ULTRASONIC PRETREATMENT PROMOTES DIACYLGLYCEROL PRODUCTION FROM LARD BY LIPASE-CATALYSED GLYCEROLYSIS

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I. INTRODUCTION

Diacylglycerol (DAG), which is produced by the esterification of glycerol with free fatty acids (FFA). Studies revealed that DAG plays a role in suppressing postprandial serum triacylglycerol (TAG) levels and body fat accumulation [1].Some reports showed that the DAG content in lard was 2.1 wt.% and DAG can be prepared by lard glycerolysis. Ultrasonic pretreatment provides a promising route, the preparation would be energy-saving, simple to operate, and easy to realize in industrial production. This study aimed to investigate the effect of ultrasonic pretreatment in the synthesis of DAG from lard using lipase-catalysed glycerolysis.

II. MATERIALS AND METHODS

The effect of ultrasonic pretreatment times of 0, 1, 5, 10, 15 and 20 min, enzyme-to-lard ratios (W/W) of 1:100, 2:100, 3:100, 4:100 and 5:100, ultrasonic pretreatment powers of 100, 150, 200, 250 and 300 W, and ultrasonic pretreatment temperatures of 40, 45, 50, 55 and 60 °C were investigated. After ultrasonic pretreatment, the mixtures were transferred to a shaking water-bath at 50 °C for 4 h with a constant speed of 180 r/min to synthesize DAG. The acylglycerol composition in the glycerolysis reaction mixture was analysed according to the method of Wang, Wang et al. [2] with a minor modification by high performance liquid chromatography (HPLC).The analysis of variance (ANOVA) was employed to analyze the significance. The Tukey procedures were performed to verify significant differences ($P < 0.05$).

III. RESULTS AND DISCUSSION

The content of DAG was 15.53% without ultrasonic pretreatment (0 min), rapidly increased to 33.68% with 5 min of ultrasonic pretreatment ($P < 0.05$) and then decreased to 16.67% with 20 min of ultrasonic pretreatment. The TAG conversion showed a similar trend to that seen for DAG content (Fig. 1 A), suggesting that 5 min was chosen.The DAG content and conversion of TAG significantly ($P < 0.05$) increased with increasing ultrasonic power from 100 W to 250 W ($P < 0.05$) and then decreased with increased ultrasonic power up to 300 W ($P > 0.05$) (Fig. 1 B), which showed that 250 W was chosen as the optimal ultrasonic power.The DAG yield increased with increasing ultrasonic temperature from 40 to 45 °C, and an obvious decrease was observed when the ultrasonic temperature exceeded 45 °C (Fig. 1 C), suggesting that 45 °C was selected as the optimum ultrasonic pretreatment temperature in further experiments. When lipase dosage increased from 1:100 (W/W) to 4:100 (W/W), the DAG contents significantly increased from 8.40% to 47.87% and the conversion of TAG increased from 40.92% to 77.86% ($P < 0.05$). There was no significant change ($P > 0.05$) with further increasing lipase dosage to 5:100 (W/W) (Fig. 1 D). Which indicated that the lipase-to-lard ratio of 4% (W/W) was chosen as the optimal lipase dosage. The conversion of TAG and DAG content using ultrasonic pretreatment was consistently higher than that of the conventional method over the 12 h of reaction ($P < 0.05$). The reaction achieved equilibrium in 4 h under ultrasonic pretreatment and yielded a 46.91% content of DAG. This was significantly shorter than the time required for a similar DAG content from the conventional method, which was 11 h (46.72%) (Fig. 1 E). The change in TAG conversion showed a similar trend to that seen for DAG content (Fig. 1 F).

IV. CONCLUSION

At the optimized ultrasonic pretreatment conditions,TAG conversion and the DAG content of lipase-catalysed glycerolysis were 76.68% and 46.91%, respectively. The ultrasonic pretreatment significantly shortened the glycerolysis reaction time. The DAG content of 4 h of glycerolysis reactions with ultrasonic pretreatment was similar to the 11 h of glycerolysis reactions without ultrasonic pretreatment. In the future, application of lard-DAG produced using ultrasonic pretreatment in myofibrillar proteins emulsions will be studied.

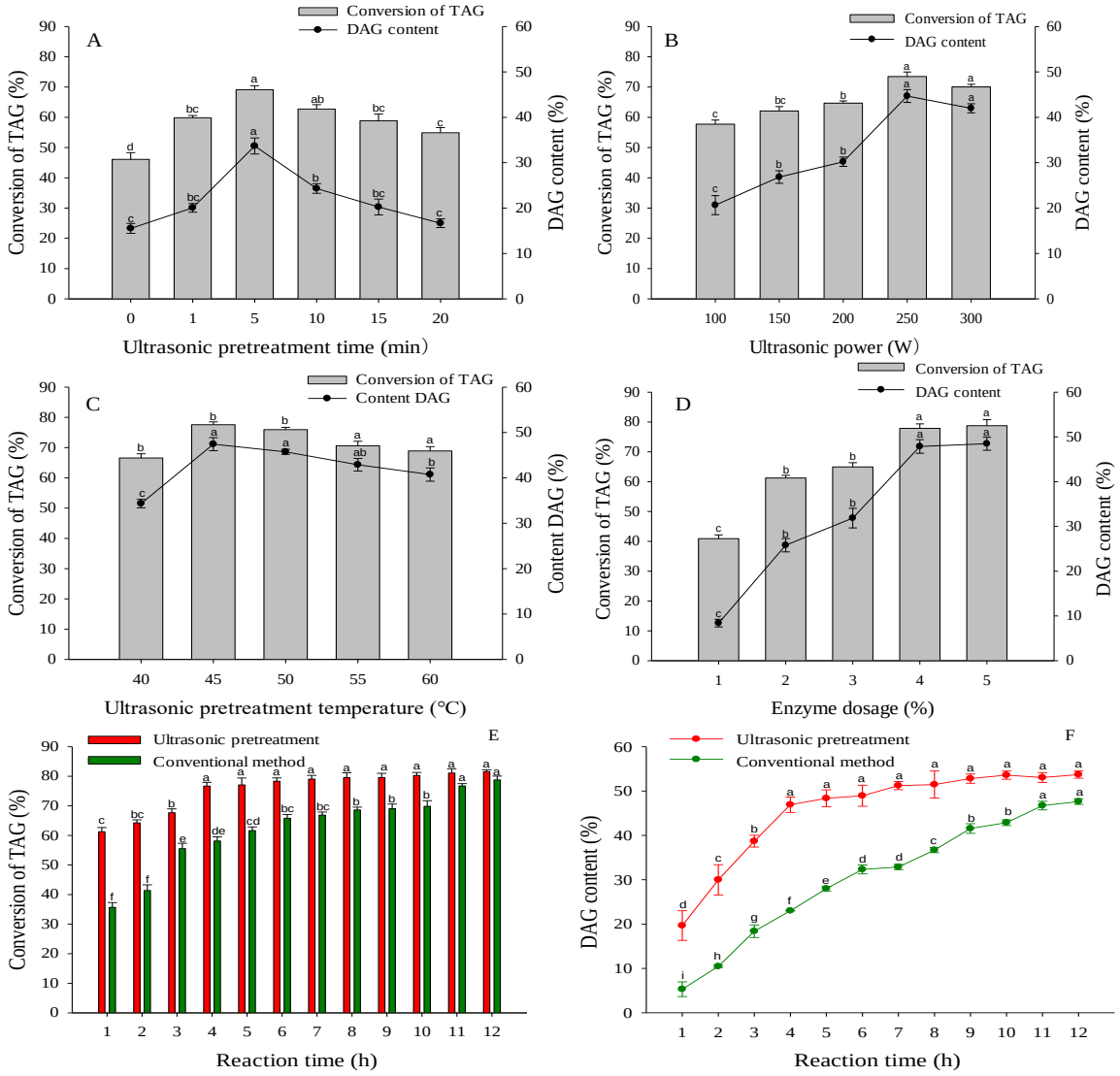

Figure 1. Effect of ultrasonic reactions and twomethods on diacylglycerol (DAG) content and conversion of triacylglycerol (TAG) in lipase-catalysed reaction. (A) pretreatment time, (B) power, (C) temperature, (D) enzyme-to-lard substrate ratio, (E) ultrasonic pretreatment and (F) conventional method, respectively .

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