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# QUALITY CHARACTERISTICS OF CHINESES-STYLE SAUSAGES MADE FROM DIFFERENT RAW MATERIALS AND STORED UNDER REFRIGERATION

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**Key Words:** Chinese-style sausage; hot-boned; chilled, frozen; quality

## Introduction

Traditionally, in Taiwan it was common to use hot-boned meat that was sold in traditional markets to make sausages. However, due to sanitary concerns, possible lacking of good temperature-control and also increasing numbers of modern meat processing facilities, more and more chilled or frozen meat are used to make sausage products. Also the supply of frozen meat imported from overseas is increasing. Raw materials from various sources, such as hot-boned, chilled or frozen meat, might have different physic-histological characteristics, and influences the qualities of processed products. Freezing applied to preserve meat has many advantages, such as holding for a longer period of time between production and use, but unfortunately, also has some disadvantages. Chilled meat currently is commonly used in making many sausage products. Hot-boning of animal carcasses and processing of pre-rigor meat have been reported to have some advantages, such as higher emulsifying capacity, water-holding capacity, and etc. How to choose appropriate meat and thus make high quality products is always a major concern for the meat industry.

## Objectives

The objective of this study was to evaluate the quality characteristics of Chinese-style sausages made from various raw materials, including hot-boned, chilled, and frozen pork, during refrigerated storage.

## Methodology

Fresh pork was ground through a 9.5 mm plate. Hot-boned meat was made into sausages immediately, while the chilled group raw materials were first stored at 4°C for 3 days, then making into sausages; frozen group raw materials were stored at -18°C for 7 days, and then thawed at 4°C for 1 day before making into sausages. Raw materials including 80% pork ham and 20% pork back fat, were mixed with 8% sugar, 3% water, 1.3% salt, 1% MSG, 0.2% white pepper powder, 0.15% polyphosphate, 0.05% sodium erythorbate, 0.012% $NaNO_2$, 0.01% five-spice powder, and 0.01% cinnamon powder.

The meat mixture was stuffed. Raw sausages were linked and dried in a preheaded oven at 50°C for 1 hr, 60°C for 2 hr. Following drying, sausages were cooled, vacuum packaged, and then stored at 4°C. At days of 0, 7, 14, 21, and 28, samples were analyzed for pH, L*, a*, and b*, TBA, VBN, and TPC. Three trials were conducted. Data were analyzed using SAS GLM with a 5% level of significance. Means were separated using Duncan's new multiple range test.

**Results & Discussion**

The data show that the pH values of the samples decreased from 6.45 to 6.30 during 21-days refrigerated storage (Table 1). This result agreed with other studies (Kuo and Chu, 2003; Wu, 2003). The decrease of pH values of the sausages was probably due to lactic acid producing bacteria fermenting sucrose added to the sausages. Less pH reduction in this study was probably because of less sugar (8%) added in this study compared to 10% sugar added in the previous studies. In this study, there was no significant difference of pH values of the sausages among the treatments. The results indicated that "L*" values of the sausage samples slightly increased with storage time (Table 2). No significant difference of "L*" values of the sausages among the treatments was observed during refrigerated storage. In this study, the "a*" values of the samples increased along with storage time for each treatment, and the "a*" and "b*" values of the sausages made from either chilled or frozen meat were significantly higher than the ones made from hot-boned meat. This result agreed with the study done by Lin and Chao (2001).

The TBA values of all sausage samples increased with storage time (Table 3). In this study, at days 0 and 7, the frozen-meat sausage samples had significantly higher TBA values than the samples prepared with other meats. This result was probably because ice crystals formed during frozen storage, partially disrupted muscle cell structure, thus increased the possibilities of oxygen interring the tissue and which would increase lipid oxidation, and result in higher TBA values of the frozen samples. After day 7, all the three groups of samples in vacuum packages had similar TBA values throughout refrigerated storage at 4ºC. Table 3 illustrates VBN values of the three sausage samples significantly increased when storage time increased. In this study, at day 0, frozen-meat sausage samples had significantly higher VBN values than the other two groups, while no significant difference was observed after 7-days storage. Also, all the samples for each group in this study did not exceed 20 mg/100 g, which is the value that is often described as the level necessary to detect meat spoilage.

No significant difference of TPC of the samples among the treatments was observed during refrigerated storage, even though the sausages prepared from hot-boned meat had higher TPC than the other two groups (Table 4). In this study, total plate counts of all refrigerated samples met an even more restrict standard which is $\leq 3\times10^6$ CFU/g for frozen non-fully cooked meat products that was established as the Chinese Agricultural Standard.

## Conclusions

In conclusion, Chinese-style sausages made from meat, hot-bone, chilled, or frozen pork, were acceptable as evaluated by microbiological and physicochemical characteristics analyzed in this study. Manufacturers should select appropriate raw materials to make sausages according to feasibility, economic concerns, and other factors. However, the importance of high quality raw materials and good sanitary processing conditions should not be overemphasized when making products.

## References


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## Tables and Figures

Table 1. The pH values of the Chinese-style sausage made from various raw materials and stored at 4ºC

| | Storage time (day) | | | | |
|---|---|---|---|---|---|
| Meat type | 0 | 7 | 14 | 21 | 28 |
| Hot-boned meat[1] | 6.45±0.16 | 6.47±0.13 | 6.48±0.18 | 6.46±0.16 | 6.30±0.23 |
| Chilled meat[2] | 6.45±0.13$^{ab}$ | 6.47±0.12$^{a}$ | 6.41±0.17$^{ab}$ | 6.48±0.17$^{a}$ | 6.25±0.33$^{b}$ |
| Frozen meat[3] | 6.47±0.14 | 6.46±0.16 | 6.48±0.09 | 6.34±0.16 | 6.30±0.33 |

[1]Hot-boned meat: Meat from hot carcasses from a local meat market was made into sausages immediately.
[2]Chilled meat: Meat was storage at 2ºC for 3 days, and then made into sausages.
[3]Frozen meat: Meat was storage at -18ºC for 7 days, thawed at 4ºC for 1 day, and then made into sausages.
[ab]Means within a row have different superscripts are significantly different ($p<0.05$).

Table 2. Color evaluation of the Chinese-style sausage made from various raw materials and stored at 4ºC

| Meat type | Storage time (day) 0 | 7 | 14 | 21 | 28 |
|---|---|---|---|---|---|
| | | | L values | | |
| Hot-boned meat | 37.73±1.24 | 37.25±1.00 | 38.59±2.48 | 37.34±2.00$^{y}$ | 39.05±3.47 |
| Chilled meat | 36.95±1.39 | 36.60±2.22 | 38.07±1.88 | 37.16±1.98$^{y}$ | 38.89±3.43 |
| Frozen meat | 37.90±1.71 | 37.65±2.83 | 39.67±2.32 | 39.50±1.92$^{x}$ | 38.85±2.55 |
| | | | a values | | |
| Hot-boned meat | 9.46±0.84$^{by}$ | 11.03±1.15$^{a}$ | 10.24±1.17$^{aby}$ | 11.33±0.61$^{axy}$ | 11.32±1.41$^{a}$ |
| Chilled meat | 10.73±1.35$^{x}$ | 11.14±1.39 | 11.36±1.33$^{x}$ | 11.98±0.86$^{x}$ | 11.73±1.13 |
| Frozen meat | 10.78±0.91$^{bx}$ | 11.82±0.96$^{a}$ | 11.13±0.49$^{abxy}$ | 11.16±0.62$^{aby}$ | 11.37±1.29$^{ab}$ |
| | | | b values | | |
| Hot-boned meat | 8.22±0.65$^{ab}$ | 7.86±0.52$^{by}$ | 8.86±0.75$^{ay}$ | 8.80±0.84$^{axy}$ | 8.88±1.33$^{ay}$ |
| Chilled meat | 8.62±0.77$^{b}$ | 8.11±0.94$^{by}$ | 8.86±0.91$^{by}$ | 8.52±1.04$^{by}$ | 10.15±0.83$^{ax}$ |
| Frozen meat | 8.16±0.85$^{c}$ | 9.74±0.63$^{abx}$ | 10.25±1.03$^{ax}$ | 9.41±0.62$^{bx}$ | 10.07±0.60$^{abx}$ |

$^{xy}$Means within a column for the same test have different superscripts are significantly different ($p<0.05$).
$^{abc}$Means within a row have different superscripts are significantly different ($p<0.05$).