Utilization of beer and brewer's grains to tenderize a sausage casing

Sakata R. [1], Oshida T. [1], Nishiumi T. [2], Yoon H. [3] and Waga M. [1,4]

[1] School of Veterinary Medicine, Azabu University, Sagamihara 252-5201, Japan,
[2] Faculty of Agriculture, Niigata University, Niigata 950-2181, Japan, [3] New-Asia Trading, Osaka 541-0055, Japan
[4] Central Research Institute, Itoham Foods Inc., Moriya 302-0104, Japan

Abstract— **In this study treatment for casings which need improved mechanical property was investigated. Beer and other components were surveyed as tenderizers. The strength of casing was measured with a rheometer and maximum force and breaking strain were determined. It was demonstrated that beer has the effect of tenderizing hog casing. Subsequently, the effect of the soda water component and ethanol component of beer were tested separately. The casings which were treated with soda water significantly decreased in maximum force. On the other hand, the casings which were treated with 5% ethanol did not show a significant difference, but showed less flexibility. In addition, brewer's grains which contained a rich organic fraction were also investigated. It was found that brewer's grains tenderized hog casings significantly. This result suggests a new method for utilization of brewer's grains.**

Keywords—**Sausage casing, Tenderization, Beer and brewer's grains**

I. INTRODUCTION

Casing is an intestine membrane used for stuffing sausage. Natural and artificial casings are presently in use for this purpose. Animal origin casings are obtained from sources such as hogs, sheep, goats, cows and horses, which offer moderate bite-resistance and possess special texture, a property shown to be essential for human consumption. Natural casing is thus preferable to artificial types. Natural casing is also superior in aeration (smoke permeability) and elasticity. However, there are certain factors that may give rise to lack of uniformity in quality, such as animal age. Thus, processes to ensure adequate tenderization and uniform quality in other regards have thus become required world-wide [1]. It is also required that this processing be cheap, safe, convenient, prompt, and homogeneously treatable. Currently, natural casing is treated by enzymes and/or organic acids (lactic acid, acetic acid and citric acid) [2, 3], and/or trisodium phosphate at casing plants [4, 5].

Cooking with beer is a general technique to tenderize meat, an effect resulting from the action of carbonic acid and organic acids such as lactic acid or citric acid. Brewer's grains are a residue generated from beer production in the brewery. This by-product is obtained by filtration after fermentation of malt with barley material. Brewer's grains are a principal ingredient of malt, and contain a high amount of cellulose, lignin, proteins, and other components. The applications for food are few, though brewer's grain has been used chiefly as a feed for cattle, and its use as a biomass or other functional material has been investigated in recent years. Brewer's grains are rich in various constituents, and its effect can be expected to be similar to beer. Moreover, there are environmental and cost advantages. This study examines brewer's grain's tenderizing effect on Chinese hog casing.

II. MATERIALS AND METHODS

1. Mechanical property

Hog casing (Japan Ham & Sausage Processors Cooperative Association, Tokyo) processed in China was used in this study after being washed in water for desalting for a period of more than 6 hours in the summer season or 12 hours in the winter. Three experiments were carried out, using the following treatments: 1) beer; 2) 5% ethanol and soda water; 3) brewer's grains (10%, 50%). Unaltered beer (Kirin Brewery, Tokyo) and soda water (Suntory, Tokyo) were used for the experiment. The concentration of ethanol was fixed at 5%, which is the general alcohol concentration in Japanese beer. Brewer's grains (Kirin Echo, Tokyo) from Kirin beer brewery were used. The components of the brewer's grains are shown in Table 1. For each experiment, casing was maintained at 5°C, 12 hours, followed by washing in water for 10 min.

Casing strength was measured in all cases with a rheometer (Creep Meter Model RE2-33005S, YAMADEN, Tokyo). Maximum force and breaking strain of all samples were determined, 60 times for each.

Table 1. Component's of brewer's grains*

General (%)		Mineral (dry)		Vitamins (ppm, dry)		Amino acid (%, dry)	
Water	74.3	Ca	0.21%	Carotene	-	Ile	1.17
CP	6.9	P	0.50%	VE	27.0	Leu	2.02
C. fiber	4.1	Na	0.01%	VB	10.2	Lys	0.97
ADF	4.9	K	0.04%	VB	20.8	Met	0.47
NDF	16.1	Mg	0.22%	VB_{12}	0.00	Phe	1.44
DCP	5.0	S	0.21%	Choline	1800	Thr	0.93
TDN	18.2	Cl	0.12%	Pantothenic acid	3.5	Trp	0.35
NR	2.6	Mn	71ppm	Niacin	58.0	Val	1.56
		Cu	31ppm	VH	0.18		
		Co	0.09ppm	Folic acid	0.05		
		Zn	140ppm				

*Standard Table of Feed Composition in Japan, 2001

2. Statistical analysis

The *t*-test of the SAS system was used for this purpose. The control and any processed casings were examined to find any significant difference in maximum force and breaking strain.

III. RESULTS AND DISCUSSION

1. Beer treatment

Maximum force showed a significant decrease ($p<0.01$), and breaking strain tended to decrease with the application of beer treatment (Table 2). A decrease of 17.6% of maximum force was observed, demonstrating the tenderization function of beer. The components which caused the change in mechanical properties are assumed to be carbonic acid, alcohol or various types of organic acids. Due to cost it is evidently difficult to use beer as a tenderizer. Therefore, the purpose of the following experiments is to identify the components of beer which cause tenderization of hog casing and establish that these components have potential in the industry.

Table 2. Control and beer treatment strength values

	Control		Beer	
	Mean	SD	Mean	SD
Maximum force (g)	596.70^{a}*	100.71	492.09^{b}	15.09
Breaking strain (%)	47.55	5.22	44.68	7.78

*Means with different superscripts differ significantly ($p<0.01$).

2. Ethanol and soda water treatment

The purpose of this experiment was to investigate the effect of inorganic components on the mechanical properties of hog casings. Inorganic elements are suitable for industrial use as they are easy to control. With soda water treatment, the maximum force decreased significantly ($p<0.05$), suggesting that carbonic acids may be one of the causes of tenderizing brought on by the beer processing. In the 5% ethanol treatment, a significant difference was not observed on maximum force. Furthermore in the case of breaking strain, it was observed that distortion decreased with 5% ethanol soaking treatment, suggesting that ethanol in beer makes hog casing less flexible (Table 3). Although tenderizing was shown in soda water treatment, the maximum force decreased by only 8.5%, which is lower than with beer treatment. This indicates that there is another cause of tenderization also involved in beer treatment, and other components of beer require investigation.

Table 3. Control, 5% ethanol and soda water treatment strength values

	Control		5% ethanol		Soda water	
	Mean	SD	Mean	SD	Mean	SD
Maximum force (g)	543.79^{a}*	77.79	514.44^{a}	77.67	497.82^{b}	85.20
Breaking strain (%)	42.10	3.32	39.86	4.66	43.39	5.07

*Means with different superscripts differ significantly ($p<0.05$).

3. Brewer's grains treatment

The action of brewer's grains containing rich organic fraction was also investigated. In case of the 10% brewer's grains treatment, maximum force was observed to decrease significantly ($p<0.01$) by 19.7% of maximum force. However, with the 50% treatment, there was no significance difference on maximum force and breaking strain (Table 4). It was assumed that because a liquid state was not achieved in the case of 50% brewer's grains treatment, the processing medicine did not adhere to the surface of the casing. This suggests that the component of brewer's grains that softens the hog casing is soluble in water.

Table 4. Control and brewer's grains (10%, 50%) treatment strength values

	Control		10%		50%	
	Mean	SD	Mean	SD	Mean	SD
Maximum force (g)	756.13^{a}*	97.23	607.46^{b}	113.38	754.92^{a}	101.03
Breaking strain (%)	39.84	4.31	40.97	4.85	42.64	6.64

*Means with different superscripts differ significantly ($p<0.01$).

IV. CONCLUSIONS

The effect of beer on casing tenderization was demonstrated in this research, and it was suggested that carbonic acid and the components contained in the brewer's grains are related. This result suggests a new method for utilization of brewer's grains. Furthermore, the benefits of using brewer's grains from an environmental perspective were noted. Future studies should aim to determine the component of beer which causes tenderization.

ACKNOWLEDGMENT

The authors wish to thank Mr. J. Lynch, Azabu University and Mr. B. Gavin for their assistance with proofreading the English manuscript. This research was partially supported by a research project grant awarded by the Azabu University.

REFERENCES

1. Reichert EJ (1998) Methods of tenderizing edible sausage casing of animal origin. Fleischwirt 76: 393
2. Nishiumi T, Nojiri T, Yosihara T, Ichinoseki S, Suzuki A, Tanabe M, Sakata R (2005) High pressure with or without organic acids for tenderizing of Chinese hog casing. Proc. 51st International Congress of Meat Science and Technology, Baltimore, USA, 2005, T80
3. Sakata R, Segawa S, Morita H, Nagata Y (1998) Tenderization of hog casing. Application of organic acids and proteases. Fleischwirt 78: 703-704
4. Houben JH, Keizer G, Bakker WAM (2005) Effect of trisodium phosphate on slip and textural properties of hog and sheep natural sausage casing. Meat Sci 69: 209-214
5. Sakata R, Nakae S, Oshida T, Nishiumi T, Yoon H (2008) Abnahme von Stabilität und Bruchdehnung: Mechanische und biochemische Eigenschaften von mit Trinatriumphosphat behandelten Naturdärme. Fleischwirt 5/2008: 59-60