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Effect of Aqueous Extract and Essential Oils of Ginger and Garlic as Decontaminat in Chicken Meat

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Abstract: A study was conducted to evaluate efficiency of aqueous extract and essential oils of ginger and garlic as decontaminating agent in chicken meat was carried out. Two concentrations of Aqueous Extract-AE (100 and 75%) and three concentrations of Essential oil-EO (1:150, 1:250 and 1:500) of ginger and garlic were for the study. Results revealed that Aqueous extract of ginger at 100 and 75% concentration did not have any effect in terms of viable log reduction with respect to the bacterial pathogens whereas essential oil of ginger at 1:150 and 1:250 concentrations brought about a significant decrease in bacterial count compared to 1:500. Based on the results it was observed that 1:150 concentration of EO of ginger was best among the different treatments used. A highly significant ($p<0.01$) reduction in bacterial counts by one log with respect to TVC, Staphylococcal counts, *E. coli* and Salmonella was observed following dipping of chicken meat in AE of garlic at 100% concentration. The efficiency of decontamination ability of AE of garlic was found better compared to EO. The order of various concentrations in causing bacterial reduction was 100% followed by 75% AE, 1:150, 1:250 and 1:500 concentration of EO. Aqueous extract of garlic was found to be better in decreasing the microbial load compared to other treatments.

Key words: Ginger, garlic, chicken meat, microbial load, essential oils, treatment

INTRODUCTION

The safety of commercially processed poultry products is a major area of concern for producers, consumers and public health officials alike worldwide for products excessively contaminated with microorganisms are undesirable from the standpoint of public health storage quality and general aesthetics (Cunningham, 1982; Mead, 1989). The contamination of chicken meat with microorganisms during processing, handling and transportation is undesirable though inevitable. A higher bacterial load on the carcass could be expected when carcasses are handled unhygenically at the abattoir (Bacchil, 1998).

Hardly 5% of the poultry meat produced in the country is from organized processing units whereas the rest is from the birds slaughtered in unorganized sector (retail shops) where due to poor hygiene there is ample scope for contamination. At the slaughter facility, the microbiological quality of freshly processed poultry carcass depends on the level of contamination from live birds, numbers and types of microorganisms introduced, cross contamination from handlers, soil and water, technical design of processing equipment, efficiency of processing methods, temperature control and sanitary practices followed (Bailey *et al*., 1987). Considerable amount of research has been done to develop effective methods for reducing the bacterial load in meat such as decontamination by chlorinated water spray (James *et al*., 1992), lactic acid spray (Barbuddhe *et al*., 1999), hot water sprays (Sinhamahapatra *et al*., 2004) and also combination of various salts (Kondaiah *et al*., 1985).

Treatment of the carcasses in the water with chemicals during processing have been found to reduce microbial numbers but as yet none have resulted in a commercially acceptable process following the alterations in appearance of the carcass by either bleaching or darkening of the finished carcass (Dickens and Whittemore, 1994). Incidence of more resistant to classic antimicrobial agents and in addition, the consumers refusal of foods prepared with chemical preservatives have compelled a research for novel natural preservatives that could sufficiently assure the safety of the food products and as well as meet the consumers demand of chemical free meat. Ginger, garlic, clove etc. are popular and freely available in the country and are used extensively in day to day cookery for a different purpose.

Studies have shown that spices have inhibitory effect on pathogens like *Salmonella typhimurium* and *Staphylococcus aureus* (Karapinar and Aktug, 1997),

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Listeria monocytogenes (Wang and Johnson, 1992), *E. coli* (Kim *et al*., 1996) and *Aeromonas* sp. (Quaglio *et al*., 2001). Hence the study was designed to evaluate the efficiency of aqueous extract and essential oils of ginger and garlic on chicken meat.

MATERIALS AND METHODS

Preparation of aqueous spice extracts: Aqueous extract of both ginger and garlic were prepared as per the method outlined by Indu *et al.* (2006). The fresh spices were obtained from the local market and were cleaned, descaled and washed in sterile distilled water. In order to obtain aqueous extract of the spices, 100 g of each washed spice was homogenized without addition of any water. The extracts obtained were initially sieved through a fine sterilized muslin cloth and the filtrate obtained was sterilized using a membrane filter (0.45 μ sterile filter). The sterilized aqueous extract obtained so was considered as the 100% concentration of the extract. Then the concentrations of 75% (75 mL of 100% conc. spice extract diluted with 25 mL sterile distilled water) and 50% (50 mL of 100% conc. spice extract diluted with 50 mL sterile distilled water) were made by diluting the concentrated extract with appropriate volumes of sterile distilled water. The extracts were prepared fresh before each trail so as to obtain best results.

Source of essential oils of spices: The essential oils of spices viz., garlic (B. No.L0721290907) and ginger (B. No. L09000272) were obtained from M/S Plants lipids Ltd/ Cochin, Kerala.

Evaluation of ginger and garlic as decontaminating agents: To evaluate the efficiency of decontaminating chicken meat, two concentrations of Aqueous Extract-AE (100 and 75%) and three concentrations of Essential Oil-EO (1:150, 1:250 and 1:500) of ginger and garlic were for the study. Chicken whole leg and breast samples were procured from the market individually for each of the treatments. Initial microbial counts of the samples were assessed as per the procedures outlined in ICMSF. The same samples were then dipped into different concentrations of AE and EO of ginger and garlic and were allowed a contact time of 2 min (Contact time was standardized based on the efficiency of the extracts to reduce bacterial counts and sensory evaluation). Then samples were drawn from each of the treated sample and microbial counts were evaluated and expressed as $\log_{10}$ cfu g^{-1} of meat sample. The difference in log values before and after treatment was used as a guide to assess the antimicrobial and decontamination ability of spice extracts.

RESULTS AND DISCUSSION

The Mean±SE values of microbial counts ($\log_{10}$ cfu g^{-1}) of different concentrations of AE and EO of garlic in reduction of bacterial pathogens are shown in Table 1. Analysis of variance revealed a highly significant ($p<0.01$) reduction in bacterial count with respect to TVC, Staphylococcus, *E. coli* and Salmonella counts. However, aqueous extract of garlic at 100% concentration was highly effective in reducing the bacterial counts by 1 log. The efficiency of decontamination ability of garlic AE was significantly better ($p<0.01$) compared to its EO. The descending order of various concentrations in causing bacterial reduction was 100 followed by 75% AE, 1:150, 1:250 and 1:500 EO of garlic. Aqueous extract of garlic was found to be more effective compared to that of

Table 1: Effect of AE (100, 75%) and EO of garlic for decontaminating chicken meat by dipping (Mean±SE) ($\log_{10}$ cfu g^{-1})

Variables	AE: 100 (%)	AE: 75 (%)	EO 1:150	EO 1:250	EO 1:500
Total viable count					
BT	5.77±0.07	5.64±0.070	5.90±0.03	5.73±0.05	5.81±0.020
AT	4.66±0.02	4.76±0.090	5.26±0.02	5.23±0.05	5.37±0.060
LR	1.11±0.06^{a}	0.88±0.060^{b}	0.63±0.03^{c}	0.50±0.02^{de}	0.44±0.020^{e}
Staphylococcus					
BT	4.58±0.06	4.56±0.070	4.72±0.07	4.71±0.06	4.61±0.100
AT	3.76±0.04	4.05±0.067	4.27±0.07	4.30±0.03	4.38±0.090
LR	0.82±0.03^{a}	0.51±0.080^{b}	0.46±0.04^{bcd}	0.41±0.09	0.23^{ce}±0.02
E coli					
BT	3.42±0.07	3.47±0.080	3.42±0.12	3.35±0.11	3.49±0.030
AT	2.71±0.05	2.96±0.110	2.77±0.04	3.02±0.15	3.35±0.020
LR	0.72±0.03^{a}	0.51±0.070^{a}	0.52±0.05^{a}	0.33±0.06^{ab}	0.24±0.050^{c}
Salmonella					
BT	3.23±0.04	3.26±0.120	3.34±0.05	3.36±0.18	3.22±0.180
AT	2.61±0.04	2.76±0.090	2.95±0.08	3.12±0.16	3.09±0.170
LR	0.64±0.05^{a}	0.50±0.040^{a}	0.40±0.08^{b}	0.24±0.02^{bc}	0.14± 0.01

^{d}BT = Before Treatment, AT = After Treatment, LR = Log Reduction, Means bearing different superscripts with in rows indicate significant difference ($p<0.01$ or $p<0.05$)

Table 2: Effect of AE (100 and 75%) and EO of ginger for decontaminating chicken meat by dipping (Mean±SE) ($\log_{10}$ cfu g^{-1})

Variable	AE: 100 (%)	AE: 75 (%)	EO 1:150	EO 1:250	EO 1:500
TVC					
BT	5.68±0.02	5.67±0.03	5.65±0.02	5.66±0.030	5.72±0.02
AT	5.65±0.02	5.65±0.03	5.14±0.04	5.30±0.030	5.51±0.06
LR	0.03±0.01^{a}	0.01±0.04^{a}	0.49±0.05^{b}	0.037 ±0.01^{bc}	0.21±0.03^{d}
Staphylococcus					
BT	4.63±0.04	4.59±0.02	4.87±0.12	4.63±0.050	4.70±0.03
AT	4.59±0.05	4.57±0.02	4.30±0.13	4.16±0.050	4.51±0.05
LR	0.03±0.01^{a}	0.02±0.05^{a}	0.57±0.03^{b}	0.47±0.040^{bc}	0.19±0.03^{d}
E. coli					
BT	3.35±0.05	3.50±0.04	3.33±0.02	3.45±0.060	3.55±0.02
AT	3.32±0.05	3.42±0.05	3.13±0.06	3.34±0.070	3.45±0.01
LR	0.03±0.01^{a}	0.02±0.01^{a}	0.22±0.05^{b}	0.12±0.010^{a}	0.09±0.01^{a}
Salmonella					
BT	3.12±0.17	3.19±0.15	3.04±0.17	3.24±0.020	3.26±0.24
AT	3.09±0.17	3.18±0.15	2.91±0.17	3.17±0.020	3.19±0.24
LR	0.03±0.01^{a}	0.02±0.01^{a}	0.13±0.01^{b}	0.07±0.010^{a}	0.07±0.01^{a}

BT = Before Treatment, AT = After Treatment, LR= Log Reduction. Means bearing different superscripts with in rows indicate significant difference ($p<0.01$ or $p<0.05$)

the essential oils. The Mean±SE values of effective concentrations of AE and EO of ginger to reduce bacterial pathogens are shown in Table 2. Results of the study revealed that a highly significant ($p<0.01$) reduction of bacterial count in different dilutions of EO of ginger with respect to TVC, Staphylococcus, *E. coli* and Salmonella counts. Dilutions of EO of ginger at 1:150 and 1:250 concentrations brought about a significant decrease in bacterial counts compared to 1:500. Based on the results it was observed that 1:150 concentration was the best among the different treatments used. However, aqueous extract of ginger was found to be not effective in reduction of microbial counts.

In the present study, the aqueous extract of garlic was better with respect to bringing down the microbial load compared to essential oil. This might be due to the fact that allicin, the active principle in garlic is water soluble and hence, it is well extracted in the presence of water (Block, 1985; Ellmore and Feldberg, 1994). However, Chung *et al.* (2003) observed that garlic could only reduce the *Staphylococcus aureus* but not inactivate it in foods. Yadav *et al.* (2002) reported a lower coliform counts in garlic extract treated samples, compared to control.

Based on the results it was observed that 1:150 concentration of EO was best among the different treatments used. Similarly, Kalemba and Kunicka opined that essential oil of ginger was more potent in inhibiting the microbial growth compared to the aqueous extract. Indu *et al.* (2006) found that ginger extract did not show any antibacterial activity against *E. coli*, Salmonella, *L. monocytogenes* and *A. hydrophila*. However, Zaika (1988) reported that ginger paste produced significant reduction in coliform counts to the tune of 2.1 log cfu g^{-1}. Suresh *et al.* (2004) and Srinivasan and Lakshmanaperumalsamy (1993) observed that ginger extract had moderate activity against common food borne pathogens.

CONCLUSION

The trend observed in the present study clearly indicates that aqueous extract of garlic and essential oils of ginger are more efficient in reduction of bacterial counts in chicken meat dipped for 2 min. However, further studies are essential to assess the active ingredients of these extracts and oils which have specific antimicrobial activity.

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