CLA AND OXIDATIVE COMPARISON OF MEATBALLS FROM BREAST AND THIGH OF BROILERS FED SOYBEAN OIL AND CLA SUPPLEMENTS

K. Intarapichet*, and B. Maikhunthod

School of Food Technology, Institute of Agricultural Technology
Suranaree University of Technology, Nakhon Ratchasima, 30000, Thailand

Key words: Chicken meatballs, soybean oil, CLA, soybean oil, oxidation

Introduction

Susceptibility of meat products to oxidation can be retarded by the presence of antioxidants. Many natural antioxidants have been used for many years to delay the autoxidation process of lipids (Han and Rhee, 2005). Conjugated linoleic acid (CLA) has been shown to have antioxidant activity. Improvement of oxidative stability of beef and chicken meat had been reported when fat sources were supplemented with CLA (Hur et al., 2004; Zanini et al., 2006). Therefore, this study was designed to differentiate oxidative stabilities of chicken meatballs made from breast and thigh meat of broilers fed soybean oil and supplemented with CLA at different levels.

Materials and Methods

Three weeks old broilers (Arbor Acres) were adapted to the diets containing 5% soybean oil (SBO) only and SBO substituted with 0.5 and 1.5% CLA for 3 weeks at the Suranaree University of Technology Farm. After slaughtering, breast and thigh meats were separately used to make chicken meatballs. The meatball batter contained 77.6% chicken meat, 15.5% ice, 3.5% tapioca flour, 2.0% salt, 0.27% phosphate, 0.15% MSG, 0.62% pepper powder, and 0.3% sugar. All ingredients were chopped in a meat chopper, formed into meatballs in 65 ^{o}C water then cooked in 70 ^{o}C water for 20 min. The meatballs were packed in plastic bags and kept in a cold room (4 ± 1 ^{o}C) for 12 days. The meatball samples were taken for analyses every 3 days.

The lipid of meatballs was extracted using chloroform:methanol (2:1, V/V) solvent, completely methylated using 0.5 M sodium methoxide in methanol at 50 ^{o}C for 30 min. The CLA methyl esters were analyzed using a gas chromatograph (GC). Four specific isomers of CLA (*c*9,*t*11; *t*10,*c*12; *c*9,*c*11; and *t*9,*t*11; Matreya LLC, USA) were used for identification. The hexanal was analyzed by Static Headspace GC. Oxidized flavor of the meatballs were evaluated by eight trained panelists using scoring method. The scores were assigned from 1 for no oxidized flavor to 5 for extremely oxidized.

Statistical analysis was evaluated by randomized complete block design. Analysis of variance was analyzed and comparison of means was done by Duncan's Multiple Range Test. Two replicates of meatballs were performed with 3 chemical analyses for each replication.

Results and Discussion

CLA contents in chicken meatballs. As shown in Figure 1, CLA concentrations significantly higher (*P<0.05*) in the meatballs by substitution of CLA in animal diets. In addition, The thigh meatballs contained higher (*P<0.05*) CLA concentrations compared with breast meatballs, particularly high in the two health benefit isomers, *c*9,*t*11 and *t*10,*c*12. This could be due to higher fat content in thigh meat and more absorption of CLA in fatty tissue (Park et al., 1999). As a result, total CLA was highest in thigh meatballs. However, very small amounts of the *cis,cis* and *trans,trans* isomers were found in the meatball products. The *cis,cis* isomer has been found to have no health benefit while the *trans,trans* is reported to associate with increased risk to health (Stender et al., 2006), particularly coronary heart disease.

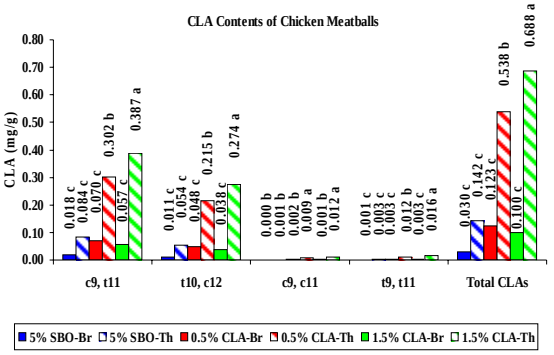

Figure 1. CLA contents in breast and thigh meatballs from broilers fed 5% soybean oil and 0.5 and 1.5% CLA supplemented in the diets; SBO = soybean oil, Br = breast meatball, Th = thigh meatball.

Lipid oxidation of chicken meatballs. Oxidative stability of the chicken meatballs in terms of hexanal concentrations measured by GC and oxidized flavor evaluated by trained panelists are shown in Figure 2A and 2B. Although hexanal contents of all of the meatballs increased as the storage time increased, differences (*P<0.05*) were found among sources of oil used in animal diets. It was obviously that the supplements of 1.5% CLA oil in the feed provided the highest oxidative stability, followed by the feed with 0.5% CLA substituted and

only soybean oil used. During day 0 to day 6 of storage, the breast meatballs from the chickens fed SBO only seemed to have slightly more susceptible to oxidation than thigh meatballs made from the same group of chickens. On the contrary, on prolong storage (after day 6 towards the end of storage), increasing of oxidation in the thigh meatballs made from the meat fed SBO were noticeably observed higher than in breast meatballs due to higher fat content of thigh meat (Zanini et al., 2006) and low amounts of CLA to prevent oxidation (Figure 1). However, the meatballs made from thigh meat fed with substituted CLA produced lower concentrations of hexanal than those made form breast meat, as the higher CLA was substituted, the lower hexanal concentrations observed. This could be because of the protective effect of both antioxidative CLA isomers, *c*9,*t*11 and *t*10,*c*12, in the meat itself (Figure 1).

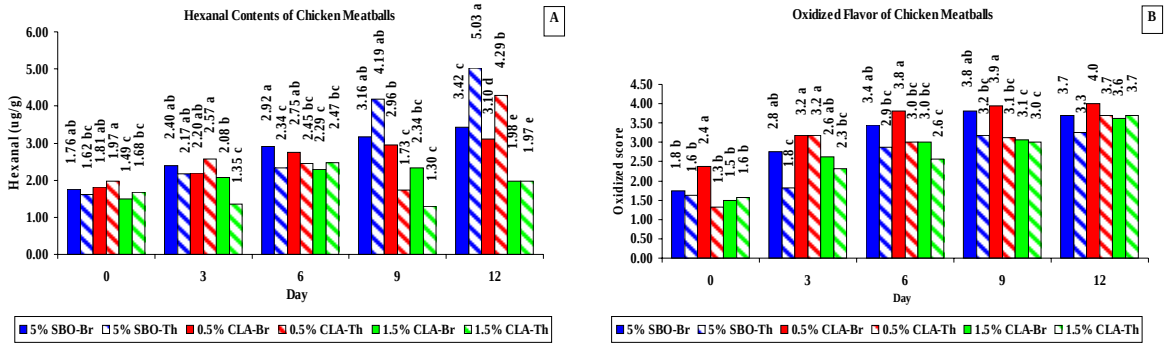

Figure 2. Hexanal contents and oxidized flavor scores of chicken meatballs affected by 5.0% soybean oil and 0.5 and 1.5% CLA supplemented in the diets; SBO = Soybean oil, Br = breast meatball, Th = thigh meatball.

Similar trends to the hexanal observation, oxidation of the chicken meatballs evaluated by the trained panelists were found to be different ($P<0.05$) among the chicken meatballs made from soybean oil and different levels of CLA substituted except for day 12 of storage (Figure 2B). During day 0 to day 9 of storage, the meatballs made from breast of all treatments had higher oxidized scores ($P<0.05$) than the ones made from thigh meat. At the last day of storage, since the sensory scores of all samples evaluated by the panelists were quite high due to high intensity of oxidized flavor, the panelists could not differentiate ($P>0.05$) the off-flavor of meatballs from all oil sources fed to the broilers.

Conclusions

Regardless of oil sources fed to the broilers, higher concentrations of CLA were observed in the meatballs made from thigh meat than those made from breast meat. The health benefit isomers, *c*9,*t*11 and *t*10,*c*12, were found higher in the thigh meatballs compared to those made from breast. From the results of hexanal contents and sensory scores, it was suggested that more oxidation occurred in the meatballs made from the broiler meat fed with soybean oil only than those from the meat fed with substituted CLA. In general, less oxidation occurred in thigh meatballs, possibly due to the protective effect of high CLA.

References

Park, Y., Albright, K.J., Storkson, J.M., Liu, W., Cook, M.E., and Pariza, M.W. (1999). Changes in body composition during feeding and withdrawal of dietary conjugated linoleic acid. *Lipids, 34,* 243-248.

Han, J., and Rhee, K.S. (2005). Antioxidant properties of selected oriental non-culinary/nutraceutical herb extracts as evaluated in raw and cooked meat. *Meat Science, 70,* 25-33.

Hur, S.J., Ye, B.W., Lee, J.L., Ha, Y.L., Park, G.B., and Joo, S.T. (2004). Effects of conjugated linoleic acid on color and lipid oxidation of beef patties during cold storage. *Meat Science, 66,* 771-775.

Stender, S., Dyerberg, J., Bysted, A., Leth, T., and Astrup, A. (2006). A *trans* world journey. *Atherosclerosis supplements. 7,* 47-52.

Zanini, S.F., Colnago, G.L., Bastos, M.R., Pessotti, B.M.S., Casagrande, F.P., and Lima, V.R. (2006). Oxidative stability and total lipids on thigh and breast meat of broilers fed diets with two fat sources and supplemented with conjugated linoleic acid. *LWT, 39,* 717-723.