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# SHELF-LIFE EXTENSION OF LOW SALT SAUSAGES USING HPMC-BASED FILMS CONTAINING NANOPARTICLE ROSEMARY EXTRACT

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**Abstract – The objective of this study was to evaluate the shelf life of fresh sausages when packaged in an antimicrobial film. manufactured using hydroxypropyl methylcellulose (HPMC) and commercially-sourced nanoparticle rosemary extract. The sausage samples were also inoculated with E-coli and stored at 4ºC to examine the antimicrobial activity of the antimicrobial film further. Results from this work demonstrated that the 0.5% Rosemary film performed better than no film and control film treatment.**

**Key Words –**

## I. INTRODUCTION

Active packaging is an innovative concept, it includes packaging in which certain additives have been integrated into the packaging system with the goal of extending or maintaining the products shelf life and decreasing the risk of pathogenic bacteria. Antimicrobial active packaging may be formed by coating a film with the antimicrobial agent, surface modification, incorporation and immobilisation of an antimicrobial substances into a packaging film (Kerry et al. 2006; Suppakul et al., 2003; Campos et al. 2011). Rosemary is a free radical scavenger, natural antioxidant, thus aids in the prevention of oxidation of oils and fats. Hydroxypropyl methylcellulose (HPMC) film is a cellulose derivative film which is tough, transparent, flexible and sensible to the presence of water but resistant to fats and oils (Lin and Zhoa 2007; Vargas et al. 2008). The main objective of this study was to manufacture a HPMC-based film encompassing commercially-sourced NP - Rose extract (0.5% NP – Rose film) and apply the film to raw sausages stored in a chill at 4ºC and then examine the antimicrobial activity of the raw sausages against the Gram-negative bacteria E-coli and Pseudomonas fluorescens (P. fluorescens) and the presence of the Gram-positive bacteria Staphylococcus aureus (S. aureus) and Lactic acid bacteria (LAB). Sausage samples were also inoculated with E-coli and stored at 4ºC to examine the antimicrobial activity of the antimicrobial film further.

## II. MATERIALS AND METHODS

The antimicrobial film and control HPMC film were both manufactured using distilled water. Nanoparticle rosemary extract (NP-ROSE) (0.5%) was sprayed on the test films. The control films had a mean thickness of 28μm and the antimicrobial film had a mean thickness of 45μm. Control (30%Fat, 2.5% salt) and a reduced salt (1% Velona, , 40% less Na than standard NaCl) and fat (20%) breakfast sausage were manufactured and packaged with the control and test films abd vacuum packed, MAP and skin packaged. Microbial analysis was conducted periodically over a 20 day period. The antimicrobial activity of the rosemary film was evaluated for the two sausage samples. Samples were tested for the presence of the Gram-negative bacteria E-coli (media- compact dry E-coli and Coliform) and Pseudomonas fluorescens (P. fluorescens) (media –Agar base to which a CFC supplement was added) and the presence of the Gram-positive bacteria Staphylococcus aureus (S. aureus) (media - Baird Parker agar) and Lactic acid bacteria (LAB) (media - MRS agar). Total Viable bacteria (media - MPCA) were conducted for each sample. Samples were inoculated with Gram-negative bacteria E-coli (NCIMB 11943) and stored with a control film (HPMC), an antimicrobial film (NP-ROSE) and with no film under vacuum pack only

## III. RESULTS AND DISCUSSION

For all treatments the total viable count showed a slight decrease in growth followed by an increase in growth. By day 20, the 0.5% Rosemary film samples had the lowest log CFU/ml. Each of the MAP packaged samples and the Skin packaged samples had no E-coli present throughout the trial. The Vacuum packaged samples had been inoculated with E-coli, thus the presence of E-coli was expected. The control film and the no film treatment resulted in the highest levels of growth by the final storage day. The Rosemary film sample was significantly ($P<0.05$) different from the

control film and the no film treatments on days 1-20. In summary, the Rosemary film showed protection against E-coli growth throughout vacuum package storage. For all treatments, the Pseudomonas count showed an increase in growth for both the control film and no film samples. The 0.5% Rosemary film MAP packaged sample showed an increase in growth through the trial. In contrast the 0.5% Rosemary film samples that were skin packaged and vacuum packaged showed a slight decrease on day 8 followed by an increase in growth. By day 20, the 0.5% Rosemary film samples had the lowest log CFU/ml. For all treatments the Lactic acid bacteria count showed a slight increase in growth for both the control film and no film samples, whereas the 0.5% Rosemary film samples showed a slight decrease on day 8 followed by an increase in growth for the remainder of the trial. By day 20, the 0.5% Rosemary film samples had the lowest log CFU/ml. For all treatments, the Staphylococcus count showed an increase in growth for both the control film and no film samples. The vacuum packaged Rosemary film sample showed a slight decrease on day 4 followed by an increase in growth for the remainder of the trial. Similarly, the skin packaged Rosemary film sample showed a slight decrease on day 8 followed by an increase in growth for the remainder of the trial. The MAP packaged Rosemary film sample showed a constant count for days 4 and 8 and the count increased for the following days tested. By day 20, the 0.5% Rosemary film samples had the lowest log CFU/ml.

Control Sausage

*E-coli* count –Vacuum package

| **Treatment** | **Day 0** | **Day 1** | **Day 4** | **Day 8** | **Day 12** | **Day 16** | **Day 20** |
|---|---|---|---|---|---|---|---|
| **No film** | 5.43±0.05 | 5.67±0.11 [a] | 5.72±0.11 [a] | 5.76±0.12 [a] | 5.81±0.04 [a] | 5.88±0.05 [a] | 5.93±0.09 [a] |
| **Control film** | 5.43±0.05 | 5.70±0.12 [a] | 5.81±0.17 [a] | 5.83±0.03 [a] | 5.83±0.08 [a] | 8.44±0.02 [a] | 5.85±0.11 [a] |
| **0.5% Rose-film** | 5.43±0.05 | 5.41±0.20 [b] | 5.39±0.22 [b] | 5.23±0.31 [b] | 5.20±0.12 [b] | 5.45±0.06 [b] | 5.55±0.16 [b] |

*Reduced salt and fat sausage*

*E-coli* count –Vacuum package

| **Treatment** | **Day 0** | **Day 1** | **Day 4** | **Day 8** | **Day 12** | **Day 16** | **Day 20** |
|---|---|---|---|---|---|---|---|
| **No film** | 5.44±0.03 | 5.78±0.12 [a] | 5.80±0.09 [a] | 5.80±0.03 [a] | 5.82±0.05 [a] | 5.88±0.05 [a] | 5.91±0.09 [a] |
| **Control film** | 5.44±0.03 | 5.79±0.06 [a] | 5.81±0.04 [a] | 5.84±0.06 [a] | 5.87±0.06 [a] | 5.88±0.04 [a] | 5.93±0.01 [a] |
| **0.5% Rose-film** | 5.44±0.03 | 5.42±0.16 [b] | 5.39±0.18 [b] | 5.24±0.18 [b] | 5.29±0.26 [b] | 5.54±0.31 [b] | 5.77±0.04 [b] |

## IV. CONCLUSION

Results from this work demonstrated that the 0.5% Rosemary film performed better than no film and control film treatments in retarding the growth of total bacteria (TVC). The Rosemary film showed protection against E-coli growth throughout vacuum package storage.


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