INFLUENCE OF CURING TECHNOLOGY ON THE QUALITY OF RAW HAM

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SUMMARY

The quality of each product is highly influenced by the technology of manufacture. Raw ham quality is mainly determined by two factors: microbiological stability and cured colour formation. Both properties depend on the uptake and overall distribution of salt and the curing adjuncts nitrite and/or nitrate (saltpetre), respectively. Salt is reducing the water activity and in this way preventing microbiological development and nitrite is giving cured ham the typical colour. The penetration of salt into muscle tissue conforms to the laws of diffusion. The influence of salting technology and the effect of saltpetre on the quality of raw ham were investigated. The comparison of a tumbling with a practically orientated brine-curing technology for raw ham production -the latter often leading to curing faults- provided the following results: By using a tumbler the salting process could be accelerated and faulty products didn't occur. The addition of nitrate had no effect on the cured colour formation if the curing temperature was below 5.°C.

INTRODUCTION

The production of raw ham is mainly based on empirically found knowledge until now. There are a lot of different curing technologies, but most of them are lacking a scientific foundation. The difficulties of curing are seen first in the salting process, i.e. in reaching and distributing a defined amount of salt within a piece of meat, because salt penetration conforms to the laws of diffusion and is therefore depending on physico-chemical parameters (Palmia, 1991). Another problem is the proper selection of the curing adjunct -nitrite or nitrate. Though it is well known, that only nitrite is the substance, which reacts with the functional groups of the constituents of meat, the addition of nitrate is wide-spread in raw ham production. In modern conditions of meat technology the control of the microbiological state during the storage of fresh meat and in the first period of curing is exerted by temperature. After the salt content decreased the water activity to a level below 95 % (Hechelmann, 1980; Leistner, 1983) it is controlled by aw. There is no need of nitrate to prevent the growth of Clostridium species. From a sensorical point of view nitrate is not able to form cured colour and flavour. Nearly all of the added nitrate remains as residual nitrate in the retail product (Wirth, 1986). The purpose of our experiments was to compare a tumbling technology with a practically orientated brine-curing technology for raw ham production with regard to the following aspects: acceleration of the salting process and evaluation of nitrate used as curing adjunct.

MATERIALS and METHODS

For the evaluations short cut hams consisting of 'top side' and 'part of leg' were used. This kind of ham is composed of the following muscles: M. gracilis, adductor and semimembranosus; M. biceps femoris and semitendinosus. In one case ten deboned unskinned ham cuts were cured for 8 weeks in a saturated brine of nitrite curing salt (99.5-99.6 % NaCl plus 0.5-0.4 % $NaNO_2$) containing 200 ppm of nitrate according to a usual handycraft technology. The curing room temperature was about 5°C. Chemical evaluations were conducted at 8 and 47 weeks after cure application. In the other case 14 deboned skinned and coarsely defatted ham cuts without intermuscular fat were dry salted in a cooling tumbler for about 24 hours with an effective tumbling time of 90 minutes. The only ingredient was nitrite curing salt in an amount of 6 % of the weight of the raw material. Seven tests with 2 hams in each case were carried out at 1, 4, 8, 15, 22, 29 and 42 days.

The analyses included the determination of sodium chloride and nitrite, nitrate and water content as well as the measurement of pH and water activity. Probes were devided into a surface and a core section. Sensorical judgements were made by a three-member panel.

RESULTS and DISCUSSION

The production of raw ham is a complicated process depending on salt penetration into the muscle and on water removal, the determining factors of the technology. These investigations were conducted to quantify the salt uptake of meat in dependence on the curing technology and to compare the curing effect of nitrate with that of nitrite.

The results in Figure 1 show, that in the case of brine-curing it takes a long time to reach a salt content, which is sufficient for achieving microbiological stability of a product. After 8 weeks of brine-curing the salt content was about 2.5 %. The factors responsible for this are: 1. Skin and subcutaneous fat, which can be considered nearly impermeable to salt ions, covered about 50 % of the ham surface. 2. The intermuscular fat between 'top side' and 'part of leg' had not been removed, so that salt penetration only took place from the surface area which was free of skin and fat. 3. The hams were packed very tightly in the curing tank and the meat:brine-ratio was 5:1. So the contact between meat surface and brine and the effective amount of salt were highly restricted. It can be assumed, that the decay of the hams was only prevented by the low curing temperature.

The tumbled hams provided more satisfying results. The products could already be considered as stable after 4 days of curing. They had a salt content over 4.5 %, and a corresponding water activity of 0.96. These results were caused by changing the technological procedure including the cut of the raw material. The meat pieces were trimmed off skin and intermuscular fat, so that the specific surface of the ham cut was enlarged thereby facilitating the assimilation the salt ions by diffusion. The second factor intensifying the salt uptake was the tumbling process. The effect can be described as follows: A defined amount of salt calculated from the totel amount of meat can be rubbed into the surface section of the hams within a relatively short period of time. In the consequence a high concentration gradient between surface and core section was produced which contributes to the acceleration of diffusion. In addition this process was supported by the subsequent removal of water by drying (Rödel and Hofmann, 1982). Because of the opposite direction of water diffusion the concentration gradient of the salt was enhanced twice.

The comparison of the curing adjuncts nitrate and nitrite concerning their curing effect and chemical behavior led to expected results (Figure 2 and 3). In the case of brine-curing with a brine containing app. 1200 ppm of nitrite and 200 ppm of nitrate the nitrite content of the hams was below 3 ppm after 8 weeks of curing, while nitrate levels were on the average 140 ppm (max. 170 ppm). After 47 weeks the final products with retail quality were investigated. The values for nitrite and nitrate amounted to about 6 and 220 ppm, respectively. This lack of nitrite was confirmed by the sensory evaluation; the panel identified a curing fault with the following characterisation after the curing period: The core surrounded by a red ring of 8 cm diameter was coloured grey to pale pink. This phenomenon could also be found in the final products. That means, that there was not enough nitrite available for good cured colour formation, although sufficient nitrate was present within the hams. The development of that red ring may be due to microbial or biochemical reactions. They were possible because of the low salt content, which was relatively constant over a long period of time. The hams produced without nitrate and by application of the tumbling technology showed a residual nitrite content of about 20 ppm in the final product with a sensorically very acceptable cured colour. Despite of this it is remarkable, that the residual nitrate reached values over 100 ppm calculated as potassium nitrate.

CONCLUSION

Most of the ham products with curing faults seem to be caused by the curing procedure. Though the curing process follows the laws of diffusion and the possibilities for the acceleration of salt diffusion in meat, especially for raw ham production, are limited, the proportion of faulty products can be decreased using an appropriate technology. According to the results of our investigations it is suggested to use a tumbler for the salting process. So it is possible to control the uptake of salt and curing adjuncts by the meat in a defined range. There is no need for nitrate as curing adjunct, if the curing temperature is below 5 °C.

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Brine-cured hams with nitrate as curing adjunct

Hams salted by a tumbler, only with nitrite as curing adjunct

Fig. 1: Salt content (NaCl)

Fig. 2: Nitrite content

Brine-cured hams with nitrate as curing adjunct

Hams salted by a tumbler, only with nitrite as curing adjunct

Fig. 3: Nitrate content