan 28 hari. Air paip dan span pinggan telah digunakan dalam proses pencucian. Lebih kurang 8 log CFU/mL kepekatan *Salmonella* telah diinokulasi atas keseluruhan permukaan telur. Penghitungan daripada permukaan telur, telur kulit yang hancur dan kandungan telur telah diuji untuk *Salmonella*. Kajian ini telah menunjukkan bahawa kelangsungan hidup *Salmonella* menurun sepanjang tempoh penyimpanan pada suhu 4°C dan 25°C bagi telur yang dicuci dan tidak dicuci. Peningkatan yang lebih ketara dalam kelangsungan hidup *Salmonella* telah dilihat bagi telur yang dicuci dan tidak dicuci yang disimpan dalam suhu 4°C untuk pada 28 hari. Selepas penderaman 1 hari, pengurangan terbanyak *Salmonella* telah dilihat pada telur yang dicuci dan yang diinkubasi pada 25°C. Terdapat 22.22% (8/36 telur dicuci) dan 8.33% (3/36 telur yang tidak dicuci) kandungan telur telah didapati dengan kewujudan *Salmonella* positif sepanjang inkubasi selama 28 hari. Walau bagaimanapun, semua telur yang disimpan pada suhu 4°C telah didapati *Salmonella* negatif dalam kandungan telur pada bila-bila masa. Kajian ini menunjukkan bahawa pencucian telur tidak memberikan kesan yang ketara kepada kelangsungan hidup *Salmonella* pada permukaan telur dan kandungannya. Penyimpanan telur pada suhu 4°C menunjukkan potensi perencatan terhadap penembusan *Salmonella* ke dalam

kandungannya. Penemuan kajian ini mencerminkan masalah keselamatan makanan di mana risiko penembusan *Salmonella* ke dalam kandungan telur dapat dikurangkan.

SURVIVAL AND PENETRATION OF *Salmonella* spp. INOCULATED ON WASHED AND UNWASHED EGGSHELL STORED AT DIFFERENT TEMPERATURES

ABSTRACT

Egg washing and storage temperature are the key factors at influencing *Salmonella* contamination on egg surface and content over a period of storage. In the present study, experiment explored the effect of washing and storage temperatures on the survival and penetration ability of *Salmonella* on the eggshell and into the egg content stored at 1, 5, 7, 15, 22, and 28 days. Tap water and dish sponge were used to mimic the household washing practice. *Salmonella* concentration at approximately 8 log CFU/mL was inoculated on egg surface with whole egg penetration method. *Salmonella* enumeration was carried out on the surface of eggshell, crushed eggshell and egg content. The study indicated that overall survival of *Salmonella* declined after 28 days of incubation at 4°C and 25°C for washed and unwashed eggs. A significant higher *Salmonella* survival was observed on the washed ($P < 0.05$) and unwashed ($P < 0.05$) eggshell surface at 4°C than 25°C on 28 days of incubation. After 1 day of incubation, the highest reduction of *Salmonella* (1.31 log CFU/mL) was observed on washed eggs incubated at 25°C. Egg content were tested for the presence and absence of *Salmonella*. There were 22.22% (8/36 washed eggs) and 8.33% (3/36 unwashed eggs) of egg contents were detected with *Salmonella* throughout 28 days of incubation. However, all the washed and unwashed eggs stored at 4°C was tested *Salmonella* negative in content at any time point. This study emphasize egg washing do not give a significant impact to the survival of *Salmonella* in eggshell and content. Storage temperature at 4°C showed potential inhibition toward the penetration of *Salmonella* in to the egg content. This finding had reflected on the food safety issue whereby the penetration risk of *Salmonella* into the egg content can be reduced.