# POLYPHOSPHATES HYDROLYSIS IN CHICKEN BREAST AND EFFECTS OF THEIR HYDROLYSIS ON HOMOGENATE GEL WHC

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**Key words**: polyphosphates, hydrolysis, $^{31}$P NMR, chicken, WHC

## Introduction

Polyphosphates have been widely used in meat processing in many countries to enhance the quality of many muscle foods. Functionalities of polyphosphates added to meat products have been extensively studied. However, the chemical and biochemical processes of the added polyphosphates have not been well studied. Researchers paid little attention on the biochemical process of the added polyphosphates themselves in meats. Once incorporated into the meat, some polyphosphates may be hydrolyzed non-enzymatically or enzymatically through the action of muscle polyphosphatase. It is important to study the hydrolysis procedure to understand how polyphosphates work and which type plays a substantial role.

In the present work, experiment was carried out to investigate the hydrolysis of TSPP and STPP in chicken breast meat using $^{31}$P NMR technique, and the WHC change of the CB homogenate gel during the polyphosphates hydrolysis. Our objective was to gain a better understanding of the interaction between hydrolysis of polyphosphates and the change of gel WHC, by monitoring which forms of the phosphate are present in the meat.

## Materials and methods

In this study, breast muscle was dissected from twelve broilers and stored for 3 h at 4℃. Visible fat and connective tissue were removed. The breast meat was divided randomly into three groups by weight. 200mL of each three marinades were injected into each group respectively. The marinade contained either 50g$Kg^{-1}$NaCl or 50g$Kg^{-1}$NaCl and 60g$Kg^{-1}$phosphates (TSPP or STPP). The samples were chilled in a refrigerator at about 4℃ after tumbling for 2 min.

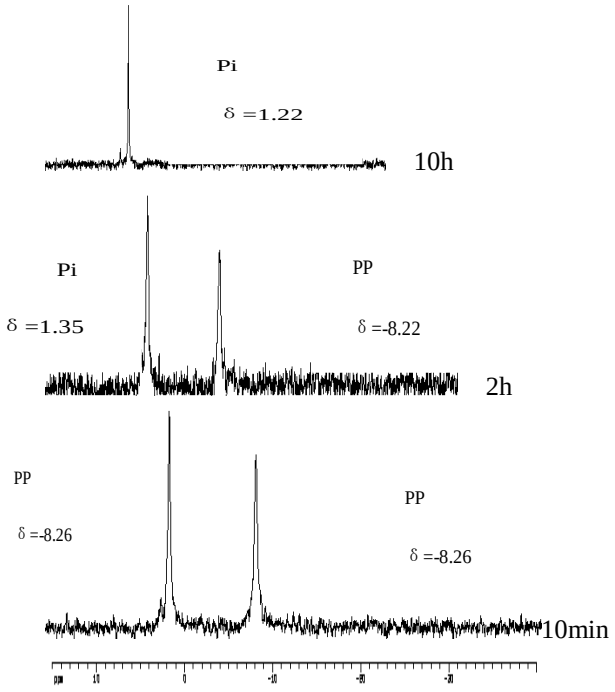
$^{31}$P NMR experiments were carried out on a proton-decoupled Bruker AVANCE –400MHz superconducting spectrometer operating at 161.975 MHz. $^{31}$P probe was used for all the experiments. NMR measurements were conducted at 10 min, 2 hr and 10 hr following marination. All samples were prepared in triplicate for analysis and each sample was determined twice. All the samples were prepared in triplicate for subsequent analysis.

## Results and discussion

*$^{31}$P NMR Spectra of TSPP and STPP Hydrolysis in the Breast Meat.* Fig. 1and 2 showed the $^{31}$P NMR spectra of chicken breast meat injected with TSPP and STPP in the presence of NaCl. It can be seen two distinctive peaks at the 10min TSPP spectra, one was Pi peak at 1.35 ppm and the other was PP peak at –8.26 ppm, PP peak still can be seen at 2h spectra. However it showed no appearance on the 10h spectra, which means it had been fully hydrolyzed. On STPP spectra, at 10 min, there were four distinctive peaks for Pi, $TPP_t$ (terminal phosphorus), PP, and $TPP_C$ (central phosphorus). At 2 h $TPP_t$, PP, $TPP_c$ peak still existed, and their chemical shifts changed little, but from the spectra of 10 hour there were only PP and Pi peaks, TPP had been fully hydrolyzed, but the derived PP had not been fully hydrolyzed to Pi, the PP peak still can be seen.

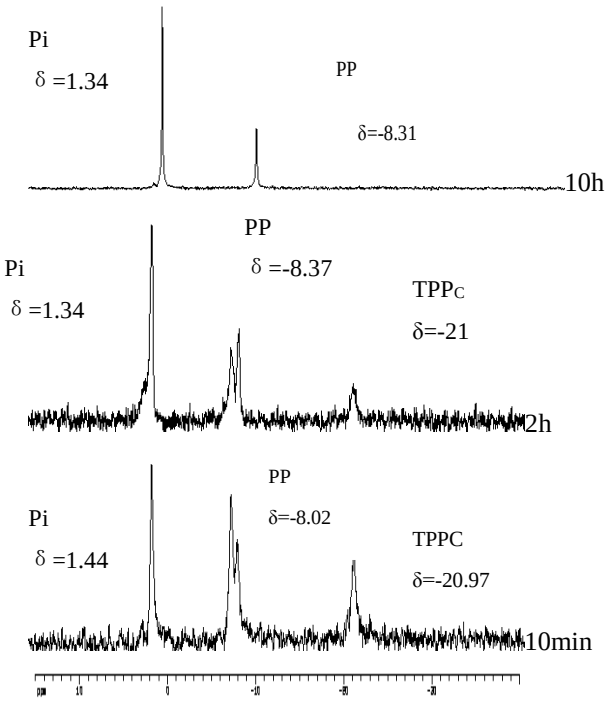
The WHC analysis showed that the WHC of the gel treated with TSPP was higher than that treated with STPP at the same ionic strength and same initial pH from 2h to 10h, with no significant difference between them ($p>0.05$). A significant reduction ($p<0.05$) of WHC treated with TSPP was observed and the decrease was faster compared to that treated with STPP from 10h to 24h (Fig.3). PP can more effectively increase WHC than TPP

before PP was completely hydrolyzed; however its effect diminishes with time.




Pi — orthophosphate； PP— pyrophosphate； δ— Chemical shift

**Fig.1 $^{31}$P spectra of CB+TSPP at different times**




Pi — orthophosphate； TPPc — central phosphorus； PP— pyrophosphate; δ— chemical shift

**Fig.2 $^{31}$P spectra of CB+STPP at different times**

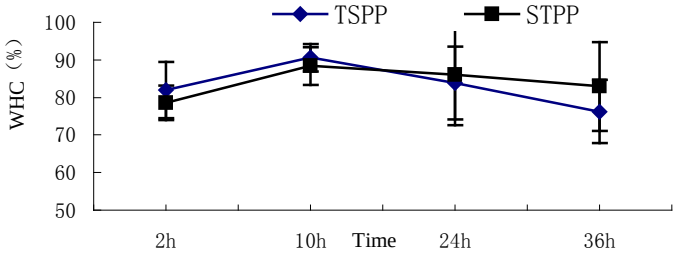



**Fig.3 The WHC of the gel formed by STPP and TSPP treated homogenates**

## Conclusions

The present results showed that both pyrophosphate and tripolyphosphate were hydrolyzed in the chicken breast meat. From the $^{31}$P NMR spectra, the typical peaks were formed by pyrophosphate and tripolyphosphate. Pyrophosphate had been fully hydrolyzed within 10h. Tripolyphosphate was also hydrolyzed completely within 10h and the rate of pyrophosphate hydrolysis was higher than that of pyrophosphates. The different hydrolysis between pyrophosphate and tripolyphosphate resulted in different effects on the WHC of chicken breast meat homogenate gel. Pyrophosphate can increase the gel WHC more effectively than tripolyphosphate, but pyrophosphate effect on the WHC of chicken breast homogenate gel diminished with its hydrolysis.

## Reference

Belton P. S, Kenneth J. Packer and Timothy E. Southon. (1987) $^{31}$P NMR studies of the hydrolysis of added phosphates in chicken meat. J Sci. Food Agric, 40:283-291

Rongrong. Li, W. L., Kerr, R. T., Toledo, and Q. Teng. (2001) $^{31}$PNMR analysis of chicken breast meat vacuum tumbled with NaCl various phosphates. J Sci Food Agric, 81:576~582