

## Effect of Ginger Rhizome Extract on Tenderness and Shelf Life of Precooked Lean Beef

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생강즙이 Precooked인 살고기 보존기간과 연화에 미치는 영향

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### 요 약

쇠고기를 양념하여 구워서 조리식품으로 만들때 사용하는 부가재료 중 생강이 고기에 미치는 영향을 연구한 결과 다음과 같은 것을 알 수 있었다.

① 고기를 재울때 소금을 넣지 않고 생강즙을 0.5~1.0%까지 넣어 자작하니 재워두었다가 구운 고기는 20~30%까지 부드럽게 개선되었고 소금을 2% 첨가하고 생강즙을 넣은 고기는 35~45%까지 부드러워졌다.

② 생강즙은 실험결과 고기의 산패를 늦추어 주었고 생강즙을 넣어 조리해서 Saran-Wrap을 가지고 2겹으로 포장해서 보관하거나 Vacuum처리하면 보존기간이 길게 되었다.

③ 생강즙은 고기의 질을 연하게 하였고 특히 진공 포장을 하지 않고도 조리식품으로 만들어진 제품으로 사용하기가 매우 편리할 것으로 생각된다.

### I. Introduction

In response to the pressure of "lean-conscious society", the beef industry is forced to focus on producing and effectively marketing lean beef and work to associate beef with active life-style and healthful living. However, a survey shows that consumers also place a high priority on taste or palatability when purchasing beef<sup>1)</sup>, and a certain amount of fat is needed for acceptable palatability. Savell and Cross<sup>2)</sup> reported that 3% chemical fat or slight marbling was the level of fat needed for acceptable palatability for beef cut from the rib and loin. One way of marketing lean beef without jeopardizing acceptable palatability is to modify the preparation and cooking methods. In oriental countries where old draft cattle were used for food, marination and cooking of thinly sliced beef was extensively employed for many centuries. Marination improves the palatability of marginally acceptable meat, and the recent trend shows increased marketing of ready-to-cook marinated meat products in retail stores.

One ingredient that has been used in marinated beef is ginger rhizome. Application of 0.5~1.0%(v/w) crude ginger extract greatly enhanced the tenderness of beef steaks and sliced beef<sup>3)</sup>. Ginger rhizome also was reported

to contain a potent antioxidant activity against heme-catalyzed lipid oxidation and extend the shelf life of fresh or precooked pork patties by three times at 4°C storage temperature<sup>5)</sup>. Improvement of tenderness and retardation of fat oxidation promises the usefulness of ginger rhizome in marinated ready-to-cook lean beef or precooked convenience beef products.

The objective of this study was to investigate the effectiveness of ginger rhizome on meat tenderness and shelf life of precooked lean beef from carcasses of marginal quality.

### II. Materials and Methods

#### 1. Ginger extract

Fresh ginger rhizome was purchased from a local supermarket. The rhizome was peeled, sliced, ground in a mortar with pestle, and squeezed through four layer of cheesecloth to produce a crude ginger extract.

#### 2. Preparation and treatment of beef.

Loin eye muscle from B maturity, select grade steer was sliced 4 mm thick, divided into 8 lots and treated as shown in Table 1. Meat samples were uniformly mixed with the appropriate solution of ingredients,

**Table 1. Experimental design**

Treatments	Sliced meat,g	Ginger extract,m/	Salt g	Water ml
T <sub>1</sub>	500	0	0	15
T <sub>2</sub>	500	2.5	0	12.5
T <sub>3</sub>	500	5.0	0	10.5
T <sub>4</sub>	500	7.5	0	7.5
T <sub>5</sub>	500	0	10	15
T <sub>6</sub>	500	2.5	10	12.5
T <sub>7</sub>	500	5.0	10	10.0
T <sub>8</sub>	500	7.5	10	7.5

held at 4°C for 1 hr, spread on a tray and broiled for approximately 4 min until no pink color was visible. Cooked meat samples of each treatment were either wrapped with Saran-wrap(no vacuum) or vacuum-package and stored in a refrigerator of 4°C.

### 3. Storage test

Rancidity test using 2-thionarbituric acid(TBA) method as described by Tarladgis *et al.*<sup>9)</sup> and microbiological assay using standard plate count method<sup>2)</sup> were performed on duplicate samples taken at 0, 2, 5, 8 and 12 days for Saran-wrap samples and at 0, 7, 14, 28, 35 and 47 days for vacuum-packaged samples. The TBA number was expressed as mg malonaldehyde per kg meat.

### 4. Tenderness test

Tenderness of broiled meat samples was determined using Lee-Kramer(LK) shear measurement as described by Lee<sup>3)</sup>.

### 5. Statistical analysis

Data were analyzed by analysis of variance with the BLM procedure of SAS<sup>7)</sup>.

## III. Results and Discussion

### 1. Effect of salt and ginger extract on meat tenderness

The treatment of meat slices with 0.5%(v/w) crude ginger extract decreased( $p < 0.05$ ) shear value by 20% in the presence or absence of salt in the formulation (Table 2). Further decrease of shear values was observed at higher concentrations of ginger extract, approximately 30 and 45% decrease at 1.0 and 1.5%. The inclusion of 2% salt alone decreased shear value by 20%. Tenderness improvement effect of salt and ginger extract was additive at all levels of extract, indicating that

**Table 2. Effect of ginger extract on meat tenderness**

Treatments	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>	T <sub>6</sub>	T <sub>7</sub>	T <sub>8</sub>
L-K shear value,								
Kg/20 g meat	140 <sup>a</sup>	113 <sup>b</sup>	101 <sup>c</sup>	75 <sup>d</sup>	112 <sup>b</sup>	90 <sup>c</sup>	79 <sup>d</sup>	60 <sup>f</sup>
Relative difference	100	81	72	54	80	64	56	43
	--	--	--	--	100	80	71	54

Each mean represents duplicate determinations. Mean with different superscripts differ significantly at  $p < 0.05$ .

**Table 3. Changes in TBA value during refrigerated storage of Saran-wrapped meat slices**

Treatment	Storage period, days				
	0	2	5	8	12
T <sub>1</sub>	0.5*	3.7 <sup>a</sup>	7.1 <sup>a</sup>	8.1 <sup>a</sup>	8.6 <sup>a</sup>
T <sub>2</sub>	0.3 <sup>ab</sup>	2.2 <sup>b</sup>	5.8 <sup>b</sup>	6.9 <sup>b</sup>	7.4 <sup>b</sup>
T <sub>3</sub>	0.1 <sup>b</sup>	1.7 <sup>bc</sup>	5.0 <sup>b</sup>	6.3 <sup>bc</sup>	7.4 <sup>b</sup>
T <sub>4</sub>	0.1 <sup>b</sup>	1.3 <sup>c</sup>	3.8 <sup>c</sup>	5.4 <sup>c</sup>	6.4 <sup>c</sup>
T <sub>5</sub>	0.4 <sup>a</sup>	3.8 <sup>a</sup>	7.4 <sup>a</sup>	8.2 <sup>a</sup>	8.7 <sup>a</sup>
T <sub>6</sub>	0.3 <sup>ab</sup>	2.8 <sup>b</sup>	5.8 <sup>b</sup>	6.6 <sup>b</sup>	6.9 <sup>b</sup>
T <sub>7</sub>	0.2 <sup>b</sup>	2.4 <sup>bc</sup>	4.8 <sup>b</sup>	5.6 <sup>c</sup>	6.8 <sup>b</sup>
T <sub>8</sub>	0.2 <sup>b</sup>	1.8 <sup>c</sup>	3.2 <sup>c</sup>	4.6 <sup>d</sup>	5.7 <sup>c</sup>

duplicate determinants. Superscript in the same column differ significantly at  $p < 0.05$ .

the ginger protease activity was not affected by the presence of salt. In the presence of 2% salt, 0.5% ginger extract was sufficient for acceptable tenderness, whereas 1.0% extract was recommendable in the absence of salt. In both cases, a 30% reduction in shear value was obtained compared with untreated controls. When crude extract exceeded 1.0% level, meat texture became overly soft and was unacceptable.

### 2. Changes of TBA values during storage

There was a rapid increase of TBA number during the first 5 days of storage, followed by a slower rate regardless of treatments (Table 3). However, a marked difference was observed in the rate of increase among treatments, T<sub>1</sub> and T<sub>5</sub> (0% extract) showing two times greater rate than T<sub>7</sub> and T<sub>8</sub> (1.5% extract) during the first 5 days of storage. At 0.5 to 1.0% crude extract which was the optimal level for tenderization without causing mushiness, it took 12 days to reach a TBA value of 7.0 compared with 5 days for untreated controls. The presence of salt did not appear to accelerate oxidation rate in the present study. The results demonstrated that ginger extract was effective in retarding the development of rancidity in precooked beef, and its effectiveness was directly related to the concentration.

**Table 4. Changes in TBA value during refrigerated storage of vacuum-packaged meat slices**

Treatments	Storage period, days				
	7	14	28	35	47
T <sub>1</sub>	0.8	0.8	1.5	2.0	2.3
T <sub>2</sub>	0.7	0.8	1.6	2.1	2.1
T <sub>3</sub>	0.6	0.7	1.4	1.6	1.8
T <sub>4</sub>	0.5	0.8	1.4	1.6	1.6
T <sub>5</sub>	0.6	0.9	1.5	2.0	2.1
T <sub>6</sub>	0.8	1.2	1.7	2.3	2.2
T <sub>7</sub>	0.8	0.7	1.1	1.4	1.8
T <sub>8</sub>	0.5	0.7	1.4	1.4	1.5

Each mean represents duplicate determinations.

**Table 5. Microbiological change during refrigerated storage of saram-wrapped meat slices(Total counts/g meat)**

Treatments	storage period				
	6 hr	2days	5days	9days	13days
T <sub>1</sub>	15	160	200	520	2760
T <sub>2</sub>	20	30	110	310	1420
T <sub>3</sub>	30	80	340	180	660
T <sub>4</sub>	10	70	40	160	280
T <sub>5</sub>	20	80	150	500	1200
T <sub>6</sub>	15	70	105	230	1300
T <sub>7</sub>	10	60	180	240	640
T <sub>8</sub>	10	50	110	180	320

stored at 4°C

for T<sub>1,5</sub> → It is acceptable up to 5 days.

for T<sub>2, T<sub>3</sub>, T<sub>6</sub>, T<sub>7</sub></sub> → it is acceptable up to 9 days.

for T<sub>4, T<sub>8</sub></sub> → It is acceptable up to 13 days.

**Table 6. Microbiological changes during refrigerated storage(4°C) of vacuum packaged meat slices(Total counts/g meat)**

Treatment	storaged period(week)				
	1	2	3	4	5
T <sub>1</sub>	60	150	1440	6200	18000
T <sub>2</sub>	40	80	350	2300	4500
T <sub>3</sub>	30	200	1600	8000	17000
T <sub>4</sub>	40	110	290	5000	19000
T <sub>5</sub>	60	160	1450	6000	17500
T <sub>6</sub>	40	85	600	2200	4000
T <sub>7</sub>	30	190	1500	7800	16000
T <sub>8</sub>	45	110	280	4800	17000

stored at 4°C

for T<sub>1, T<sub>2</sub>, T<sub>3</sub>, T<sub>5</sub>, T<sub>6</sub>, T<sub>7</sub></sub> → It is acceptable up to 2 weeks.

for T<sub>4, T<sub>8</sub></sub> → It is acceptable up to 3 weeks.

Lee *et al.*<sup>4)</sup> also reported similar results in pork patties. The inclusion of 0.5% extract in fresh or precooked pork patties retarded the rate of TBA value increase by 2.5 to 3 times compared with untreated con-

rols. Poste *et al.*<sup>6)</sup> reported a rapid increase of TBA value in precooked pork during the first 4 days of storage at 4°C followed by a small increase between 4 and 16 days. The off-aroma scores by trained panel correlated well with the TBA values during the first 8 days of storage. Because off-flavor is the major factor affecting the shelf-life of precooked meat products, the inclusion of ginger extract can extend the shelf-life by at least two times.

For vacuum-packaged beef (Table 4), the TBA values increased very slowly during 47 days of storage for all treatments. Though ginger extract at greater than 1.0% level tended to lower TBA values, the differences among treatments were low in magnitude and nonsignificant.

### 3. Microbiological changes during storage

No systematic increase of total bacteria counts or spoilage was detected during the storage periods for both Saran-wrap or vacuum-packaged beef samples. The inclusion of ginger extract did not pose any microbiological safety problems.

## References

1. AMI 1987. Giant Lean Awareness and Usage. Research report to the Center for Meat Marketing Research, American Meat Institute. February, (1987).
2. Clark, W.S. Jr., Brazis, A.R., Fowler, J.L., Johns, C.K., and Nelson, F.E. 1987. Standard plate count method. Chap. 5. In Standard Methods for the Examination of Dairy Products, 14th ed., E.H. Marth (Ed.), p. 77-94. Amer. Public Health Assn., Washington, D.C.
3. Lee, Y.B. 1983. A modified sample preparation method for measuring meat tenderness by the Kramer shear press. *J. Food. Sci.* 48: 304-305.
4. Lee, Y.B., Sehnert, D.J., and Ashmore, C.R. 1986a. Tenderization of meat with ginger rhizome protease. *J. Food Sci.* 51: 1558-1559.
5. Lee, Y.B., Kim, Y.S., and Ashmore, C.R. 1986b. Antioxidant property in ginger rhizome and its application to meat products. *J. Food Sci.* 51: 20-23.
6. Poste, L.M., Willemot, C., Butler, G., and Patterson, C. 1986. Sensory aroma scores and TBA values as indices of warmed-over flavor in pork. *J. Food Sci.* 51: 886-888.
7. SAS. 1982. SAS User's Guide: Statistics. SAS Inst. Inc., Cary, NC.
8. Savell, J.W., and Cross, H.R. 1988. The role of fat in the palatability of beef, pork, and lamb. In Designing Foods. D.L. Call (Committee Chair), p. 345-355. National Academy Press, Washington, D.C.
9. Tarladgis, B.G., Watts, B.M., Younathan, M.T., and Dugan, L.R. 1960. A distillation method for the quantitative determination of malonaldehyde in rancid foods. *J. Amer. Oil Chem. Soc.* 37: 44-48.