A Research Note

Molds as Protective Cultures for Raw Dry Sausages

JOGINDER SINGH BERWAL* and DINCHEV DINCHO

Institute of Meat Industry, 65, Cherni Vrah Blvd., 1407 - Sofia, Bulgaria

(MS# 93-141: Received 17 August 1993/Accepted 15 August 1994)

ABSTRACT

Mold strains \( T_1 \) and \( T_9 \) belonging to Penicillium camemberti and \( N_1 \) of Penicillium nalgiovensis were used as protective cultures for production of raw dry sausages. Their use completely eliminated the growth of undesirable molds, originating from the natural house mycoflora, which often produce mycotoxins and lead to several other defects. Potassium sorbate (KS), an anti fungal agent, was also tested for protecting sausages against the growth of molds but its effect was short lived. The use of \( T_1 \), \( T_9 \) and \( N_1 \) mold strains also improved the organoleptic qualities of the sausages.

Key words: Molds, Penicillium, dry sausages, mycoflora

Raw dry sausages are popular meat products of most of the European countries and certain other parts of the world. A mold coating on raw dry sausages are considered to be an indicator of good quality and completion of the process of ripening by many manufacturers. The traditional source of molds on raw dry sausages is the natural house mycoflora. This often consists of heterogenous molds composed of representatives of different species and families (1-3, 9) in most of the cases Penicillium, Scopulariopsis and Aspergillus being the predominant molds. Many of these molds are undesirable and may lead to serious problems both for the consumer as well as producer. Molds belonging to the genera Aspergillus and Penicillium have been found to produce mycotoxins which are carcinogenic, toxic and terratogenic compounds (10, 13). Fink-Gremmals and Leistner (4) reported that Ochratoxin A (OA) is produced as secondary metabolite by various species of genera Penicillium and Aspergillus. Dry sausage manufacturers often try to find out ways to check this mold growth either by cleaning the sausages by the help of brushes which involves a lot of labor or by using antifungal chemical agents, which are neither advisable or very effective. Over the years, efforts have been made to isolate and select some desirable molds which could be used in the meat industry. The growth of desirable molds on the meat and meat products has been found to have positive effects on appearance, aroma, taste and preservation (11). It was in continuation to similar efforts of isolating molds for using them as protective cultures in meat industry that we conducted this study.

MATERIALS AND METHODS

Mold strains used

We used three strains of Penicillium. Two of these \( T_1 \) and \( T_9 \) belonged to species P. camemberti isolated, identified and selected by us (1). The third strain \( N_1 \) belonged to P. nalgiovensis obtained from the collection of Institute of Meat Industry, Sofia, Bulgaria.

Sausages

A Bulgarian raw dry sausage "Sredna Gora" was made as per Bulgarian national standards.

Application of protective cultures

The conidi were harvested from the 12 to 14 days old colonies of the three strains grown on Czapek-Dox agar. A conidial suspension containing \( 10^6 \) spores per milliliter and 15% skim milk powder was prepared for each individual mold strain. Separate suspensions were applied to three different groups of sausages as \( T_1 \), \( T_9 \) and \( N_1 \). Conidial suspension was applied on the surface of filled sausages by help of spraying.

Control

Two groups of control \( C_1 \) and \( C_5 \) were kept. The surface of the sausages of control group \( C_5 \) was treated with a solution of 10% KS (antifungal agent) along with 15% skim milk powder. The control group \( C_5 \) was treated with nutrient suspension containing 15% skim milk without conidi.

Ripening and drying of sausages

The sausages with different treatments were hung in rows in a drying room. The temperature of this room was monitored between 10 to 15°C and the relative humidity between 70 to 95% during the complete period of ripening and drying.

Organoleptic evaluation

The method of 9-point hedonic scale was used.
TABLE 1. Rate of growth of different mold strains on sausage "Sredna Gora."

<table>
<thead>
<tr>
<th>Sausage treatments</th>
<th>Day(s) of ripening period</th>
<th>1</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₅</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>±</td>
<td>±</td>
<td>±</td>
<td>±</td>
</tr>
<tr>
<td>C₇</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>±</td>
<td>±</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>T₁₁</td>
<td>-</td>
<td>±</td>
<td>+</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>T₁₉</td>
<td>-</td>
<td>±</td>
<td>+</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>N₇</td>
<td>-</td>
<td>+</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
</tbody>
</table>

- No growth.
± Scattered colony, spots of mycelial growth.
+ Good growth of molds.
++ Well formed mold coating which is continuous in appearance.
+++ Uniform, thick mold coating.

RESULTS

The process of ripening and drying the sausages was visually observed everyday to record the growth of molds (Table 1).

On the third day, the sausages treated with strain N₇ of *P. nalgiovensis* and T₁₁ of *P. camemberti* possessed growth but was more on the surface of sausages treated with strain N₇. After the 10th day, mold colonies were recorded on control C₅. These colonies were of different colors: green, black, white, and creamish. On the control C₅ group of sausages it was observed that till the 20th day, no mold growth was recorded but on the 23rd day, 4 to 5 colonies of molds were observed scatteredly. On the 30th day, the sausages treated with protective cultures of mold strains possessed uniform mold coating, which was white and thick in case of T₁₁ and T₁₉ strains of *P. camemberti*, whereas it was greyish white in case of strain N₇ of *P. nalgiovensis*. Mold growth belonging to a variable mycoflora including *Cladosporium* and *Aspergillus* was observed on the surface of C₅ and C₇ group of sausages. It was recorded that throughout the period of 30 days, the sausages treated with the three protective cultures possessed no other growth of molds except that of the strains used as protective cultures (Fig. 1).

FIGURE 1. Mold coating on sausages "Sredna Gora" after 30 days of ripening. These sausages are typical Bulgarian raw dry sausages. Sausage treatments are seen in the figure wherein N₇ = *P. nalgiovensis*; T₁₁, T₁₉ = strains of *P. camemberti*; C₅ = control; C₅ = KS.

The results of the organoleptic evaluation (Table 2) showed that the sausages ripened by using mold strain T₁₁ and T₁₉ of *P. camemberti* were found to be liked the most. They were also evaluated to be the best in terms of taste and aroma in comparison to C₅, C₇ and N₇. The sausages of group C₇ were preferred least.

TABLE 2. Organoleptic evaluation of sausages ripened by using different mold strains.

<table>
<thead>
<tr>
<th>Organoleptic attributes</th>
<th>C₅</th>
<th>D₇</th>
<th>T₁₁</th>
<th>T₁₉</th>
<th>N₁</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>6.6⁺⁰</td>
<td>6.2⁺⁰</td>
<td>6.2⁺⁰</td>
<td>6.2⁺⁰</td>
<td>6.2⁺⁰</td>
</tr>
<tr>
<td>Flavor</td>
<td>5.6⁺⁰</td>
<td>4.8⁺⁰</td>
<td>6.6⁺⁰</td>
<td>6.6⁺⁰</td>
<td>5.6⁺⁰</td>
</tr>
<tr>
<td>Consistency</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Taste</td>
<td>5.6⁺⁰</td>
<td>4.6⁺⁰</td>
<td>6.6⁺⁰</td>
<td>6.6⁺⁰</td>
<td>5.6⁺⁰</td>
</tr>
<tr>
<td>Overall acceptability</td>
<td>5.7⁺⁰</td>
<td>5.2⁺⁰</td>
<td>6.6⁺⁰</td>
<td>6.6⁺⁰</td>
<td>6.6⁺⁰</td>
</tr>
</tbody>
</table>

Means in the same row that are not followed by the same superscript letter are significantly different (*P*<0.05). n = 5.

Note: Results are based on 9-point hedonic scale.

DISCUSSION

Grazia et al. (6) used molds as starter cultures and reported that sausages ripened with molds as starter cultures were protected against undesirable molds and evaluated to be better for taste in comparison to control which possessed more acidic taste.

Mintzlaff and Leistner (12) studied the effect of *P. nalgiovensis* when used as a starter culture for ripening sausages and reported that it enhanced the product quality by improving the aroma and eliminating the undesirable molds. The production of aromatic compounds, which contributes to several desirable flavor notes by filamentous fungi has been established by several research workers (5, 7, 8, 14).

The use of KS as an antifungal agent did not prove 100% effective in our experiments as on the 23rd day some mold colonies were observed. Grazia et al. (6) reported similar findings in their experiments. It was concluded that the use of KS does not protect the sausage completely against the growth of undesirable molds.

From this study we found that the strains *P. camemberti* isolated by us could be used as a protective culture for the production of raw dry sausages. Their use could effectively protect the raw dry sausages from pathogenic and toxigenic molds which grow under natural commercial fermentation. In addition to this, they also improve the product quality.

REFERENCES