

STUDIES ON THE PREPARATION AND UTILIZATION OF HOG SMALL INTESTINE II. EFFECT OF SALTING LEVEL ON THE QUALITY CHARACTERISTICS OF SMALL CASINGS

K. T. Lee¹, H. R. Kim² and K. Kataoka²

Department of Food Science, Kangnung National University
Kangnung-si, Kangwon-do, Korea

Summary

This study was carried out to examine the salting and desalting of small casings from hog and to determine the shelf-life during cold storage. The concentration of salt in the casings equilibrated with that of the added salt after 1 day for 10%, after 2 days for 20% and after 7 days for 40% salting level. During desalting at 15 and 30°C, residual salt concentrations in the casings decreased to less than 1% after 1 hour for 10% salt, after 12 hours for 20% salt and after 24 hours for 40% salt. The total colony count of the freshly prepared casing was about \log_{10} 4.2. The initial microflora of the prepared casings was dominated by lactic acid bacteria. The higher the salting level, the greater the microbial growth was suppressed during 6 months of storage at refrigerator temperature (4°C). A salt content of 20% is satisfactory if the casings are being stored for less than 1 month before being used.

(Key Words: Casing, Salting, Quality Change, Hog)

Introduction

The disposal of animal by-products is a problem for slaughterhouse management. A lot of inedible animal by-products are improperly processed and thus contribute to environmental pollution. If adequately processed, these materials can be utilized as high-value supplementary food materials. Among the intestinal tract of animals, the small intestine is often used as a sausage casing. However, its practical utilization has been poorly studied.

When hog small intestine is to be processed as a casing, its product shelf-life and quality changes during storage must be examined. Salt is usually added to give additional stability during storage. However, longer storage could adversely affect the tenderness of the casing (Scheid, 1962). Schweigmann and Seeger (1988) showed that about one-third of the hog small casings examined in the German market had a salt concentration between 10 and 20%. Commercial salt-packed casings are normally prepared by rubbing the cured casings with 40-60% salt and packing the casings

in barrel (Riha and Solberg, 1970). Excessive salt addition is not only wasteful but can also cause quality loss and require longer desalting times. This is not necessary for domestic casings that will be used within a relatively short period of time. The salted level could be adjusted depending upon the distribution and storage time before the casings are used by the consumer.

The present study was undertaken to provide information for developing a hygienic and rational way to process hog small intestines for use in large-scale sausage production. For this reason, the proper salting level, casing desalting time and microbial quality during storage were examined.

Materials and Methods

Small intestines were carefully obtained from twelve freshly slaughtered pigs and were processed and manufactured into casings according to a standard procedure (Kim et al., 1990). To the prepared casings, 10, 20 and 40 dry weight percent salt (w/w) were added and the product was stored in a refrigerator at about 4°C for one week. The salt concentration after salting was determined at 1, 2, 3 and 6 hours. Casing desalting was carried out in a beaker containing about 200 times the casing weight in tap water. The temperature was controlled at 15 or 30°C respectively. The salt concentration during desalting was determined at

¹Address reprint requests to K. T. Lee, Department of Food Science, Kangnung National University Kangnung-si, Kangwon-do, Korea.

²Faculty of Animal Products Technology, Okayama University, Okayama, Japan.

Received November 24, 1993

Accepted June 21, 1994

1/2, 1, 2, 4, 6, 12 and 24 hours. The salt (NaCl) content in casings was measured by the Volhard's method (Aurand et al., 1987) after the casings were ground up. The microbial changes in salted casings

stored at refrigerator temperature (4°C) for up to 6 months was investigated. The conditions for the microbiological evaluations are shown in table 1.

TABLE 1. NUTRIENT AGARS AND INCUBATION CONDITIONS FOR THE MICROBIOLOGICAL ANALYSIS OF HOG SMALL CASINGS

Microorganism	Agar	Incubation condition	Counting of colony
Total mesophile aerobes	Standard 1 (Merck 7881)	37°C/2 days	total
Total mesophile spore forming aerobes*	Standard 1 (Merck 7881)	37°C/2 days	total
Lactic acid bacteria	MRS (Merck 10660)	37°C/3-4 days	catalase negative
Enterobacteriaceae	DHL (Merck 1143)	37°C/1 day	oxidase negative
Micrococcus/Staphylococcus	KRANEP (Merck 5395)	37°C/2 days	total

* Heat shocked at 90°C for 30 min.

Results and Discussion

Equilibration of salt concentration during curing

The changes in the salt concentration in the casings during curing are presented in figure 1. The time at which the salt concentration in the casing was equilibrated with the added salt was 1 day for 10%, 2 days for 20% and 7 days for 40% salting level respectively. At the 40% level, the salt concentration was maintained at approximately 38%, which is the maximum solubility value of salt in water. Therefore, some undissolved salt is present on the outside of the casing. This excessive salt did not have any practical effect on improving the shelf-life of the casing.

Residual salt concentration after desalting

Salted casings should be desalted before being stuffed with sausage emulsion. In a mass production system, the desalting method and time must be standardized to control the residual salt concentration in the casing. Improper desalting can increase the salt concentration of the sausage product. Therefore, the salt concentration in the sausage formulation should be reduced. The solubility of salt soluble meat proteins decreases as the salt level decreases, and therefore the sausage

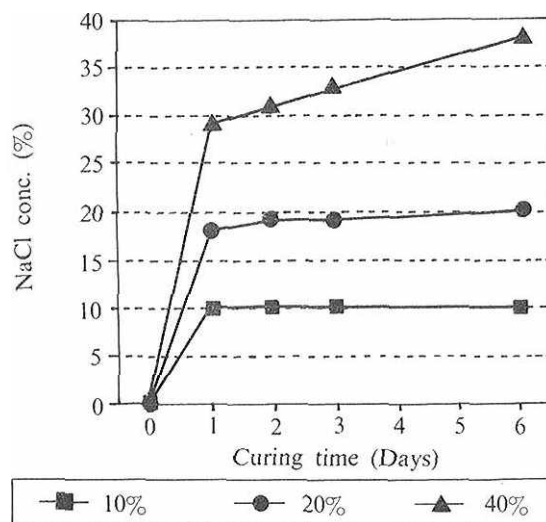


Figure 1. NaCl concentration in small casings after desalting with various salt levels as a function of curing time at 4°C.

emulsion stability will decrease (Bechtel, 1986). Thus, the casings should be desalted to allow the current level of salt in the emulsion.

The residual salt concentrations after desalting as functions of time and temperature are presented in figure 2 and 3. The salt concentrations in the

HOG SMALL CASINGS

casings decreased rapidly within 30 minutes at both 15 and 30°C, with desalting being quicker at 30°C. When the desalting time was more than 30 minutes, the rate that the residual salt concentration decreased was considerably slower. The residual salt concentration was less than 1% after 1 hour for 10% salting level, after 12 hours for 20%, and after 24 hours for 40% respectively. Casings

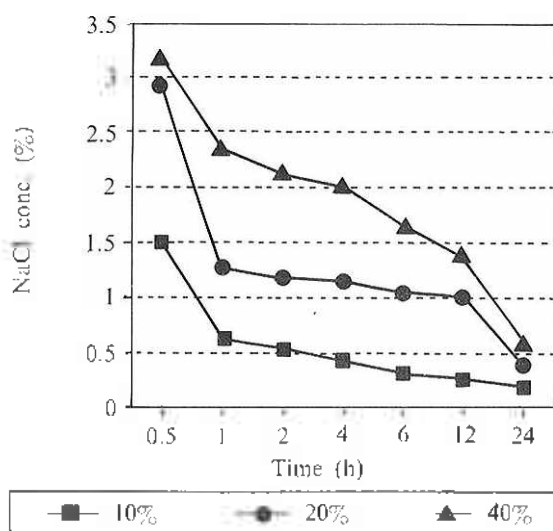


Figure 2. Residual NaCl concentration in small casings with various initial salting levels after desalting at 15°C.

Microbial behaviour of salted casings during cold storage

Natural casings are contaminated with various microorganisms including *Bacillus*, *Pseudomonads*, *Clostridium*, *Micrococcus*, *Proteus*, *Staphylococcus*, *Enterobacteriaceae* and *Lactobacillus* etc. (Pezacki, 1974). The storage life of casings is very dependant on the way they were processed. A colony count of between \log_{10} 3.7 and \log_{10} 4.6 is regarded as normal (Bogdanov, 1968). Rinsing with water reduced the microbial loading on the prepared casings. Kim et al. (1990) reported that the total colony count of hog small intestine could be as high as \log_{10} 5.71, but decreased to \log_{10} 3.78 after rinsing and salting.

The total colony count of freshly prepared casings was about \log_{10} 4.2 (table 2). The initial microbial flora of the prepared casings was composed mainly of lactic acid bacteria and *Enterobacteriaceae*, which supported by the observations

that had been salted to 40% had a residual salt level of 1.98% after 2 hours and 1.63% after 4 hours respectively desalting at 30°C. These salt concentrations correspond with that of sausage emulsion, which means that the casing could be used for stuffing after the above mentioned desalting times.

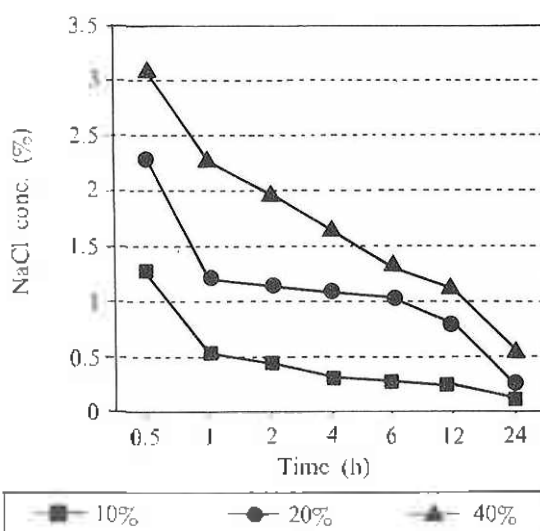


Figure 3. Residual NaCl concentration in small casings with various initial salting levels after desalting at 30°C.

of Kim et al. (1990) and Pearson and Dutson (1986). The *Micrococcus/Staphylococcus* and spore forming aerobes counts were \log_{10} 2.14 and less than \log_{10} 2.01 respectively.

The total colony count increased with storage time in the casing salted at 10%, but decreased in the casings salted at higher levels. The higher the salt content, the stronger this effect (table 2). This indicates that salt has an inhibitory effect on microorganisms in casings at salt levels higher than 10%. In the casings salted at 10%, lactic acid bacteria could multiply, but very slowly. At 10% salt content, *Enterobacteriaceae* growth was inhibited. Abbar and Tahir (1989) reported that the initial *Enterobacteriaceae* count of about \log_{10} 7.0 was reduced by 4 log units in the casings at about 20% salt level after one week storage. These results demonstrate that gram positive bacteria are more resistant to low salt levels than gram negative bacteria. However, lactic acid bacteria had

less tolerance to salt when the level was greater than 10%.

As long as the salt concentration was 20% or higher, spore forming aerobes did not grow over the storage time.

To produce salted casings with a shelf-life of

180 days, high salting levels, for example, 40% or more, are required as done in practice. However, lower salt levels may be satisfactory, if the casings are only being stored for a short time up to 30 days.

TABLE 2. CHANGES OF MICROBIAL COUNT (\log_{10} CFU/g) OF SALTED SMALL CASINGS DURING CHILLED STORAGE AT 4°C AS A FUNCTION OF SALT LEVEL

Microorg.	Salt conc. (%)		Days											
	10	20	0			30			90			180		
Total aerobes		4.20		5.04	3.65	3.78	6.28	3.60	2.18	6.33	3.12	2.18		
Lactic acid bacteria		3.37		3.52	3.63	3.23	3.68	3.05	2.35	3.85	2.30	2.30		
Micrococcus/ Staphylococcus		2.14		< 2.00	< 2.00	< 2.00	< 2.00	< 2.00	2.30	2.30	< 2.00	< 2.00		
Enterobacteria- ceae		3.27		2.45	2.60	2.30	< 2.00	< 2.00	2.30	2.30	2.30	< 2.00		
Spore forming aerobes		< 2.00		< 2.00	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00	< 2.00		

Acknowledgements

The authors acknowledge the Kangnung National University for financial support to carry out this study.

Literature Cited

- Abbar, F. M. and M. M. Tahir. 1989. Beef casings and finished beef sausages as a source of Salmonella in Iraq. *J. of Food Protection* 52:254-255.
- Aurand, L. W., A. F. Woods and M. R. Wells. 1987. Food composition and analysis. An AVI Book. Publ. Van Nostrand Co., N. Y., pp. 608.
- Bechtel, P. J. 1986. Muscle as food. Academic Press, Inc., London, pp. 182-184.
- Bogdanov, V. H. 1968. Technische Mikrobiologie von Lebensmittelprodukten. Verlag Lebensmittelindustrie,

Moskau, pp. 210.

- Kim, H. R., K. T. Lee and K. Kataoka. 1990. Studies on the preparation and utilization of hog small intestine casing. I. Quality characteristics as a raw material for sausage casing. *Korean J. Animal Sci.* 32:334-338.
- Pearson, A. M. and T. R. Dutson. 1986. Advances in meat research. Vol. 2, Meat and poultry microbiology. AVI Publ. Co., Westport, CT., pp. 17.
- Pezacki, W. 1974. Hygienische-technologische Fragen der Würstherstellungsverfahren. *Monatshefte für Veterinärmedizin* 29:290-295.
- Riha, W. E. and M. Solberg. 1970. Microflora of fresh pork sausage casings. 2. Natural casings. *J. Food Sci.* 35:860-863.
- Scheid, L. 1962. Geplatzte Bratwurst. *ATZ.* 96:4.
- Schweigmann, A. and H. Seeger. 1988. Untersuchungen zur Normbeschaffenheit von Naturdärmen. *Fleischwirtschaft* 68:970-978.