# PROCESSING OF PERMENTED SAUSAGE USING STARTER CULTURES

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Summary: The purpose of the present research was to study the relative effects of starter cultures used in the dairy industry over the natural fermetation in processing of fermented sausages. Three strains of lactic acid bacteria, namely, Lactobacillus acidophilus, Lactobacillus plantarum and Streptococcus lactis were used. The type of starter culture and duration of fermentation significantly affected the pH, titrable acidity and percent loss of weight of sausages during ripening. The control group of sausages, without any starter had highest ultimate pH whereas L. acidophillus had lowest. Titrable acid content was maximum in the sausages treated with L. plantarum followed by S. lactis, L. acidophillus and control group. Control group had least weight loss and sausages with L. plantarum had greatest loss. Organoleptic attributes were highest for the sausages made with L. plantarum.

## Introduction

Fermented sausages are produced in Goa (India) by traditional processing method without the addition of starter culture. In such sausages lactobacilli appear as natural contaminants and produce acid in favourable situation. The lactobacilli lower the pH and exert an inhibitory effect on other spoilage organisms (Ninivaara, 1955; Daly et al. 1973; Niskanen and Nurmi, 1976). Although the acid production is important in fermentation of sausages, the other factors viz. the type of acid, hydrogen peroxide, antibiotic type compounds and some metabolities are also involved (Tagg et al., 1976, Schillinger and Lucke, 1991). The traditional production practices suffer due to lack of uniformity in quality and frequent spoilage of the product leading to foodborne illness. The use of starter cultures under controlled condition for the processing of fermented sausages has becomne commercial practice in USA and Europe. Starter cultures are widely used in milk industry in India but commercial starter for meat fermentation is not available in this country. In the present experiment the starter cultures available from milk industry were used for the processing of fermented sausage and their effects on fermentation, ripening process and quality of the sausage were investigated.

## Materials and Methods

Processing of sausages: Lean pork procured from local market was trimmed of fat, packaged in polyethylene bags and stored at -20°C until used. Fat from the same animal was also collected and stored like lean. Before use the lean and fat was tempered at 4±1°C for 12 hours. Partially thawed meat was ground twice in a meat grinder by passing through 9 mm plate and once through 5 mm plate. Fat cubes were ground once through 5 mm plate. Nine parts lean and one part fat were weighed separately and mixed throughly by hand and divided into four equal portions of one kg each. One part was taken as control and three parts for the individual starter cultures viz. Acidophillus, L. plantarum and S. lactis. In all groups 20 gm sugar, 20 gm sodium chloride, 0.156 gm sodium nitrate, 0.078 gm sodium nitrite and 1.0 gm spices was added. Spices contained mixture of black pepper 25%, nutmeg 10%, red pepper 8%, cloves 5%, cinnamon 5%, cardamom 5%, cumin 5%, coriander 15%, ginger 10%, mustard 7% and mace 5%. All ingredients were sprinkled over the ground

meat and mixed for half minute. Sugar was added at the end and mixing continued for another two minutes in a Bowl chopper (Hobart make). The mixed ground meat was kept for 8 hours at 4°C.

Culture inoculation: Freeze dried vacuum sealed ampules of L. acidophillus, L. plantarum and S. lactis were obtained from National Dairy Research Institute, Karnal. Lactobacilli cultures were revived in tomato juice broth and streptococci in the yeast and dextrose broth. After the revival of cultures they were activated in litmus milk broth and maintained in skim milk broth. As per experimental need fresh milk broth was prepared and starter culture was inoculated to it from the maintenance media. After 48 to 72 hours of incubation at 37°C the total lactic counts was taken as per procedure described in APHA (1976). Amount of starter cultures in per ml was calculated to be poured to the meat batter and volume was adjusted by adding 5 ml of distilled water.

Starter cultures of $10^8$ concentration were added to the three portions of meat batters and one portion was taken as control. After addition of cultures the meat batters were mixed at medium speed for ½ minutes separately . Control portion was also mixed for another ½ minute. Final sausage mix was stuffed into pig casings through a hand operated sausage stuffer.

Fermentation and Drying: Stuffed sausage chubes were kept in humidity chamber for fermentation and drying for 12 days as per following schedule:

| Temperature | Relative humidity | Days |
|---|---|---|
| 24-20°C | 85-90% | 2 |
| 20-15°C | 75-80% | 2 |
| 15-10°C | 55-60% | 8 |

The weight loss, titrable acid and pH were noted during fermentation and drying phase. For estimation of pH, 10 gm of sausage meat was blended for 10 minutes with 100 ml distilled water in a mixer. The pH of homogenate was recorded by a pH meter. After measurement of pH the meat slurry was titrated with 0.1 (N) NaOH solution to an end point of alcoholic phenolpthalin, i.e. pH 8.30. The m eqv of NaOH required for the titration of the sausage sample were converted and expressed as percent lactic acid. The method described by Keller et al. (1974) was followed for determination of the percent weight loss of the fermented sausage.

After 12 days sausages were kept at room temperature and sensory attributes were evaluated on 7 point hedonic scale by a panel of ten judges.

**Results and Discussion**

The most important objective of fermentation in processing of this type of sausage is to achieve low ultimate pH in the product. All the starter cultures used in the present experiment were effective in lowering down the pH of the sausages. The drop of pH value below 5 from 6.01 within 24 hours of fermentation was achieved in all the groups of sausages having starter culture. A rapid decline of pH is recommended for manufacture of fermented sausages (AMI, 1982). On the 8th day, sausages treated with starter showed lowest

pH as compared to the untreated control which had highest pH. The mean and SE for the overall pH chages and titrable acid (Lactic acid) on 8th day of processing are presented in Table 1.

Table 1: Effect of different starters on the changes of pH, titrable acid and weight loss during ripening process, (overall Mean±SE)

| Treatment | pH | | Percent titrable acid | | Percent weight loss | |
|---|---|---|---|---|---|---|
| | 0 day | 8th day | 0 day | 8th day | 3rd day | 12th day |
| Control | 6.017 | 5.185[a] | 0.027 | 0.412[c] | 2.097[c] | 9.331[c] |
| | ±0.031 | ±0.019 | ±0.004 | ±0.002 | ±0.327 | ±0.705 |
| L. acidophillus | 6.017 | 4.715[c] | 0.027 | 0.874[c] | 9.835[b] | 19.799[b] |
| | ±0.031 | ±0.064 | ±0.004 | ±0.049 | ±0.313 | ±0.823 |
| L. plantarum | 6.017 | 4.750[c] | 0.027 | 0.936[a] | 10.645[a] | 22.902[a] |
| | ±0.031 | ±0.066 | ±0.004 | ±0.051 | ±0.218 | ±0.926 |
| S. Lactis | 6.017 | 4.948[b] | 0.027 | 0.917[a] | 9.578[b] | 19.795[b] |
| | ±0.031 | ±0.059 | ±0.004 | ±0.053 | ±0.343 | ±0.960 |

Mean value having common superscripts do not differ significantly (P 0.05).

In control group the fermentation was dependent on natural contaminants present in meat. The minimum pH value (5.2) for the control group was higher than the recommended value (4.5 - 4.7) for fermented sausages, which is generally accepted as the upper limited for safety and quality of the product (Deibel et al., 1961). The sausages containing L. plantarum and L. acidophillus as starter culture had reached the recommended pH. The different starter cultures had different rate of drop of pH. However, difference between the ultimate pH of L. acidophillus and L. plantarum was not significant. The significant difference was observed in the group treated with L. lactis which was also below pH 5.0 and pH of below 5.0 is considered sufficient to provide safety of the product, but chances of Staphylococcus aureus growth can be ruled out only below pH 4.7 (Bacus, 1984).

The three strains of bacteria were good producers of lactic acid in sausages. The quantity of lactic acid on the 8th day was about 1%. Acton and Keller (1974) reported the acid content in summer sausage - Cervelat and thuringer ranging between 0.5 to 1.5%. The present finding indicated that the three starters were effective lactic acid producers in fermented sausage.

After 12 days of ripening all experimental sausages showed significant difference in weight reduction. The percent reduction in weight was significantly higher in the sausages with lower pH i.e. in group treated with starter cultures. On the other hand, the control group of sausages having the highest pH showed minimum loss of weight. In general, the loss in percent weight recorded in the present study was rapid as compared to other reported values. Keller et al. (1974) stated that 30% loss of weight generally take more than 15 days of drying. In the present study only pork was used for the preparation of sausage and product made from pork looses moisture easily due to less water binding capaicity of pork protein in comparison to other meat proteins (Bacus, 1984).

The means for sensory scores are presented in Table 2.

Table 2 : Effect of startrs on the sensory scores of the fermented sausage, Mean±S.E.

| Treatment | Appearance | Flavour | Texture | Sourness | Overall acceptability |
|---|---|---|---|---|---|
| Control | $3.95^{c}$ | $4.10^{c}$ | $3.90^{c}$ | $4.15^{c}$ | $3.25^{c}$ |
| | ±0.45 | ±0.47 | ±0.40 | ±0.42 | ±0.50 |
| L. acidophilluss | $4.65^{b}$ | $4.55^{b}$ | $4.38^{b}$ | $5.93^{b}$ | $4.93^{b}$ |
| | ±0.48 | ±0.50 | ±0.49 | ±0.52 | ±0.55 |
| L. plantarum | $5.63^{a}$ | $5.75^{a}$ | 5.53 | $6.63^{a}$ | $6.15^{a}$ |
| | ±0.49 | ±0.42 | ±0.59 | ±0.58 | ±0.68 |
| S. tactis | $4.43^{c}$ | $4.66^{b}$ | $4.55^{b}$ | $5.86^{b}$ | $4.81^{b}$ |
| | ±0.50 | ±0.57 | ±0.57 | ±0.57 | ±0.75 |

Mean value having common superscripts do not differ significantly (P 0.05)

Sensory characteristics like appearance, texture, sourness, flavour and overall acceptability were significantly influenced by starter cultures. The sensory attributes had higher scores for the sausages prepared with L. plantarum over the other starters used. L. plantarum produced good flavour and tanginess to the product. Petaja (1980) also reported that L. plantarum is better aroma and flavour producer.

**Conclusion**

L. plantarum can be used as starter culture for the production of fermented pork sausage. However, it would be desirable to study if the combination of L. plantarum with other strain of bacteria can improve the quality of the product further.

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