CHEMICAL AND MICROBIOLOGICAL PROFILES OF "MUM" (THAI FERMENTED SAUSAGE)

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***Abstract*— Mum is a Thai fermented sausage abundantly produced and consumed in the north-eastern region of Thailand. The chemical and microbiological characterization of 10 brands Mum sausages collected from 2 province (Khon Kaen and Chaiyaphum) were determined throughout the storage time and separated into 2 trials (trials I= storage at ~30C° until day 14 and trials II= storage at ~30C° untill day 3, then vacuum-packaged, and stored at 4C° untill day 28). In both trials, a significantly rapid decrease in pH, continuously increase in lactic acid (P<0.05) as maximum at 3 days were observed. Dehydration throughout storage was more intense in trial I, which showed final lower moisture content and a_w values lower than trial II. LAB counts increased rapidly at the first 3 days of storage and decreased after drying and storage. Enterobacteriaceae counts were significantly reduced in both trial, ending up at less than 10^3 CFU/g in trial I and absent in trial II.**

***Index Terms*— Thai fermented sausage, Mum, chemical profile, microbiological profile, shelf life**

I. INTRODUCTION

In Thailand, there are many different types of natural fermented products and almost all of them are only known at local or regional levels. In the north-eastern region, a traditional fermented sausage called ''Mum'' is composed of a mixture of beef, liver, lard, cooked rice, salt, garlic, cinnamon, and some food additives (i.e. nitrate, nitrite, and antioxidants) (Phithakpol *et al*., 1995). Some edible byproducts like liver, heart, and kidney contain valuable vitamins and other nutrients. Liver which contains sufficient carbohydrate and therefore could be easily incorporated in sausages (Pearson & Duston, 1988). However, the production of fermented sausages in Thailand has utilized the naturally occurring lactic acid bacteria, might result in products with inconstant qualities. The specific characteristics and qualities of the final products mainly be related to the raw materials employed, the agro-ecosystem of the area of production, the traditional technology of manufacture, and etc. Fermented sausages are stable if produced under ideal conditions. Study of the ecology of fermented sausages is of primary importance to understand the microbiological and chemical changes occurring during fermentation and maturation. The bacteria found most commonly in Thai fermented meat products are lactobacilli, pediococci and micrococci, but the precise role of these bacteria in the quality of the products is not known (Thiravattanamontri *et al.,* 1998). Nowadays, producers of Thai fermented sausages are interested in extending the shelf-life of this product in order to increase the potential market and satisfy consumer demands. This paper presents a survey of microbiological, and chemical characteristics of Mum fermented sausages which were collected in Thailand.

II. MATERIALS AND METHODS

Sampling; Mum sausage were collected from 5 different local retail stores in 2 provinces of Thailand (Khon Kaen and Chaiyaphum), and separated into two trials as follows:

Trial I After collection, sausages were hung vertically on stainless steel hangers at room temperature (~30C°) until day 14. The sausages were sampled for analyses during storage time at day 0, 1, 2, 3, 7, and 14.

Trial II After collection, sausages were hung vertically on stainless steel hangers at room temperature (~30C°) until day 3 and then, sausage were vacuum packaged and stored at 4C° until day 28. The sausages were sampled for analyses during storage time at day 0, 1, 2, 3, 7, 14, 21 and 28.

Microbiological analyses; Mum fermented sausage were subjected to microbiological analysis to monitor the dynamic changes in the populations responsible for the ripening of fermented sausages and their hygienic quality. In particular, 25 g of the samples was taken aseptically, diluted in 225 ml of 0.85% NaCl solution. and homogenized for 2 min (Stomacher, Oskon Co., Ltd., Thailand). After serial dilution, appropriate dilution samples (1 or 0.1 ml) were poured or spread on triplicate agar plates. Total aerobic mesophilic bacteria count was determined on Plate Count Agar (Merck, Dram Stadt, Germany), incubated at 35C° for 48 h (APHA, 2001); lactic acid bacteria count was incubated on MRS agar (Merck, Dram Stadt, Germany) at 30C° for 72 h anaerobically (APHA, 2001); total enterobacteriaceae was incubated on Violet Red Bile Agar (Merck, Dram Stadt, Germany) at 35C° for 24 h (APHA, 2001). Results were expressed as $\log_{10}$ numbers of colony forming units/gram (cfu/g).

Chemical analysis; Measurement of pH was performed according to the AOAC (1990) methods. 10 g of sausage sample was blended with 90 ml of distilled water in a laboratory blender for 2 min, filtered and then pH of the filtrate was determined by a digital pH meter (Weilheim, Germany). Titratable acidity was determined as % lactic acid by titrating with 0.1 N NaOH, using phenolphthalein as an indicator (AOAC, 1990).

Statistical analysis; Data from microbiological, physical, chemical and sensory were analysed by ANOVA (SAS, 1998) and means were compared by using the Duncan's multiple ranges test. Significance was defined at $P<0.05$.

III. RESULTS AND DISCUSSION

Results of pH and lactic acid content are shown in Fig. 1. The pH of Mum sausage was found to decrease significantly ($P<0.05$) after 3 days of storage (Fig. 1a and 1b) in both trials. With a rapid decrease in pH, lactic acid continuously increased ($P<0.05$) and reached a maximum after storage for 3 or more days (Fig. 1c and 1d) As expected, the values of titratable acidity had an inverse relationship to pH during the ripening process. In trial I, pH values decreased only until day 3 and afterwards increased until day 14. During the refrigerated storage (4C°, trial II) of all brands, pH values slightly increased until 28 days.Various studies have reported that this pH increase could be due to an accumulation of non-protein nitrogen, amino acid catabolism products (Pe´rez-Alvarez et al., 1999) or due to the growth of spoilage bacteria (Ahmad and Srivastava, 2007).

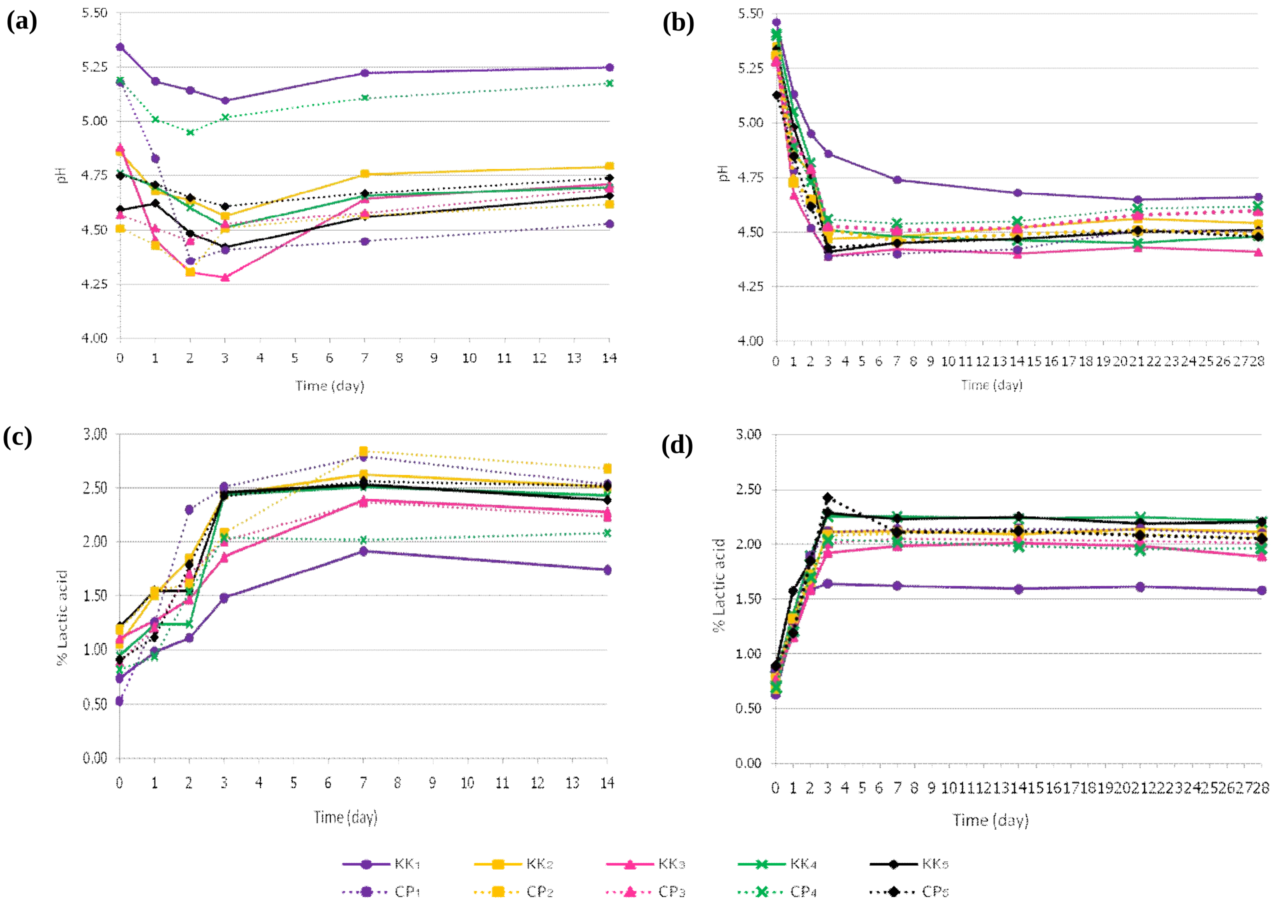


Fig. 1 Changes in pH values and lactic acid contents of Mum sausages during storage for trial I (a and c) and II (b and d).

The results showed water activity (a_w) were decreased markedly during the period of storage from day 0 to 14 in trial I (Fig. 2a). However, water activity decreased continuously but more slowly after vacuum-packed and stored at 4C° until day 28 in trial II (Fig. 2b). This might be due to the water activity during storage hardly changed after packaging. According to Girard (1988), low a_w may extend the lag phase of the growth of undesirable microorganisms. Therefore, water activity of samples must be reduced as quickly as possible to stop or to delay spoilage microorganisms in the product. The moisture content of sausages decreased in a similar pattern with a_w in the both trials (Fig. 2c and 2d).

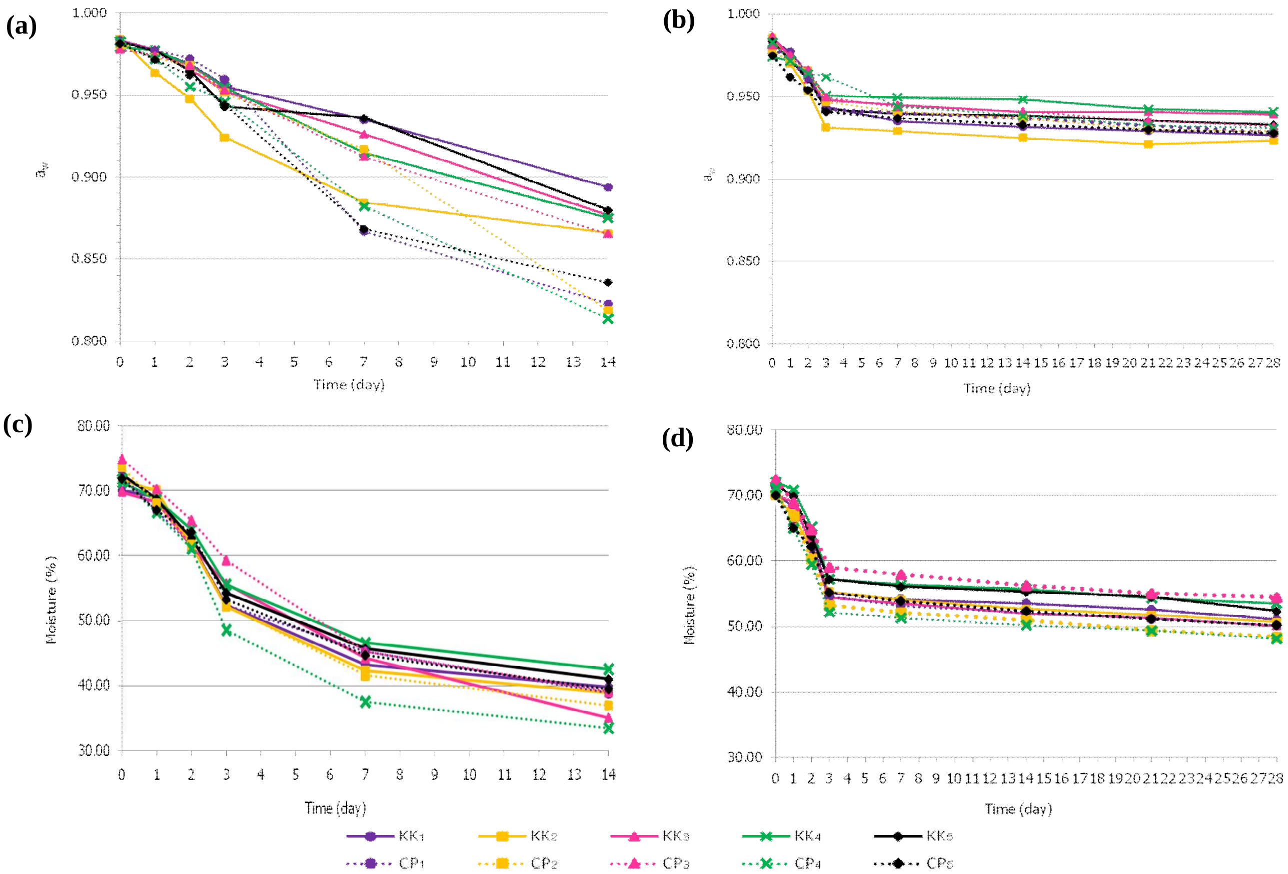
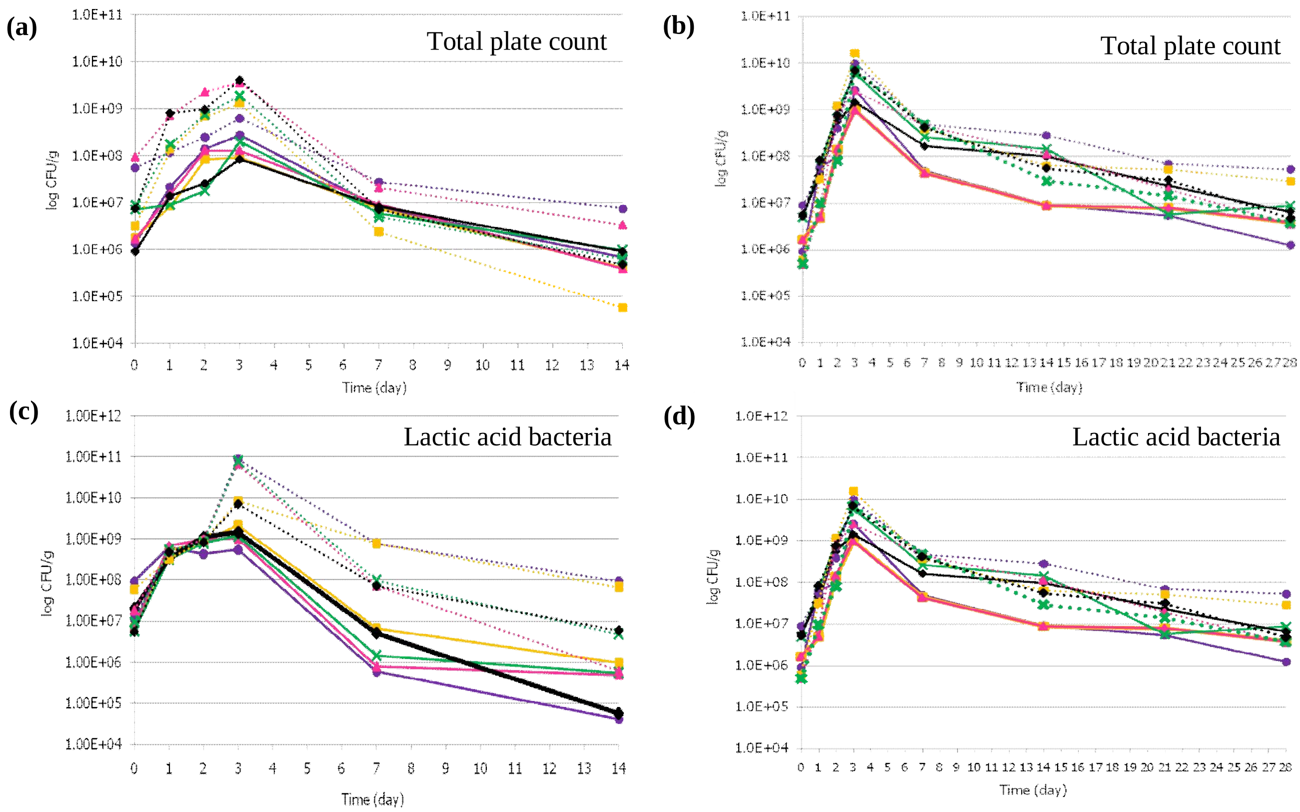


Fig. 2 Changes in water activity and moisture contents during storage for trial I (a and c) and II (b and d).

Microbial changes are presented in Fig.3. At 3 day, the total plate counts increased up to 10^{8}-10^{10} cfu/g for trial I and 10^{9}-10^{11} cfu/g for trial II. However, the total plate counts in both trials showed a continuously decrease ($P<0.05$) after the third day of storage (fig. 3a and 3b). The counts of LAB for the sausage that collected from Khon Kaen and Chaiyaphum provinces increased rapidly during the first 3 days of storage and reached levels up to 10^{6}-10^{8} and 10^{5}-10^{7} cfu/g, respectively ($P<0.001$) in the both trials. After drying and during storage, the LAB counts in Mum sausages decreased (fig. 3c and 3d).



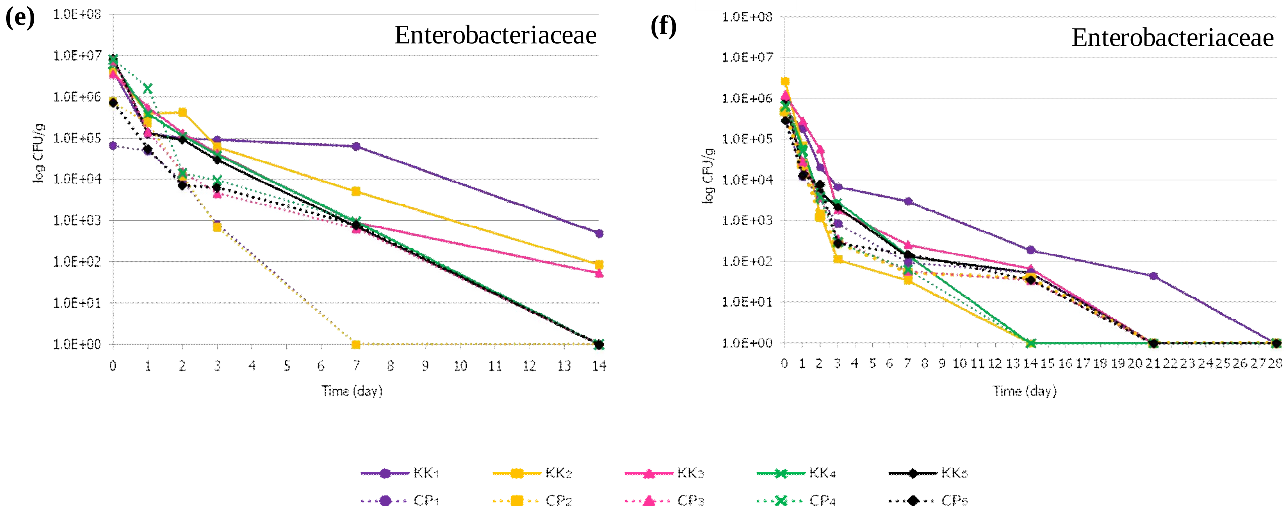


Fig. 3 Changes in counts of lactic acid bacteria, total plate count and enterobacteriaceae during storage for trial I (a, c and e) and II (b, d and f) .

The initial enterobacteriaceae count in the sausage ranged from 10^5-10^7 cfu/g and decrease rapidly until the end of storage (<10^3 cfu/g and not detectable for trial I and trial II, respectively). The reduction rates of enterobacteriaceae were higher in sausages stored at room temperature (~30°C, trial I) than at refrigerated temperature (4°C, trial II). In both trial, the enterobacteriaceae counts of all sausages that collected from Chaiyaphum were not detectable after day 14 and 21 of storage time (trial I and trial II, respectively). This results imply that enterobacteriaceae was inhibited, probably due to the decrease of pH, moisture, a_w and antimicrobial mechanisms of some competitive microbial flora.

IV. CONCLUSION

The microbiological and chemical properties of the Mum fermented sausages collected from difference manufacturers and areas in Thailand that studied in this paper were various probably due to the sausages processed under the difference conditions (i.e. ingredient, raw material, enterobacteriaceae, and microflora). In this study, Mum sausages from Chaiyaphum province had higher LAB counts and lower enterobacteriaceae counts which seemed to be benefitial. Also storage at higher temperature might shorten shelf-life and loss moisture of product.

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