Technology and Microbiology of Chinese Silk Bound Rabbit

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SUMMARY: Chinese silk bound rabbit (chansi tu 缠丝兔) is a traditional special local food in Sichuan. It is made of choice rabbit together with many precious Chinese herbed medicines for our studies. The microbial stability of Chinese silk bound rabbit depends primarily on the hurdle effect of water activity (a_w), not on pH. A quick reduction of a_w 0.85 is achieved within 24 hours due to the added humectants (salt 2.5-3.0%, sugar 1-2%), the intensive drying at higher temperature (50-60°C) and low moisture (65-70% RH). But the pH remains quite high (pH 6.5-6.8) because the lactic acid bacteria are few and grow rather slowly. Chinese silk bound rabbit can be classified as a traditional meat product of a_w-type Intermediate Moisture Food (a_w-IMF), which is a raw but non-fermented, nutritious, safe and storable without refrigeration.

INTRODUCTION: In China there are a high yield of meat and a great variety of meat products. Traditionally flavored local specialities such as Jinhua ham (Jinhua huotui 金华火腿), Guangdong sausage (Guangdong xiangchang 广东香肠), Taicang floss (Taicang rousong 太仓肉松), Beijing roast duck (Beijing kaoya 北京烤鸭), Nanjing cured duck (Nanjing banya 南京板鸭) and Guanghan silk bound rabbit (Guanghan chansitu 广汉缠丝兔) etc. have a long history (Lo et al.1980).

Chinese silk bound rabbit is a traditionally flavored, special local food in sichuan, but it is the Guanghan silk bound rabbit produced in Guanghan city of Sichuan, that is the most famous. The earliest known reference to Chinese silk bound rabbit was dated from last years of Qing Dynasty, with a fame of over a hundred years (Wu et al.1985).

Chinese silk bound rabbit which is like a silkworm in spring has a beautiful shape with a clear red-brown color and delicious taste. It's produced mainly in the cold season and stored without refrigeration for the most important festival in China, the Spring Festival (in February). It is a truly desirable food that serves not only as a precious gift to friends and delicacy at dinner, but also as a nutritious food for the health.

Chinese meat products are known from time immemorial, however their technology and the preservative principle are studied only recently. Lo et al.(1980), Lin et al.(1980, 1981), Ockerman et al.(1982), Shin et al.(1982), Shin and Leistner (1983), Ho et al.(1984) as well as Leistner et al. (1984, 1985, 1986) investigated the technology and microbiology of Chinese dried meats and Chinese susages, but apparently little is known about the technological and microbiological data of Chinese silk bound rabbit. It is not even clear whether this product should be called such as raw ham fermented product. Therefore we visited several meat processing factories and reproduced Chinese silk bound rabbits with traditional way in our laboratories. This paper describes the technology and microbiology of Chinese silk bound rabbit.

MATERIALS and METHODS: For our studies Chinese silk bound rabbit was made of choice Chinese Rabbit or hybrid of 4 to 6 months old, weighing 2 to 2.5 kilograms. After slaughtering, skinning, drawing and dressing, the dressed carcass was cured in dry cure mixture for 48 hours. The components of the product cured for our studies are listed in Table 1.

Table 1. Ingredients (in gram) cured for Chinese silk bound rabbit in our laboratories

Dressed carcass	1000.0	5-spice powder*	2.0
Nitrite curing salt	25.0	Chinese white spirit	2.0
Sugar	10.0		

*Star anise, cinnamon, shannai (三奈), fennel, ginger; ratio 5:2:1:1:1

Then the thoracico-abdominal cavity of carcass were smeared with spices that were mixed fermented soya beans (Douchi 豆豉) or sweet brown sauce (Tianmianjiang 甜面酱), soya sauce, sugar, monosodium glutamate, Chinese white spirit, Chinese herbed medicines and spices (sharen 砂仁, cardamon, clove, cinnamon, star anise, fennel, ginger juice, pepper and huajiao 花椒). Afterwards the smeared carcass was bound from head to tail in a spiral with a flaxen rope 4 to 5 metres in length. Our experimental products were dried for 4 hours at 75-80℃, 70-80% RH and then for 12-14 hours at 50-60℃, 65-70% RH. That then the product was cooled and vacuum packaged. We stored the finished product at below 20℃ and 70-80% RH up to 40 days. The product can be ripened with the special flovor during ripening and may be stored without refrigeration for at least 3 months.

RESULTS and DISCUSSION: According to Chinese national hygienic standard of food, we investigated the physico-chemical and microbiological data of 36 Chinese silk bound rabbit samples during processing. These products contained 6-9% Nacl (average about 8%), 40-50% miosture (most about 45%), 8-22 ppm nitrite (most <20 ppm) and had an a_w-range 0.82-0.88 (most 0.85) and a pH-range 5.8-6.8 (most 6.6).

Table 2. Changes of a_w, pH and microbial flora(per gram) in Chinese silk bound rabbit during ripening

Ripening time(days)	a_w	pH	Total count	Lactic acid bacteria	Enterobacteriaceae
0 (1)	0.96	6.8	2.0×10^7	2×10^3	3×10^3
0 (2)	0.90	6.8	5.2×10^6	1×10^3	4×10^2
1	0.85	6.7	5.5×10^5	1×10^2	1×10^2
10	0.83	6.6	3.0×10^6	$<1 \times 10^2$	$<1 \times 10^2$
20	0.85	6.6	4.0×10^6	$<1 \times 10^2$	$<1 \times 10^2$
30	0.85	6.5	5.3×10^6	2×10^2	$<1 \times 10^2$
40	0.86	6.5	7.5×10^6	5×10^2	$<1 \times 10^2$

(1) Before curing; (2) After curing

In Table 2, the average data of the samples are listed, indicating the observed changes in a_w, pH and the microflora in Chinese silk bound rabbit during processing. Due to the added humectants (salt 2.5-3.0%, sugar 1-2%), the intensive drying at higher temperature(50-60℃) and low moisture(65-70%RH), the a_w of the product decreased within 48 hours of curing to 0.90 and after 24 hours of ripening to 0.85 till 30 days of ripening. The product reached rapidly in the intermediate moisture range. But the pH of the product occured only little changes and remained quite high (6.5-6.8) during ripening because the lactic acid bacteria were few and grew rather slowly in the product. Thus The product was not sour to the taste. A sour meat product is generally considered to be defective or spoiled and could be refused in China.

Our experimental studies have shown Chinese silk bound rabbit is primarily preserved by a rapid decrease of a_w and not by pH like Chinese sausage which have been reviewed recently by Leistner et al. (1984, 1986). Added nitrate and nitrite improve only the color and flavor of the product but not the stability, because the residual nitrite levels are low (<20 ppm). However the microbiology of the product is not identical with the microbial processes in fermented sausages and raw ham of the European type, which have been expounded by lücke (1984) and leistner et al. (1985).

experimentally we also investigated the behaviour of Enterobacteriaceae, Salmonellae and pathogenic Staphlococci in Chinese silk bound rabbit, as per microbiogical examination of Chinese food hygienic standard. Due to the rapid a_w decrease, the added Chinese herbed medicines, the added spices and the vacuum packaging, little changes of the microflora were observed and samples of the product were not spoiled by microorganisms during the ripening time in our experiments.

Leistner et al. (1984) conducted inoculation studies with Chinese sausage and observed that Salmonellae, pathogenic staphylococci, yeasts and moulds are eliminated during processing. The microflora recorded in Table 2 could neither cause spoilage nor food-poisoning. In fact, Chinese silk bound rabbit usually is steamed before consumption. Thus, this heat treatment eliminates undesirable bacteria and parasites, which may be present in the product. Therefore, Chinese silk bound rabbit if properly processed is indeed safe food. However, staphylococcus aureus could be a problem, because this organism survives in our investigation and could grow at about a_w 0.86 during the ripening of the product. Further inoculation studies on the elimination of risk of Staphylococcus aureus in the product are advisable.

CONCLUSIONS: Chinese silk bound rabbit can be classified as a traditional meat product of a_w-type Intermediate Moisture Food (a_w-IMF), which is a raw but non-fermented, nutritious, safe and storable without refrigeration. The microbial stability of Chinese silk bound rabbit depends primarily on the hurdle a_w, not on pH like Chinese sausage. But the microbiology of the product is not identical with the microbial processes in fermented sausage and raw ham of the European type.

Chinese silk bound rabbit should be introduced into other developing countries and it could be of benefit to them, since it is easy to prepare and does not need strickly controlled ripening conditions. It also could be of interest to food designers in industrialized countries. Therefore, a better strategy is probably to study the principle of traditional meat products for a better understanding, the improvement and development of meat preservation in developing countries.

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