PE4.16 The water activity and biogenic amines of Chinese-style semi-dry sausage formulated with high sugar and dried by 10¢J, RH 80% 56.00

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Abstract - Physicochemical properties and microbial stability of Chinese-style semi-dry sausage formulated with 8%, 10% and 12% sugars, respectively, dried by 10˚C, RH 80% and at 0-5¢J refrigerated storage for 8 weeks were investigated. The moisture content, crude protein, water activity, pH value and Coliform counts of all samples were not affected by drying and sugar contents for 8 weeks; metmyoglobin content, the TBARS value, TPC and Coliform counts and biogenic amines contents were increased with the increased storage time (P < 0.05) but the nitrite residue were reversely (P < 0.05). The sausage formulated with 12% sugar and dried by 10¢J had lower metmyoglobin, putrescine, cadaverine and tyramine contents than the others (P < 0.05), but the TBARS value of the samples formulated with 10% sugar and dried at 10¢J was significantly lower. The sensory evaluation results were shown that all samples formulated with 12% sugar gained the best scores.

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Index Terms - Chinese-style semi-dry sausage, sugars, water activity, biogenic amines.

I. INTRODUCTION

Most Chinese-style sausage sold in Taiwan market were dried by 50-60˚C presently. The heat treat of sausages might speed up the lipid oxidation caused off-flavors [1] and they might be shrink, firm and had bad water-holding capacity [2]. According to the research of Huang [3] indicate that the water activity (aw) of most Chinese-style sausage selling in Taiwan market was between 0.81-0.96, however the aw for growth of the bacteria was: 0.90-0.99 [4], the quality of this products was easily to be effected. On the side, the formation of Chinese-style semi-dry sausage in Taiwan always added 6-¬12% to conform to Taiwanese flavor [5].But sugar was the energy resource for microorganism growth, biogenic amines may be produced by bacterial enzymatic decarboxylation of free amino acids if the condition of drying wasn¡¦t inappropriate [6]. The results of Chang¡¦s research [7] said that Chinese-style sausage treated by 10¢J drying temperature had significantly lower TBARS value. According to some studies, adding high concentration of sugar not only could inhibit denature of protein [8] but also could decrease water activity to reduce the peroxide decomposing rate during lipid peroxidation [9]. And it`s not easy for protein to precede the decomposition reaction and decarboxylation in low temperature. Furthermore, other works have indicated that the use of sugar inhibited the presence of biogenic amines in some fermented meat products [10, 11]. The objective of this study was to investigate the quality characteristics of Chinese-style semi-dry sausage formulated with 8%, 10% and 12% sugars, dried by10˚C, RH 80% and at 0-5˚C refrigerated storage for 8 weeks

II. MATERIALS AND METHODS

A. Chinese-style sausage manufacture

Sausages were prepared with pork ham and back fat which were purchased from a local company. Lean tissue was trimmed of heavy connective tissue and external fat, and then ground through a 9 mm plate. The lean meat and pork fat were mixed with 1.5% salt, sodium nitrite (0.25%), white pepper powder (0.2%), sodium polyphosphate (0.15%), sodium ascorbate (0.05%), glucolactone (0.1%), seasons(0.05%) and 8%,.10%, 12% sugar, respectively, and then cured at 0-4¢XC for 3 days. The cured meat was stuffed into hog casings (28-30 m m), linked and then dried at 55¢XC for 5 h and 10˚C, 80-85% relative humidity (RH) for two days, respectively. Following drying and vacuum packaging, sausages were stored at 0~4¢J and analyzed at 0-8 weeks. Three replicates with batches were conducted in this study.

B. Physicochemical analyses

Moisture and crude protein were determined in triplicate using the AOAC [12] methods. The pH value of sausage samples was determined according to the Chemistry Laboratory Guidebook of USDA [13].Water activity of ground samples was measured with a water activity analyzer (Rotronic Ag, HygroPalm AW1-SET/14) after equilibrium at 25 ¢Jand averaged.

Approximately 5 g ground samples were placed in a measuring container, and then the Hunter L* (lightness), a* (redness), and b* (yellowness) values of samples were measured with a color meter (Color difference meter, Model TC-1, Tockyo Denshouku CO, LTD., Japan). The metmyoglobin content of sausage was measured from modified procedures of Warriss [14] and Trout [15] and was calculated using the following formulas [16]: Metmyoglobin = {1.395 ¡V [(A572 ¡V A700)/ (A525 ¡V A700)]} ¡Ñ 100. TBA values of the samples were determined according to the methods described by Faustman et al. [17]. Microbiological analyses were determined in triplicate using the methods of Bacteriological Analytical Manual for Foods (BAM) of FDA [18]. According to the method of Konosu et al. [19], Biogenic amine were extracted from 5 g of sausage sample with 7% trichloracetic acid (TCA) to extract and was detected as their benzoyl derivatives by HPLC[20]and to quantify these amines standard solutions were prepared in the same way as samples. Sensory evaluation needs twenty untrained panelists evaluated attributes of color, flavor, texture, juiciness and overall acceptability of sausage samples. At weeks 0 to 8 of storage, the sensory evaluation was conducted using a 1¡V7 scale, with 1 representing the lowest intensity and 7 the highest intensity, respectively, for all attributes

III. RESULTS AND DISCUSSION

There was decrease trend of pH value in all samples during storage time but no significant difference between all treatments ($p > 0.05$). Moisture content and cure protein of all sausage samples were not affected by drying and sugar contents for 8 weeks storage time and they were between 46.55-46.81% and 21.25-22.98%, respectively. The change in aw of Chinese style semi-dry sausage formulated with 8%, 10% and 12% sugar by different drying temperature during storage time were shown in figure 1. Wu [21] and Okerman and Kuo [22] thought that vacuum package could lower the rate of the water loss during the storage at 4¢XC and Scott [23, 24] proposed to express aw as the ratio of vapor pressure of water in food to the vapor pressure of pure water at the same temperature and total pressure. In this experiment, all samples were used vacuum package and storage at 0-4¢XC therefore the aw in all treatments were not affected by drying methods and sugar contents for 8 weeks storage time. The L value of the samples dried by 55¢XC were significantly higher than the others ($P < 0.05$) and the a value were reversely. However, there is no significant difference in b value in all samples ($p > 0.05$). The nitrite residues of all samples were significantly decreased with the increased storage time; while the nitrite residues of samples dried by 10˚C were significantly lower than 55˚C.With the increased sugar content, the Chinese-style semi-dry sausage had a significantly lower nitrite residue ($p < 0.05$).Because adding sugar can promote the degradation of nitrite and reduce the nitrite residue in cure meat [25]. The TBARS value of the samples formulated with 10% sugar and dried by 10˚C was significantly lower than the others, and all samples were significantly increased with the increased storage time ($P <0.05$). According to Chang`s [7] research showed that the activity of Superoxide dismutase (SOD), glutathione peroxidase (GSHPx), catalase (CAT) and carnosine content of sausage products dried by 10¢J were significantly higher than dried by 55˚C ($P < 0.05$).That¡¦s why the Chinese style semi-dry sausage dried by 10˚C could decrease the TBARS value. Metmyoglobin content were significantly increased with the increased storage time ($P < 0.05$), while metmyoglobin content of samples formulated with 12% sugar and dried by 10¢J was significantly lower than the others ($P <0.05$). TPC of the samples of dried by 55˚C was significantly lower ($P < 0.05$) than others, and all samples were significantly increased with the increased storage time ($P < 0.05$).Moreover, all TPC of the samples were still lower than 106 after storage for 72days which matched the request of CAS (Chinese Agriculture Standards). The change in coliform counts of Chinese style semi-dry sausage was not affected by drying and sugar contents for 8 weeks storage time. They were all lower log 4.7 CFU/g and increased with the increased storage time slowly. £]-phenylethylamine (Fig. 2) in Chinese-style semi-dry sausage kept constant during storage time and only a little change during 1st~4th week. But there was no significant difference in all samples. Diamines like spermine (Fig. 3) and spermidine (Fig. 4) in the experiment also had similar change during storage time. Small changes in polyamine contents are usually found during sausage fermentation because these amines are naturally present in raw materials and they are not formed by microbial decarboxylation of amino acids [26, 27]. There was no agmatine in all Chinese-style semi-dry sausages samples found in this experiment and tryptamine and histamine content were only found in week 0, they were 0.79 ¡Ó 2.57 and 0.53 ¡Ó 1.53 mg/kg dm respectively. It was suggest that the

meat be used in the study had better hygiene, cured by high sugar content and storage at 0-4¢J with vacuum package could control the bacteria to subsist. The tyramine (Fig.5), cadaverine (Fig. 6) and putrescine (Fig. 7) contents of all samples dried by 10¢J were significantly lower than treated by 55¢J¡]P < 0.05¡^. As Klausen and Lund [28], Diaz-Cinco et al. [29] and Halász et al. [30] reported that amine content depends on temperature, and increase with time and storage temperature. The tyramine (Fig. 5), cadaverine (Fig. 6) and putrescine (Fig. 7) contents increased with the increased storage time (P<0.05), while that formulated with 12% sugar and dried at 10¢J to be significantly lower than others (P<0.05). Bover-Cid et al. [31] found that tyramine, cadaverine, tryptamine and phenylethylamine amines formed during ripening, their contents being significantly higher in sausages without sugar. González-Fernández et al. [32] reported that chorizo dry sausage added 0.5-1.0% sugar had lower biogenic amines contents and Arnold and Brown [33], Smith [34] and Masson et al. [35] said that during the fermentation sugar would formed acid could suppress the biogenic amines being produce. And all evidences showed that sugar additive might be able to decrease biogenic amine accumulation during the manufacture and storage of sausage. The sensory evaluation results were shown that all samples formulated with 12% sugar gained the best scores. With the increasing of storage time, the flavor scores of samples formulated with 10% sugar were higher than the others.

IV. CONCLUSION

In conclusion, as what we expect that adding higher sugar and drying by lower temperature in Chinese-style semi-dry sausage is a potential way to produce a meat product which not only had better flavor and appearance but also could improved lipid and color stability, furthermore reduced the biogenic amines content.

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