

SHELF-LIFE EXTENSION OF PORK MEATBALLS BY SELECTED THAI CULINARY HERB AND SPICE EXTRACTS

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Abstract – The ethanolic extracts from four selected Thai culinary herbs and spices, i.e., holy basil, Vietnamese coriander, turmeric and green peppercorn, were investigated for their antimicrobial ability to extend the shelf life of pork meatballs aerobically or vacuum packaged and stored at 4°C. Total plate counts of microbial growth, lactic acid bacterial counts and water activities of the meatballs were determined every 3 days for the storage period of 9 days. According to the Thai FDA for the marginal acceptable microbial standard counts of $\leq 5.0 \log \text{cfu/g}$ food, the meatballs made with the extracts from holy basil and green peppercorn and packaged in both aerobic and vacuum conditions had the highest shelf life of 9 days while those made with Vietnamese coriander and turmeric extracts had the shelf life of about 6-9 days and the control meatballs had the shelf life less than 6 days. In addition, the water activity values of all meatballs were not significantly different ($p > 0.05$) which were in the range of 0.969 – 0.980.

Key Words – Antimicrobial efficacy, water activity, aerobic and vacuum packaging

I. INTRODUCTION

Since the ancient times spices have been used as important ingredients in cooking, cosmetics, perfume, medicine and trade exchanges. Herbs and spices are natural plant products and used not only as flavoring and coloring agents, but also as food preservatives and folk medicines. Nowadays, many herbs and spices are recognized as useful bioactive ingredients for improving digestion and natural health remedies such as mediating inflammation and pain, chemoprevention, respiratory health, Alzheimer's dementia and diabetes [1]. They have been used in food products because of their antioxidant and antimicrobial properties. Culinary herbs and spices have a long history of use in cooking as they can reduce food spoilage and control against the growth of food-borne pathogens. In Thailand, varieties of native and local herbs and

spices are used as valuable components of the “Thai cuisine”, giving original flavors and desirable sensory properties. In addition, previous studies have shown that not only contributing their flavors and fragrances to food dishes but Thai culinary herbs and spices have also shown to have effective antimicrobial [2] and antioxidant activities [3].

The objective of this study was to investigate the use of some Thai culinary herb and spice extracts for their antimicrobial efficacies to extend the shelf life of pork meatballs, aerobically and vacuum packaged during refrigeration storage.

II. MATERIALS AND METHODS

Preparation of herb and spice extract

Four selected herbs and spices namely; holy basil (*Ocimum sanctum* Linn), Vietnamese coriander (*Polygonum odoratum* Lour.), turmeric (*Curcuma longa* Linn) and green peppercorn (*Piper nigrum* Linn) were purchased from local markets in Nakhon Ratchasima and Sakon Nakhon Province, Thailand. The herbs and spices were cut into small pieces, freeze dried and finely ground. The extract was obtained from ethanolic extraction of dried herb or spice at room temperatures for 24 h. The extract was filtered and evaporated to dryness in a rotary evaporator at 40°C and kept at -20°C until use.

Preparation of pork meatballs

Pork meatball batter model was prepared using 5 g lean ground pork, 2% salt, 0.25% sodium phosphate, 15% ice, 2% tapioca starch and 0.2% herb and spice extract. After chopping, the meatball batter was stuffed in a 20 mm diameter plastic casing, cooked in hot water at 70°C for 30 min, cooled in chilled water and cut into pieces with the length of about 2.5 cm. The meatballs were aerobically and vacuum packaged in plastic bags and stored at 4°C.

Microbial analysis

Microbial enumeration and water activity of the meatball samples were performed every 3 days during storage. Total plate counts (TPC) and lactic acid bacterial (LAB) contents were performed using Petrifilm™ (3M, USA.) and incubated at 37°C for 24 h.

Water activity determination

The water activity of sample was measured using an AQUA LAB instrument.

Statistical analysis

Analysis of variance ($p \leq 0.05$) and DMRT were performed using SPSS for Windows. Two replications of the experiment were performed with triplicate analyses per replication.

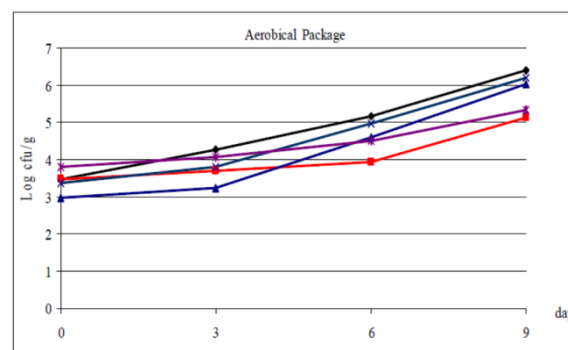
RESULTS AND DISCUSSION

Antimicrobial activity of herb and spice extracts added in pork meatballs

Initial TPC of all pork meatballs sampled at day 0 were less than 4 log cfu/g sample. Figures 1 and 2 show the microbial profiles of meatball samples during storage in both aerobic and vacuum packages, respectively. Similar trend of microbial growth was found in both packaging conditions. The meatballs without any herb and spice extracts had higher counts than those added herb and spice extracts at all time of storage. Microbial growth retardation of these selected herb and spice extracts in meat product was consistent with other natural extracts studied [4], to a greater or lesser degree. Among four selected culinary herbs and spices used in this study, holy basil and green peppercorn extracts gave similar and the lowest PC. Hence, it could be mentioned that they had the highest efficacy in extending the meatball shelflife packaged in both aerobic and vacuum package conditions.

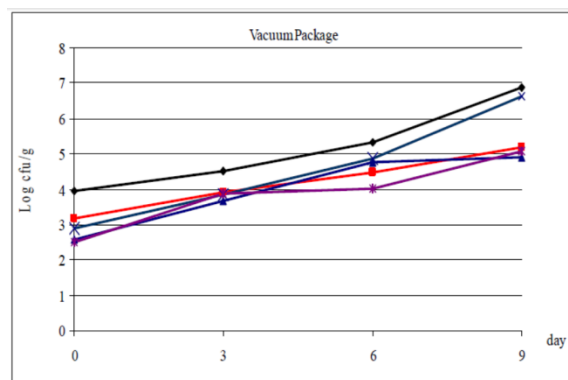
According to the Thai FDA standard for the marginal acceptable microbial counts of ≤ 5.0 log cfu/g sample, the control meatballs packaged in both conditions could be kept less than 6 days. When packaged in aerobic condition, the meatballs added turmeric, Vietnamese coriander, holy basil and green peppercorn could be kept for about 6, 6, 9 and 9 days, respectively. However, it was obvious that under vacuum condition the meatballs added with holy basil, Vietnamese coriander and green

peppercorn had similar shelf life of about 9 days while turmeric extract added could extend the shelf life only up to 6 days of storage.



◆ Control, ■ Holy basil, ▲ Vietnamese coriander, × Turmeric, * Green peppercorn

Figure 1. Total microbial contents of aerobically packaged pork meatballs and stored at 4°C.



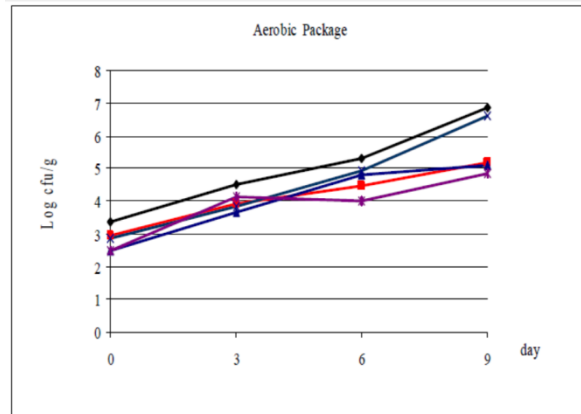
◆ Control, ■ Holy basil, ▲ Vietnamese coriander, × Turmeric, * Green peppercorn

Figure 2. Total microbial contents of vacuum packaged pork meatballs and stored at 4°C.

The LAB counts of all meatballs, aerobically and vacuum packaged, are shown in Figures 3 and 4.

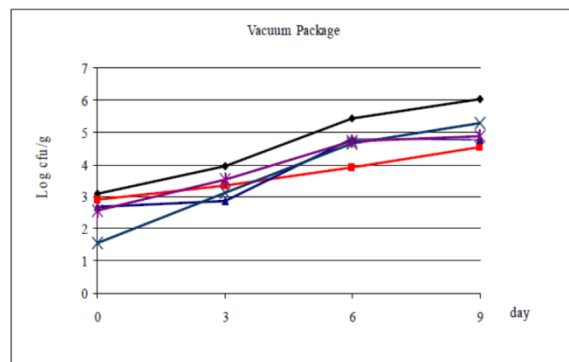
The initial LAB counts for both packaging conditions were less than 4 log cfu/g sample. However, throughout the storage period LAB reduction by all selected culinary herb and spice extracts was better in vacuum packaging than in aerobic packaging condition. At the end of storage time, the meatballs added holy basil, Vietnamese coriander and green peppercorn extracts has lower LAB counts than control meatballs of about 2 log and 1.5 log cycles in aerobic and vacuum package

condition, respectively, while those with turmeric extract had similar counts to control meatballs of about 6.61-6.88 log cfu/g and 5.28-6.04 log cfu/g, respectively.



◆ Control, ■ Holy basil, ▲ Vietnamese coriander
× Turmeric, * Green peppercorn

Figure 3. Total lactic acid bacteria of aerobically packaged pork meatballs and stored at 4°C.



◆ Control, ■ Holy basil, ▲ Vietnamese coriander,
× Turmeric, * Green peppercorn

Figure 4. Total lactic acid bacteria of vacuum packaged pork meatballs and stored at 4°C.

Water activity (a_w)

Table 1 shows the water activity (a_w) value of pork meatballs with and without addition of herb and spice extracts. The a_w values of all meatball treatments slightly decreased as time of storage went by but differences were not found ($p > 0.05$). The values were in the range of 0.969 – 0.980.

Table 1. The water activity of pork meatballs with herb and spice extracts during storage day

Storage time	Aerobic Packaging				
day	CON	HOB	VNC	TMR	GPP
0	0.975	0.973	0.980	0.976	0.980
3	0.972	0.972	0.976	0.974	0.977
6	0.971	0.971	0.975	0.974	0.974
9	0.969	0.971	0.972	0.971	0.973
Storage time	Vacuum Packaging				
day	CON	HOB	VNC	TMR	GPP
0	0.976	0.974	0.980	0.975	0.981
3	0.974	0.971	0.975	0.972	0.973
6	0.971	0.970	0.974	0.972	0.973
9	0.971	0.970	0.973	0.969	0.973

CON = Control, HOB = Holy basil, VNC = Vietnamese coriander, TMR = Turmeric, and GPP = Green peppercorn.

III. CONCLUSION

All four selected Thai culinary herb and spice extracts could extend the shelf life of pork meatballs about 3 to 6 days longer than control meatballs. Green peppercorn, holy basil and Vietnamese coriander extracts provided superior efficacy in microbial growth inhibition over the extracts from turmeric.

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