EFFECTS OF ENCAPSULATED POLYPHOSPHATES ON MICROBIOLOGICAL AND PHYSICOCHEMICAL PROPERTIES OF COOKED GROUND BEEF

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Abstract – The objective of this study was to examine the effect of various (0.0, 0.25 and 0.5%) levels of added encapsulated(e) and unencapsulated(u) sodium tripolyphosphate (STP) or sodium acid pyrophosphate (SPP) at 0.5% added total polyphosphate (PP) on microbiological and physicochemical properties of cooked ground beef during refrigerated storage (0, 7, 15 d). Results indicated that the highest OP and pH levels, and the lowest CL were determined in samples with STP ($p<0.05$). There was no significant changes in pH and OP during storage. Additionally, CL, pH and microbiological properties were not affected by the use of ePP. TBARS and LPO values of samples with PP were lower than that of the control ($p<0.05$). Study results showed an improvement on reducing TBARS and LPO formation in cooked ground beef by using ePP instead of uPP counterpart ($p<0.05$). This study results suggested that the use of 0.25% ePP and 0.25% uPP combination can provide benefits to meat manufacturers regarding improving shelf life of precooked meat products.

Key Words – Encapsulated polyphosphate, ground beef, quality.

I. INTRODUCTION

The quality of ready-to-eat meat (RTE) products is affected by chemical and microbiological changes. Food additives are widely used in the meat industry to prevent lipid oxidation and microbial growth. PP are food additives that have antioxidant and antimicrobial effects depending on chain length. Many research about using PP in meat products showed that increasing chain length of PP improves antioxidant and antimicrobial effects [1, 2]. However, the ability to inhibit lipid oxidation and microbial growth by added PP in cooked meat products is reduced by phosphatases. Even though phosphatase activity is greatly reduced by cooking, most of the added PP are lost by the time meat is cooked due to phosphatase activity in meat. Encapsulation technology can be applied to PP to protect them from phosphatases in order to achieve more effective inhibition of lipid oxidation and microbial growth in cooked meat products [3,4]. The goal of this research was to investigate the effect of various level of added ePP and uPP and their combinations on microbiological and physicochemical quality of cooked ground beef during storage.

II. MATERIALS AND METHODS

Beef (*Musculus longissimus dorsi*) were purchased from a local slaughterhouse (Isparta, Turkey). All treatments contained 1.0% sodium chloride (meat weight basis, 106404; Merck, Germany) and 10% added distilled water (meat weight basis). Ground meat was formulated with various amounts of ePP (0.0, 0.25, and 0.5%) that was combined with uPP counterparts to contain 0.5% total added PP (PP weight basis). The two PP used (STP: Brifisol 5-1327; SPP: 5-1230) were provided by a commercial supplier (BK Giulini Corporation, Simi Valley, CA, U.S.A.). Encapsulation of PP was carried out by a commercial coating company (Coating Place Inc., Verona, WI, U.S.A) as described by Kılıç *et al*. [5]. Ground meat samples were cooked in capped plastic centrifuge tubes (50 mL) eight hours after the PP was added. Ground meat (approximately 45 g) was placed into each tube and heat processed (74 °C endpoint temperature) in a water bath [4, 5]. Cooked samples were stored in tubes (0, 7, 15 days) at 4 °C. CL, pH, color, OP [6], LPO [7], TBARS [4], total mesophilic aerobic bacteria, yeasts and moulds, and total coliform bacteria counts [8] were evaluated.

III. RESULTS AND DISCUSSION

The use of STP resulted in lower CL than the control and samples with SPP ($p<0.05$). pH values of samples with STP were higher than the control and samples with SPP ($p<0.05$). Samples with STP showed a gradual increase with

storage ($p<0.05$) whereas there was no significant changes in pH with storage at control and SPP-containing samples. CL, pH and total mesophilic aerobic bacteria, yeasts and moulds, and total coliform bacteria counts were not affected by the use of ePP. According to results, the higher ($p<0.05$) OP was determined in the samples with STP compared to SPP and control. There was no difference in OP levels between samples containing 0.5% uPP and 0.25% ePP plus 0.25% uPP, whereas the lowest OP levels were determined in 0.5% ePP-containing samples ($p<0.05$). Additionally, there was no increase in OP levels in all samples during storage. The lower TBARS and LPO levels were determined in all PP groups compared to control ($p<0.05$). TBARS of samples with SPP were also lower than those of samples with STP. Study results showed that TBARS and LPO levels were decreased with increasing ePP ratio in cooked ground meat ($p<0.05$). Furthermore, TBARS values increased with storage in groups except with ePP groups, whereas LPO values increased with storage in all groups ($p<0.05$). However, increasing trend was lower in samples with ePP compared with other samples. According to color results, the lowest L* and b* values were determined in samples with STP or SPP compared with control ($p<0.05$). Furthermore, the higher a* values were determined in samples with STP compared to SPP and control groups ($p<0.05$). Additionally, there was decrease in a* values during storage in all groups except 0.5% eSPP group ($p<0.05$). There was no significant effect of using ePP on the color values. The results showed that the applied cooking process was significantly effective on the inhibition of microorganisms. Whereas yeast and mold were not detected in the raw and cooked samples, the total mesophilic aerobic and coliform group microorganisms were totally eliminated with the cooking process ($p<0.05$).

IV. CONCLUSION

This study showed that the use of 0.25% or 0.5% ePP were significantly effective in preventing lipid oxidation. Furthermore, there was a decreasing trend in OP with increasing ePP ratio, whereas increasing ePP ratio had no effect on CL, pH and microbial counts. According to results, the use of 0.25% ePP and 0.25% uPP combination can provide benefits to meat manufacturers regarding improving shelf life of precooked meat products.

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