Damanhour University
Faculty of Veterinary Medicine
Department of Food Hygiene and Control

Improvement the Shelf-life and Health Related Properties of Ready to Eat Meat by Using of some Plant Extract

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Gomaa Saber Rezk Zaqzouq

(**B.V.Sc.** Faculty of Veterinary Medicine, Alexandria University, 2006)

(**M.V.Sc.** Faculty of Veterinary Medicine, Alexandria University, 2013)

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LIST OF ABBREVIATIONS

APC	Aerobic Plate Count
APHA	American Public Health Association
BHI	Brain Heart Infusion
BP	Baired Parker agar
CDC	Centers for Disease Control and Prevention
CFR	Code of Federal Regulations
E.O.S.	Egyptian Organization for Standardization and quality control
EC	European Commission
EFSA	European Food Safety Authority
EMB	Eosin Methylen Blue
EO(s)	Essential oil
FAO	Food and Agriculture Oganization
FDA	Food and Drug Administration
FRPERC	Food Refrigeration and Process Engineering Research Centre
GMP	General Manfacturing Process
GRAS	Generally Recognized as Safe
ISO	International Organization of Standardization
LPS	Lipopolysaccharide
MFDS	Ministry of Food and Drug Safety
MR	Methylo Red
MRSA	Methicillin Resistant Staphylococcus Aureus
PEO	polyethylene oxide
RTE	Ready to eat
SE(s)	Staphylococcal Enterotoxins
SEPO	Staphylococcal food – poisoning outbreaks
TBA	Thiobarbituric Acid
TSI	Triple suger iron
TVN	Total Volatile Nitrogen
U.V.R	Ultra Violet Ray
USFDA	U. S. Food and Drug Administration
VP	Vagous Proskour
VRB	Violet Red Bile agar
WHO	World Health Organization

7. ENGLISH SUMMARY

The present study was conducted to evaluate the safety of some meat product (shawerma, kofta, pasterma and sausage) at El Beheira governorate in addition to evaluation of efficacy of natural essential oils as antimicrobial agents and food preservatives. Therefore, a total of 100 random samples of meat product shawerma, kofta. Pastrama and sausage (25 for each) were collected from local butcher shops and supermarkets in El Beheira governorate. The collected samples were transferred directly to the laboratory of food hygiene, Animal Health Research Institute, Damanhur Branch, in an isolated ice box under complete aseptic conditions with undue delay to be subjected to microbial examination; in addition to, evaluation of natural preservative effect of essential oil.

Our results revealed that, the APC (cfu/g) of the examined samples of meat products ranged from 1.8×10^4 to 8.5×10^5 with the mean value $2.4 \times 10^5 \pm 1.9 \times 10^5$ cfu/g in shawerma, 1.5×10^4 to 3×10^5 with the mean value $1.5 \times 10^5 \pm 7.2 \times 10^4$ cfu/g in kofta, 1.1×10^4 to 1.1×10^6 with the mean value $1.7 \times 10^5 \pm 2.1 \times 10^5$ cfu/g in pasterma and 1.2×10^5 to 2.4×10^6 with the mean value of $9.8 \times 10^5 \pm 6.5 \times 10^5$ cfu/g in sausage. Samples of sausage were the most contaminated ones followed by shawerma, pasterma and Kofta.

Concerning *Staph. aureus* count (cfu/g) of meat products were ranged from 1.2×10^2 to 2.1×10^3 with the mean value of $7.4 \times 10^2 \pm 5.6 \times 10^2$ cfu/g in shawerma, 1.3×10^2 to 3×10^3 with the mean value of $1.1 \times 10^3 \pm 6.9 \times 10^2$ cfu/g in kofta, 2.5×10^2 to 3.2×10^3 with the mean value of $1.5 \times 10^3 \pm 7.5 \times 10^2$ cfu/g in pasterma and 1.1×10^2 to 3.1×10^3 with mean value of $8.7 \times 10^2 \pm 8.8 \times 10^2$ cfu/g in sausage. The incidence of *Staph. aureus* in beef shawerma, kofta, pasterma and sausage were 60, 68, 44and 52%, respectively.

Coliform count of the examined samples it was ranged from 1.1×10^2 to 5×10^3 with the mean value $2.2 \times 10^3 \pm 1.3 \times 10^3$ in shawerma, 2.4×10^2 to 3.5×10^3 with the mean value $1.5 \times 10^3 \pm 9.2 \times 10^2$ cfu/g in kofta, 1.2×10^2 to 2.4×10^3 with the mean value $6.8 \times 10^2 \pm 6.4 \times 102$ cfu/g in pasterma and 2.1×10^2 to 1.1×10^4 with the mean value of $1.9 \times 10^3 \pm 2.1 \times 10^3$ cfu/g in sausage. The incidence of *E. coli* in the examined samples of beef shawerma, kofta, pasterma and sausage were 52, 36, 36 and 44%, respectively.

The antibacterial activity of examined essential oils (clove and garlic) with different concentration (0.3, 0.5 and 1) % on viability of *Staph. aureus* and *E. coli*, the results revealed the count of tested bacteria in examined minced meat samples were as follow:

The log means value ± SD of *Staph. aureus* counts in control samples of examined

minced meat at storage period (3hrs, 1st, 2nd, 3rd, 4th days) were 6.04 ± 0.11, 5.95 ± 0.83, 6.09 ± 0.91, 6.15 ± 1.33 and 6.99 ± 1.31 cfu/g, respectively. While the mean values of *E. coli* were 5.24 ± 0.27, 5.47 ± 0.47, 5.53 ± 0.44, 5.67 ± 0.49 and 5.97 ± 0.76 cfu/g, respectively.

Concerning the effects of clove on *Staph. aureus*, the log means value $\pm$ SD in treated minced meat samples with clove 0.3% at storage period (3hrs, 1st, 2nd, 3rd, 4th days) at 4 ± 1 ^{o}C were 5.52 ± 0.76, 4.93 ± 0.95, 4.47 ± 1.26, 4.19 ± 0.99 and 5.31 ± 1.03 cfu/g, respectively, with reduction percent of 8.63, 17.19, 26.52, 30.31 and 24.08 % respectively. With clove 0.5% at storage period (3hrs, 1st, 2nd, 3rd, 4th days) were 5.00 ± 1.18, 3.91 ± 1.23, 3.46 ± 0.77, 0.00 ± 0.00 and 0.00 ± 0.00 cfu/g, respectively, with a reduction percent of 17.22, 34.26, 43.14, 100.00 and 100.00 %, respectively. While with clove 1% at storage period (3hrs, 1st, 2nd, 3rd, 4th days) were 3.97 ± 1.23 cfu/g and then not detected from the first day till 4th day of experiment with a reduction percent 34.31 after 3hrs of treatment and 100% in the remain days of experiment not detected from the second day of experiment with a reduction percent 100%.

Concerning to effects of clove on *E. coli*, revealed that, the log means value $\pm$ SD of *E. coli* in treated minced meat samples with clove 0.3% at storage period (3hrs, 1st, 2nd, 3rd and 4th days) were 5.08 ± 0.47, 4.43 ± 0.51, 3.87 ± 0.54, 4.63 ± 0.50 and 4.86 ± 0.61 cfu/g, respectively, with a reduction percent of 3.11, 19.14, 30.12, 18.24 and 18.60%, respectively. While clove 0.5% log mean of *E. coli* at storage period (3hrs, 1st, 2nd, 3rd and 4th days) were 4.39 ± 0.65 ,3.89 ± 0.59, 3.26 ± 0.76, 0.00 ± 0.00 and 0.00 ± 0.00 cfu/g, respectively, with a reduction percent of 16.25, 28.88, 41.09, 100.00 and 100.00%, respectively. While with clove 1% the log mean of *E. coli* at storage period (3hrs, 1st, 2nd, 3rd and 4th days) were 4.36 ± 0.71, 3.73 ± 0.59 cfu/g ,respectively and then not detected from the second day till 4th day of experiment with a reduction percent 16.86 and 31.85% after 3hrs and first day of treatment and 100% in the remain days of experiment not detected from the second day of experiment with a reduction percent 100%.

Concerning to the effects of garlic on *Staph. aureus* % the log means value $\pm$ SD in treated minced meat samples with garlic 0.3% at storage period (3hrs, 1st, 2nd, 3rd, 4th days) at 4 ± 1 ^{0}C were 5.88 ± 0.91, 5.22 ± 1.13, 4.36 ± 1.32, 4.43 ± 1.18 and 4.75 ± 1.05 cfu/g, respectively, with a reduction percent of 2.67, 12.26, 28.35, 26.41 and 32.05 %, respectively. While garlic 0.5% were 5.30 ± 0.70, 4.52 ± 1.30, 0.00 ± 0.00, 0.00 ± 0.00 and 0.00 ± 0.00 cfu/g, respectively, with a reduction percent of 12.32, 24.10, 100.00, 100.00 and 100.00 %

respectively. While garlic 1% at storage periods were 4.66 ± 0.71, 3.88 ± 0.61, 0.00 ± 0.00, 0.00 ± 0.00 and 0.00 ± 0.00 cfu/g, respectively, with a reduction percent of 22.84, 34.80, 100.00, 100.00 and 100.00 %, respectively.

Concerning to the effects of garlic on *E. coli*, the log means value $\pm$ SD of *E. coli* in treated minced meat samples with garlic 0.3% at storage period (3hrs, 1st, 2nd, 3rd and 4th days) were 4.67 ± 0.60, 4.37 ± 0.51, 3.79 ± 0.57, 3.93 ± 1.00 and 4.58 ± 0.70 cfu/g, respectively with a reduction percent of 10.90, 20.12, 31.43, 30.72 and 23.25% respectively. With garlic 0.5% the log means value $\pm$ SD of *E. coli* at storage period (3hrs, 1st, 2nd, 3rd and 4th days) were 4.46 ± 0.55, 3.87 ± 0.43 cfu/g, respectively and then not detected from the second day till 4th day of experiment with a reduction percent of 14.95, 29.23, 100.00, 100.00 and 100.00%, respectively. garlic 1% the log mean $\pm$ SD counts of *E. coli* at storage periods were 4.36 ± 0.61, 3.55 ± 0.46 cfu/g, respectively and then not detected from the second day till 4th day of experiment with a reduction percent 16.86and35.25% after 3hrs and first day of treatment and 100% in the remain days of experiment not detected from the second day of experiment with a reduction percent 100%.

Concerning to mixture of the two tested oils by concentration 0.3% in the experiment, the log means value $\pm$ SD of *Staph. aureus* with mixd of the two oils 0.3% at storage period (3hrs, 1st, 2nd, 3rd and 4th days) were 5.30 ± 1.00, 3.63 ± 1.23, 3.56 ± 1.23, 4.07 ± 0.88 and 4.34 ± 0.99 cfu/g, respectively with a reduction percent 12.23, 38.91, 41.49, 32.39 and 37.85 % respectively. It was observed that, mix of the two oils 0.3% better in growth inhibition of staphylococci and higher in reduction percent than garlic oil 0.3% and clove 0.3%, higher reduction percent and complete inhibition of Staphylococci in minced meat. That's mean mix of oils 0.3% has a synergistic effect and improves the antibacterial effect of garlic 0.3% and clove 0.3% rather than the oil alone at this concentration; in addition to the mix of oil possess an accepted and preferable odor and flavor so can use it to overcome the un accepted flavor of high concentration particularly clove oil.

The log means value $\pm$ SD of *E. coli* with mixed of the two oils 0.3% at storage period (3hrs, 1st, 2nd, 3rd and 4th days) were 4.63 ± 0.42, 3.83 ± 0.45 3.64 ± 0.49, 3.84 ± 0.53 and 4.20 ± 0.57 cfu/g, respectively with a reduction percent of 11.81, 30.12, 34.18, 32.29 and 29.73 % respectively. It was observed that, mix of oils 0.3% better in growth inhibition of *E. coli* and higher in reduction % than garlic 0.3% and clove 0.3%. That's mean mix of oils 0.3% has synergistic effects and improves the antibacterial effect of garlic 0.3% and

clove 0.3% rather than the oil alone at this concentration.

From the obtained results, it was revealed that the sensory properties of the samples were enhanced by addition of essential oils (clove and garlic). In addition, addition of essential oils leads to enhancement of the shelf life of minced meat samples at storage period at 4 $\pm 1^{o}$C.