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REDUCTION OF PRODUCT HAZARD BY USING STARTER CULTURES IN RAW FERMENTED SAUSAGES

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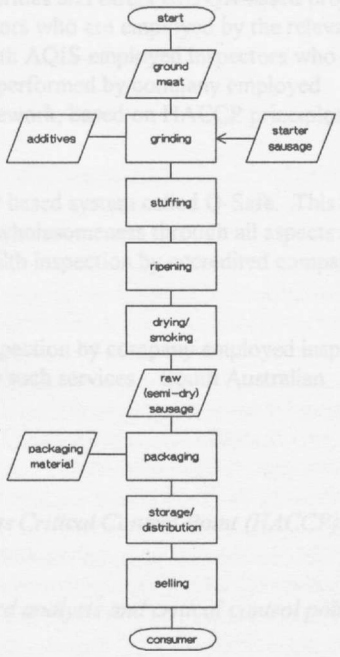
Introduction

The Hazard Analysis and Critical Control Point (HACCP) principle has been developed to avoid the presence of harmful numbers of pathogenic microorganisms in ready-to-eat foods.
In pasteurized meat products pathogenic microorganisms are controlled through close surveillance of the heating process and strict hygiene procedures during further handling. Because fresh deboned meat is not always free of pathogens, their presence in raw meat products cannot be totally avoided. The preparation of raw (semi-dry) sausage types, especially those with high pH values and/or ripened at higher temperatures, can be critical in this respect.

Raw sausage process

From a technological point of view preparation of raw (semi-dry) sausage is a rather simple and robust process. Heavy mistakes have to be made before noticeable sensory deviations will occur. Nevertheless, pathogenic microorganisms are found in raw sausages. *Listeria monocytogenes* and *Staphylococcus aureus* are the pathogens of most concern in products of this type. Because the outgrowth of pathogens, unlike spoilage organisms, cannot always be detected by sensory assessment, the preparation process of raw sausage should be controlled by correct procedures and physical measurements such as temperature, time, pH and wateractivity.
Raw (semi-dry) sausages are made of a mixture of minced meat and fat together with sodium chloride, spices and, if desired other additives such as nitrite, nitrate and ascorbate.
This mixture is stuffed into a casing followed by a ripening and drying process under more or less standardized climatological conditions.
The production process is visualized in Figure 1.

Figure 1 Flow diagram for (semi dry) sausage

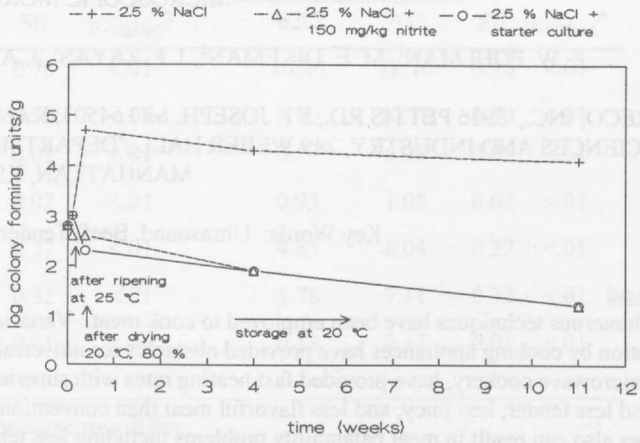


Starter culture

The ripening process is a particularly critical step in the preparation of raw sausage. The sensory quality and safety are determined to a great extent by the initial speed and degree of acidification. To be sure about a constant ripening process an appropriate starter culture should be used.
In the past TNO has spent a great deal of research on raw sausage preparation. This research was predominantly aimed at the selection of suitable starter cultures and the effect of these cultures on aroma production. Recently a new starter culture has been isolated according to the latest views in the field of starter culture selection. TNO starter cultures are supplied in the form of a so-called "starter sausage" in stead of a freeze dried culture. The advantage of this starter sausage is a more rapid onset of the growth of the starter culture in the production sausage resulting in a faster acidification.

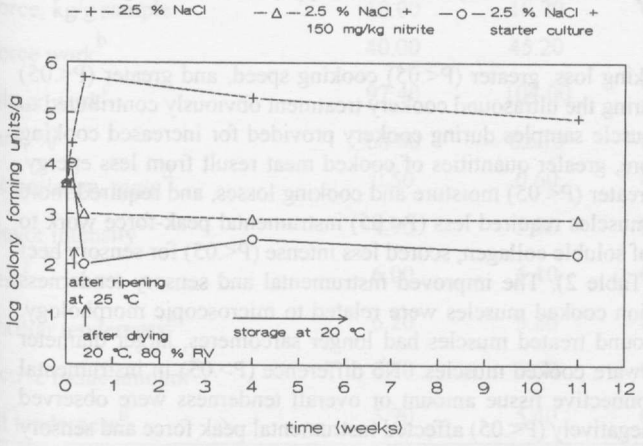
Challenge tests

Figure 2 Growth of L. monocytogenes inoculated in raw sausage prepared with NaCl, alone or in combination with nitrite or a starter culture



Experiments were carried out to determine the inhibitory effect of a TNO starter culture, a *Lactobacillus curvatus*, on the growth behaviour of the relevant pathogens mentioned above, inoculated in raw sausages of different composition and varying in ripening conditions. In Figures 2 and 3 examples are given of the development of pathogens in raw sausages prepared with 2.5 % sodium chloride, alone or in combination with 150 mg/kg nitrite or a starter culture. The results of the experiments showed that addition of 2 to 3 % sodium chloride is hazardous because of the possible development of pathogenic micro-organisms in the ripening phase, even when prepared and stored under refrigeration. Although nitrite has an obvious inhibitory effect on pathogens, addition of 150 mg/kg appeared to be insufficient, especially at higher ripening temperatures. In addition, 0.3 % Glucono Delta Lacton (GDL) can be used. However, GDL is known to have a detrimental influence on the taste of the product. In some types of raw sausage the red colour formed as a result of the use of nitrite is regarded as undesirable as well. A better way to suppress the development of pathogenic micro-organisms is the use of an appropriate starter culture with or without the addition of sodium nitrate. An active starter culture as supplied by TNO in the form of a starter sausage will prohibit the growth of pathogens even without addition of dextrose.

Figure 3 Growth of S. aureus inoculated in raw sausage prepared with NaCl, alone or in combination with nitrite or a starter culture



Acceleration of ripening

Up to now research was aimed at the selection of starter cultures. Much less attention has been paid to the formulation of the raw sausage and the preparation process. For optimum results, however, it is neccesary to adjust the process conditions exactly to the starterculture used. The time schedule as well as the temperatures used in the ripening and drying processes are determined more or less empirically.
In practice, the climate and time still are controlled either by hand or with a timer, often resulting in batch differences. Because fermentation is not always optimal variations might develop in product quality and risks with regard to product safety. Also, logistic problems may arise when the ripening time has to be prolonged because of insufficient acidification.
Progress is now being made at TNO in optimization of the ripening proces by modelling the most important process parameters. In this way the ripening process can be accelerated and the critical initial phase can be passed through more rapidly. Also, developments are being made towards a faster and more intensive aroma formation in raw sausage. These developments result in a more efficiently controlled raw sausage production and improved product quality and safety. Because pathogens are effectively controlled by this process an additional cooking step can be omitted.