Public Abstract

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Title:APPLICATIONS OF LACTIC ACID AND ITS DERIVATIVES IN MEAT PRODUCTS AND METHODS TO ANALYZE RELATED ADDITIVES IN RESTRUCTURED MEAT

The food supply system in the United States is among the safest in the world. Even so, each year, foodborne illnesses affect 48 million Americans and accounts for 17% of the total population in the United States and leads to 128,000 hospitalizations and 3,000 deaths. The “Farm-to-table” movement refers to the stages of food production from harvesting, storage, food processing, packaging, marketing, and preparing it to be eaten. Any stages of the food chain might cause foodborne illnesses if the foods are not handled properly. The strategies for reduction or prevention of foodborne illnesses are needed at various stages. Lactic acid and its derivatives are widely applied to various processed food products for multiple functions; it can be used as an acidulant, flavoring, pH buffering agent and bacterial spoilage and pathogen inhibitor. In this research, the application of lactic acid for antimicrobial study was investigated; the analysis methods for lactic acid by HPLC (High performance liquid chromatography) and FTIR (Fourier transform infrared spectroscopy) were used to analyze the residual amount of lactic acid in different types of meat; quantitative and qualitative properties of sodium alginate in restructured meat were investigated using FTIR.

The objective of the first two stages was to determine if lactic acid could be employed as a shelf life extender in fresh beef products. Lactic acid solution was used for pre-chill and post-chill beef carcass washing. The study was conducted in two phases. The first phase consisted of application of lactic acid to pure culture strains and application to beef carcasses. Pure cultures of STEC-8 cocktail were exposed to 55 °C and 25 °C of 0.5% lactic acid for 0 s, 15 s and 30 s. The results were very promising. There were 5.7-6.0 log reductions when STEC-8 were exposed to 55 °C lactic acid, regardless of contact time; however, there was only 1-log reduction when the STEC-8 were exposed to 25 °C lactic acid regardless of exposure time. In the second phase, beef carcasses were inoculated with STEC-8, and sprayed with 2.0% lactic acid. The observations from this study showed that there were 1.8 and 1.2 log reductions at 55 °C and 25 °C, respectively. When an electrostatic sprayer was used, there were no significant differences between spray times, even with different temperatures.

The objective of the third phase was to determine the amount of encapsulated lactic acid in restructured meat and to measure residual lactic acid on the meat surface when fish fillets were immersed into different concentrations of lactic acid solutions ranging from 0% to 5%. This study involved two common lactic acid applications. First, immersion of meat pieces into different concentrations of lactic acid solution; Second, addition of encapsulated lactic acid powder into restructured meat. The amount of lactic acid was evaluated and analyzed with different instruments, such as HPLC and FTIR. The results showed as sodium alginate concentration increased, it showed high WHC, low moisture and low pH when compared with control samples. Compared with HPLC, FTIR method cannot provide extract values, and can only predict the possible amounts. However, these two methods could be used to determine lactic acid levels in the meat industry if they are interested in determining the residual chemical level in meat samples or attempting to determine factors that influence meat quality.

The objective of the fourth phase was to compare different effects of hydrocolloids added to a restructured fish product. In this study, rather than lactic acid, encapsulated lactic acid was added into restructured

meat. It was used to release free calcium ions from the calcium carbonate and hence develop alginate gelation. Eight types of meat binders were formulated into fish meatballs, and then physical and chemical characteristics were compared to control samples without binders. The eight types of meat binders included cornstarch, commercial meat-binder, carrageenan, methylcellulose, Activa® RM, plasma powder FG+, plasma powder FG and encapsulated lactic acid with sodium alginate and calcium carbonate. The aim of this stage was to compare and investigate the behaviors of different restructured products with different meat binders during chilled storage and after cooking. This study showed that samples treated with Activa® RM and FG+ and FG produced satisfactory binding in fish balls. These three binders can result in higher cooking yield, hardness texture, and maintain both cooked and raw fish ball lightness during storage period. Considering overall parameters evaluated in this study, it is concluded that Activa® RM binder showed the best functionality or performance, following with FG+ and FG treatments. Samples treated with sodium alginate performed at a medium level.

In the final phase of this study, the FTIR analysis method was developed to quantitate sodium alginate levels and quantify properties of the restructured meat with added sodium alginate, which was added to fish samples at concentrations of 0, 0.5, 1.0, 2.0, or 5.0%. In this study, there were two sample pre-treatment methods for FTIR analysis, which included a directly drying method; the samples were hydrated by vacuum oven only; and a chemical preparation method, which included fat removal by acetone, enzymatic protein degradation, polysaccharide precipitation, and centrifugation. The objective of this research was to develop a useful alternative method for direct quantitation of total sodium alginate in restructured meat. The results showed that a direct drying method could be used to analysis sodium alginate in meat sample. The FTIR spectroscopy combined with PLS and PCA methods at wavenumber of 800 cm-1 can be used for the quantitative analysis of control and different concentrations of sodium alginate. FTIR technique also can be used as a screening tool to determine types of polysaccharides that may be added into meat samples.

In summary, this study is important to the food industry. The promising results could contribute to consumer health. The purpose of this project was to provide reference data for food safety, including both shelf life study and chemical residual testing, which may provide solutions for processing added-value meat samples.