6-P18

UTILIZATION OF STARTER CULTURE FOR SOFT SALAMI SAUSAGE

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Background:
Starter cultures have been widely used to shorten the aging period necessary in the production of various fermented meats. Addition of a starter culture is a common practice nowadays in fermented meat products, especially sausages. Starter cultures are responsible for the meat acidification which is important for product preservation, control of spoilage, and prevention of the growth of pathogenic bacteria. During fermentation, starter cultures grow rapidly and inhibit the growth of unfavorable bacteria. However, fermented sausages have not appealed to Japanese tastes.

Objectives:
The objective of this study was to gain knowledge on the inhibitory effects of starter culture on pathogenic bacteria in soft salami sausage during fermentation and drying.

Methods:
Starter culture
The starter culture used to soften salami sausages was composed of *Staphylococcus carnosus* 2 : *Pediococcus pentosaseus* 1 (Flora carn SP, Chr. Hansen, Denmark).
Preparation of sausage
Soft salami sausage preparation was carried out using the methods described in Table 1 and illustrated in figure 1.
Pathogenic bacteria
The pathogenic bacteria strains used in this study were *Eschericia coli* JCM1649, *Staphylococcus aureus* JCM 2152, *Salmonella choleraesuisu subsp. choleraesuis* JCM 1652, *Yersina enterocolitica* JCM 7577, *Clostridium perfringens* JCM 1290 and *Bacillus cereus* JCM 1290.
Microbiological analysis
Microbiological analysis was carried out during the fermentation and drying process. The homogenates and dilutions were made following the recommendation. 10g of each sample were homogenized with 90ml of sterile saline water for 1 min. Thus making a 1/10 dilution. Successive decimal dilutions were prepared by mixing 1ml of the previous dilution with 9ml of sterile saline water. Total bacterial, *E.coli*, *Sta.aureus*, *Sal.choleraesuis*, *Y.enterocolitica*, *Cl.perfringens* and *B.cereus* counts were enumerated in Standard Methods Agar, Desoxycholate Agar, Mannitol Salt Agar, MLCB Agar, CIN Agar, CW Agar and NGKG Agar, respectively. All bacterial cultures were incubated at 35℃ ±2℃ for 48 hours. *Cl.perfringens* were incubated under anaerobic conditions. After incubation, plates with 30 to 300 typical colonies were counted. The detection limit for all bacterial counts was 10^2cfu/g.
PH and Water activity
The pH and water activity values were measured during the fermentation and drying process.

Results and discussion:
The initial total bacterial count was 1.0×10^4/g in the control sausage and at 2 days it increased to approximately 10^5/g (Fig. 2, control). In comparison, the total bacterial count in the experimental sausage (Fig. 2, starter) at 2 days was approximately 10^7/g. The total bacterial count of the experimental sausage rapidly increased and the pH value was lower (Fig. 3) during the fermentation and drying process as compared to the control sausage. As may be surmised, the starter culture bacteria were the predominant microflora in the soft salami sausage during the fermentation and drying process.
When *Sta.aureus, E.coli, Sal.choleraesuis*, *Y.enterocolitica*, *Cl.perfringens* and *B.cereus* were inoculated at levels of 10^3/g, in soft salami sausage, *Cl.perfringens* and *B.cereus* counts decreased to the detection limit for the fermentation process in both the control and experimental sausages. In the control sausage (Fig. 4) *Y.enterocolitica* counts decreased to the detection limit for 5 days. *Sta.aureus, E.coli* and *Sal.choleraesuis* counts decreased for 15 days and 22 days. On the other hand, in sausages inoculated with starter culture (Fig. 5) *Y.enterocolitica* counts decreased to the detection limit for 4 days, *Sta.aureus* for 11 days, *E.coli* and *Sal.choleraesuis* for 15 days. When the pH and wa value decreased to levels lower than 5.1 and 0.91 (Fig. 6 and 7) all pathogenic strains of bacteria used in this study were decreased. The decreases were more noticeable in the starter culture inoculated sausage than in the control sausage.

Conclusions:
Starter culture inoculated at a 10^6/g concentration grew rapidly and maintained itself as the predominant microflora of soft salami sausages during fermentation and drying process . When *Sta.aureus, E.coli, Sal.choleraesuis, Y.enterocolitica, Cl.perfringens* and *B.cereus* were inoculated at levels of 10^3/g, *Cl.perfringens* and *B.cereus* counts decreased to the detection limit during fermentation. *S.aureus, E.coli, S.choleraesuis* and *Y.enterocolitica* counts also decreased with the drying time; the decreases being more marked in the starter culture inoculated sausage than in uninoculated sausage.

Pertinent Literature:
Yutaka Morioka, Hideo Nohara, Miho Araki, Miki Suzuki, Masahiro Numata, Anim. Sci. Technol. (JPN) 67 (2) : 204-210, 1996

Chill — Meat,-1 ℃

Grind Ⅰ — Beef, 3.3mm,

Grind Ⅱ — Pork, 1.0mm

Cube — Pork backfat 2.0mm ^{3}, freeze

Mix — Addition of dry and curing ingredients
(bacterial starter culture 10^6/g and pathogenic bacteria 10^3/g)

Stuff — Stuff into cellulose casings (3.5cm in diameter)

Ferment — 30 ℃ , R.H.100 % , 2 days (Smoke, 30min.)

Dry — First 10days, 15 ℃ , R.H. 90 %
Next 10days, 15 ℃ , R.H. 80 %

Fig. 1 Processing procedure of soft salami sausages

Table 1. Ingredients of soft salami sausage

Ingredients	Rate
Lean pork	50.00%
Lean beef	25.00%
Pork fat	20.00%
Sodium chloride	2.50%
Sodium nitrite	200ppm
Sodium ascorbate	0.10%
Sodium glutamate	0.30%
Glucose	1.00%
Spice	0.85%

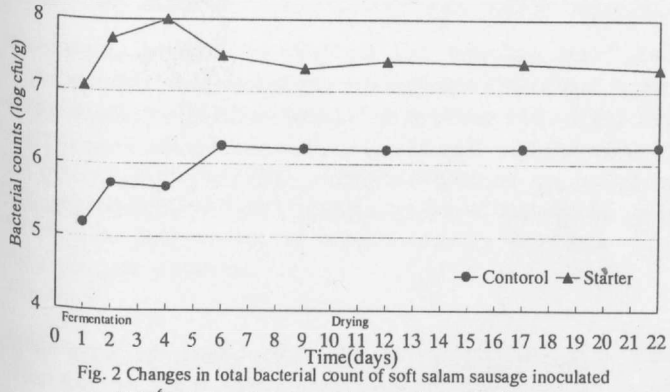


Fig. 2 Changes in total bacterial count of soft salam sausage inoculated with 10^6/g starter culture during fermentation and drying process

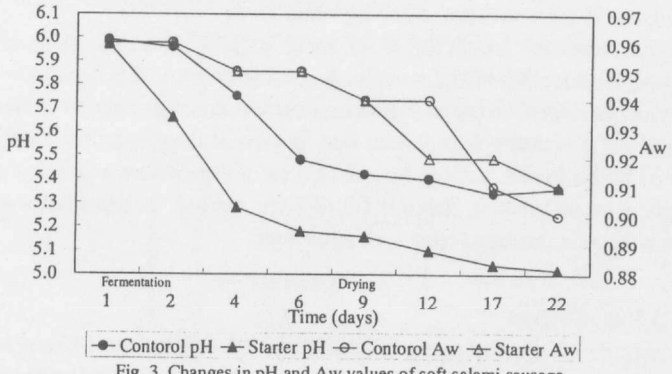
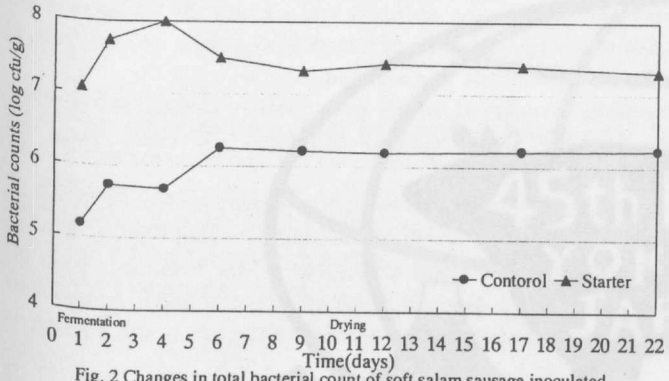


Fig. 3 Changes in pH and Aw values of soft salami sausage inoculated with starter culture during fermentation and drying process



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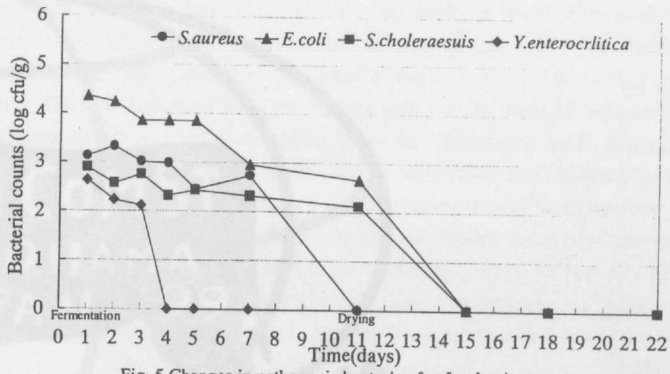

Fig. 5 Changes in pathogenic bacteria of soft salami sausages inoculated with starter culture during fermentation and drying process

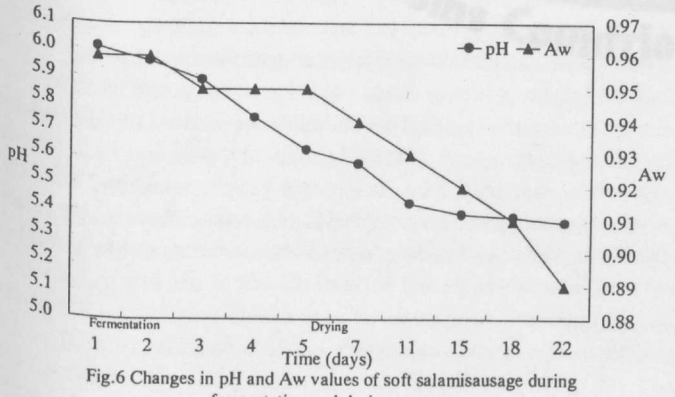

Fig.6 Changes in pH and Aw values of soft salamisausage during fermentation and drying process

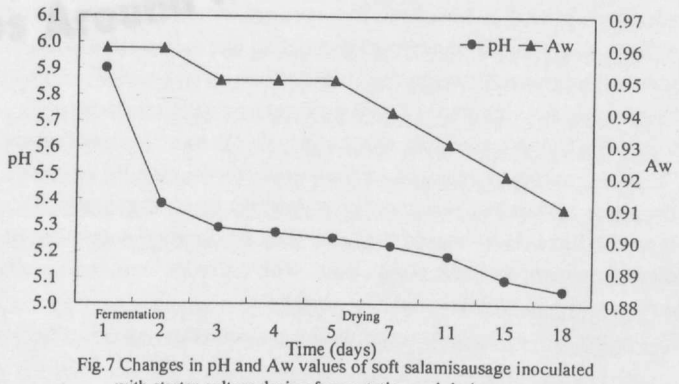

Fig.7 Changes in pH and Aw values of soft salamisausage inoculated with starter culture during fermentation and drying process

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