O-03-03

Influence of lard-based diacylglycerol on water distribution and microstructural properties od thermally induced gels of porcine myfibrillar protein at different NaCl concentration (#238)

Xinxin Zhao, Baohua Kong

Northeast Agricultural University, Department of Food Science, Harbin, China

Introduction

Myofibrillar protein (MP) gelation plays an important role in the characteristics of processed meat products. The gel formation of MP is influenced by many factors, and one of the most important factors is salt concentration. Addition of fat to meat products has a strong effect on the physicochemical properties. However, overconsumption of lard has been shown to cause lifestyle-related diseases. Triacylglycerol (TG) as the primary component of lard can be transformed into diacylglycerol (DG) through the enzymatic glycerolysis. DG have unique nutritional properties and health benefits, as well as specific physicochemical properties compared to TG. The objective of this study was to investigate the effects of lard-based DG on the water mobility and microstructural properties of thermally induced pork MP gels at a different NaCl concentrations.

Methods

Lard-based (DG) was synthesized according to the procedure of Zhao et al. [1]. After the reaction, DG was collected by filtration to remove lipase and the DG content was 46.91%, corresponding to unpurified DG (UDG). To obtain a high purity of DG, wiped film molecular distillation (SPE10, manufactured in Haiyuan Biochemical Equipment Co. Ltd., Wuxi, China) was carried out in two steps. Myofibrillar protein (MP) was extracted according to the procedure of Xia et al. [2]. For the emulsion gels system, a 1% MP solution and a 6% MP solution were prepared in 50 mM piperazine-1, 4 bisethanesulfonic acid (PIPES) (pH 6.0) at various NaCl concentrations (0, 0.1, 0.3, and 0.6 M). The pre-emulsion was obtained by the homogenization of the mixture of completely melted pork fats (4.2 g of lard, UDG or PDG) and 1% MP solution (16 g) for 1 min with an IKA T18 Ultra-Turrax (IKA-Werke GmbH & Co., Staufen, Germany) at a speed of 17,000 r/min. Then, the pre-emulsion was immediately added to the 6% MP solution by gently stirring with a glass rod to prepare the mixtures containing the final protein concentration of 4% (w/w) and the final fat content of 8% (w/w). Each of composites were stored at 4 °C for one nigh to ensure the complete hydration of the protein [3]. The composites were heated in a water-bath at 75 °C for 20 min. After heating, the formed gels were immediately cooled in crushed ice for 3 h and were equilibrated at room temperature for 30 min prior to further analysis. The transverse relaxation time (T_2) measurements of the composite gels were performed using a Bruker low field nuclear magnetic resonance (LF-NMR) analyser minispec mq 20 (Bruker Corp., Germany). The microstructure of the composite gels was studied using a Hitachi-S-3400N field emission scanning electron microscope (SEM) (Hitachi High Technologies Corp., Tokyo, Japan) according to the procedure of Niu et al. [4].

Results

Fig. 1 and Table 1 show the distribution of T_2 relaxation times and T_2 relative peak areas of MP gels with or without fats at different NaCl concentrations. The LF-NMR curves exhibited one or two different forms of trapped water (T_{21a} and T_{21b}). T_{21a} water was more tightly entrapped within the gel network than T_{21b} [5]. The increase in NaCl concentration and the addition of UDG or PDG caused an increase in T_{21} relaxation times and reduction in T_{22} relaxation times. As shown in Table 1, as the concentration of NaCl increased from 0 M to 0.6 M, the relative area A_{21} values significantly increased ($P < 0.05$). The results indicated that the relative content of entrapped water increased and the relative content of free water decreased. Compared to the pure MP gels, the composite gels with fat resulted in significantly lower ($P < 0.05$) T_{21} relaxation times. Meanwhile, the relative area in A_{21} of UDG- and PDG-composite gels were significantly higher than those of control and lard-composite gels. By comparison, the relative area in A_{22} of samples at different NaCl concentrations and addition different fats exerted an opposite trend to corresponding the relative area A_{21} values. As shown in Fig. 2, the gels appeared as a more compact and homogeneous gel structure when the NaCl concentration increased. Compared with the MP alone, relatively compact and homogeneous protein matrices with fat globules and small pores were observed in the gels with fats. Moreover, smaller fat globules for UDG- and PDG-composite gels were observed compared with that of lard-composite gels.

Conclusion

The results revealed that an increase in the NaCl concentrations and addition of UDG or PDG improve the gel-forming ability and gel quality. In general, lard-based DG could be used as a potential functionality-enhanced oil to improve the quality of comminuted meat products.

Notes

Relative peak area (%)	Sample	Concentration of NaCl (M)			
		0	0.1	0.3	0.6
A_{21}	MP	13.77 ± 0.86^{cC}	21.87 ± 1.26^{bB}	24.29 ± 1.81^{cB}	29.89 ± 1.24^{cA}
	Lard + MP	16.95 ± 0.48^{bC}	26.53 ± 1.39^{aB}	29.20 ± 0.86^{bB}	36.01 ± 2.01^{bA}
	UDG + MP	18.72 ± 0.75^{abD}	29.78 ± 1.82^{aC}	35.93 ± 1.47^{aB}	43.95 ± 0.93^{aA}
	PDG + MP	20.74 ± 0.93^{aD}	32.03 ± 1.39^{aC}	39.30 ± 1.05^{aB}	49.14 ± 2.23^{aA}
A_{22}	MP	86.17 ± 0.91^{aA}	78.06 ± 0.72^{aB}	75.62 ± 0.72^{aBC}	70.09 ± 2.94^{aC}
	Lard + MP	82.92 ± 0.51^{bA}	73.22 ± 0.48^{bB}	70.71 ± 1.10^{aB}	63.81 ± 1.25^{abC}
	UDG + MP	81.20 ± 0.82^{bcA}	69.94 ± 1.46^{bcB}	63.84 ± 1.44^{bC}	55.79 ± 1.37^{bcD}
	PDG + MP	79.17 ± 0.25^{cA}	67.77 ± 1.26^{cB}	60.69 ± 2.63^{bB}	50.72 ± 2.67^{cC}

Table 1
Distributions of T2 relative peak areas of gels prepared with myofibrillar protein (MP) alon

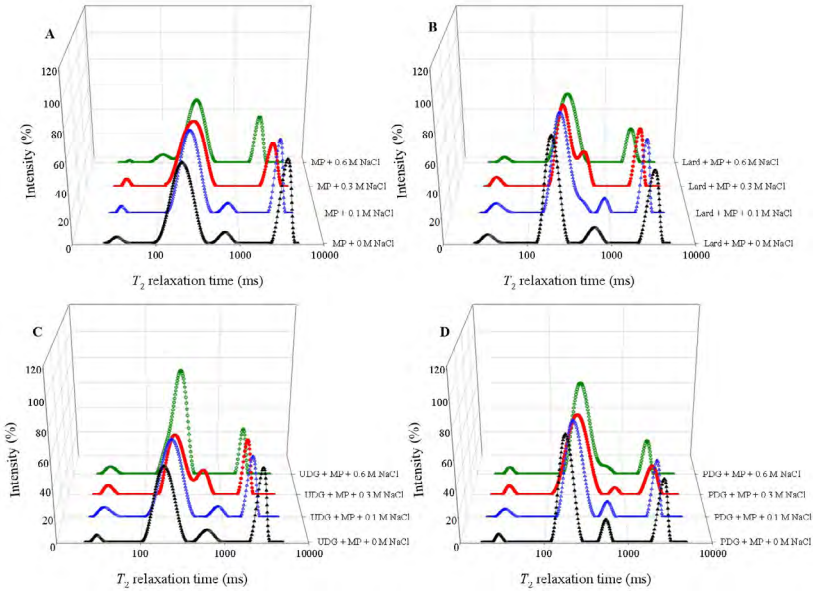

Fig. 1.
Distribution analysis of LF NMR T2 relaxation times of gels prepared with myofibrillar prote

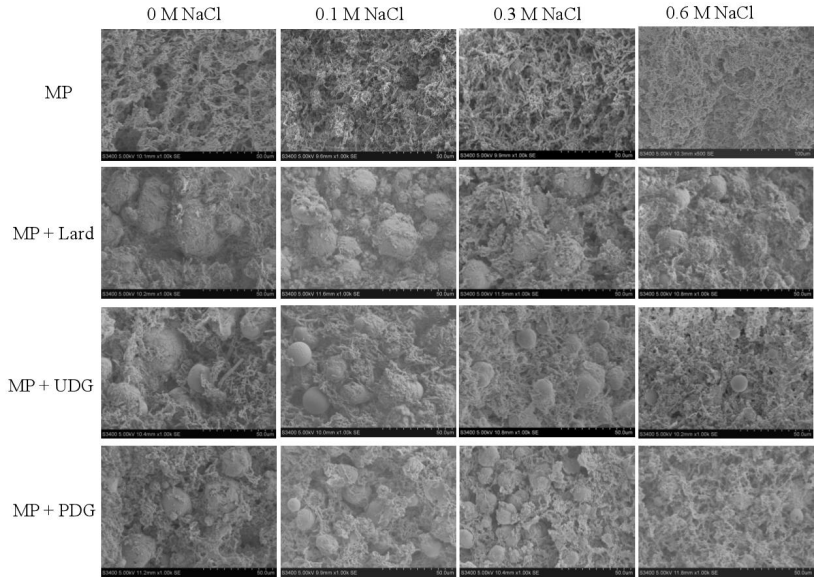

Fig. 2.
Scanning electron micrographs (magnification: 1000×) of gels prepared with myofibrillar prot

Notes