EFFECTS OF PACKAGING METHODS ON BINDING ABILITY IN RESTRUCTURED BEEF USING TRANSGLUTAMINASE

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Background

The development of fresh meat process was for the decrease of cost and energy during the processing, and by restructuring technology change of meat shape and composition. Restructured meat products are of increasing commercial importance to the meat industry (Donnelly & Purslow, 1987). The methods were developed for binding of fresh meat by mean of an enzymatically formed gel containing plasma components as essential ingredients. For restructured meat products, using the alginate, calcium carbonate and albumin for bind, has developed in restructured steaks and chops (Marriott al., 1983; Means and Schmidt, 1986; Schaake et al., 1993; Trout et al., 1989[a, b]). They investigated the textural characteristics, tensile strength, color and color stability in restructured meat. Recently, a binding method of fresh meat developed with transglutaminase (TG) and Frimex with trombin as an enzymatically. Many studies have been carried out to use thin unique enzyme reaction, cross-linking between protein molecules, to change rheological properties of food proteins (Ikura, 1980; Motoki & Nio, 1983; Fatoumato & Meunier, 1991). Use of the enzyme may eliminate the need for freezing in the meat binding process, reduce or eliminate the required salt and phosphate, because of the binding in the meat binding process. Recently, TG was screened and purificated from microorganism (Ando et al., 1989) produced by fermentation of Saccharomyces cereviciae (Nielsen et al., 1995).

Objectives

The Objective of this study was to examine the effects of packaging methods on tensile strength, color changes, press and cooking loss, and textural properties in restructured beef using TG.

Methods

Materials : Samples for restructured beef were thawed at 5°C for 1 day of frozen topside beef, trimmed fat and connective tissue to eliminate effect of them and cut as 3-5 thickness. As a binding material, Transglutaminase (TG, ACTIVAtmEB, Ajinomoto. Japan) which powder included TG 0.5%, sodium caseinate 60% and maltodextrin 39.5% was used. TG solution was prepared using 1% TG of sample's weight followed adding 4-fold volume cold water.

Treatments : Restructured beef was packed by 5 treatments which were ; (a) air packed and pressed (AP), (b) air packed after treated TG, no-pressed (TGA), (c) vacuum packed after treated TG, no-pressed (TGV), (d) air packed after treated TG, and pressed (TGAP) and (e) vacuum packed after treated TG and pressed (TGVP). TG was added 1% of raw samples to them and pressed for 16hrs in refrigerator with 5kg pressure for binding.

Color : Surface color was measured before and after restructuring beef using the Hunter L(Lightness), a(redness), b(yellowness) system by Color difference meter (Minolta, CR-200, Japan). The value of standard plate was L=97.49, a= -0.26 and b=2.97.

Pressing and cooking loss : Percentage of pressing loss was expressed as (Weight before bound – Weight after bound)/Weight before bound X 100. The cooked samples were drained, removed from their packages, blotted with paper towels, and reweighed. Percentage of cooking loss was calculated as (Weight before cook - Weight after cook)/Weight before cook X 100.

Tensile strength (TS) : Tensile strengths for restructured beef samples were carried out similar to as described by Purslow et al.(1987) using TA-XT2 texture analyzer (SMS, England). Samples were cut with dimension of height 10 x widths 10x lengths 20mm for measurement. The samples pulled apart with extension rate of 1.0mm/sec until the adhesive joint fractured.

Texture : TA-XT2 texture analyzer (SMS, England) used to determine texture parameters from force by texture profile analysis (TPA). Compression was carried out on sample height 10 x widths 10 x lengths 20mm. Samples were compressed twice to a degree of 60% at 1.0mm/s crosshead speed.

Results and Discussion

Surface color of restructured raw beef was showed in table 1. by means of several packaging methods. Lightness (L value) of raw beef before binding was 3.90±1.19, redness (a value) was 23.81±1.61 and yellowness (b value) was 9.92±1.46. TGA was 44.6±1.34 after 16hrs for binding with air packed and press. L values among treatments were significantly different except treatments between B.B. and AP. Compared to AP and TGAP, L value was increased ($p<0.05$) by press. The redness value decreased by restructuring while they were not different among packaging treatments. In yellowness, they was no difference among treatments except TGV treatment compared to B.B. treatments ($p<0.05$).

Pressing and cooking loss of restructured beef with various packaging methods were presented in table 2. TGA treatment showed the lowest pressing loss value with 2.15±0.25% while TGVP treatment showed the highest value with 8.49±1.04%. Pressing affected the pressing loss value, so that pressing loss value of TGA was significantly different from TGVP. Cooking loss ranged from 27.7% to 33.78% by treatments. AP treatment revealed to the highest value with 33.78%. Cooking loss of TGV treatment was the lowest value and different from those of other packaging methods, exceptionally.

Tensile strength of restructured raw beef by packaging methods showed in table 3. AP treatment can not be measured on tensile strength because that the sample was not bound. TGA treatment was the lowest with 109±19.7g, and TGVP was the highest with 150±4.8g in restructured raw beef. The tendency of tensile strength value increased by press treatment. Vacuum packaged treatment showed higher tensile strength than air packed one. In restructured cooked beef, a tensile strength value of the press treatments (TGAP and TGVP) was higher than the no-press treatment (TGA and TGV). In texture, hardness of restructured raw beef showed with the range of 2342±546.6g - 4906±1791.4g by different packaging methods (Table 4). Gumminess showed a significant different between treatments in restructured raw beef ($p<0.05$). However, adhesiveness, springiness, cohesiveness and chewisiveness were not significantly different by packaging methods. Hardness of TGVP was the highest with 15824.7±3239.2g and TGA was the lowest with 11074.2±1902.2g ($p<0.05$) in restructured cooked beef. Gumminess and chewisiveness increased by press treatment. Hardness, adhesiveness, gumminess and chewisiveness of restructured cooked beef were higher than restructured raw beef.

Conclusion

The effect of packaging methods on color, pressing and cooking loss, tensile strength and textural properties of TG treatment restructured beef were investigated. The redness of restructured beef decreased compared to raw beef. The reason of color changes restructured beef after bind was originated from the separation of colorant from the beef. Pressing loss of vacuum-packed treatment was higher than air-packed treatment. Raw beef can not measured on tensile strength, which sample was not bound and separated each other piece. There was no significant different on tensile strength between air-packed and vacuum-packed restructured beef. The tensile strength of TGAP was significant different from that of press treatment. Packaging method affected hardness, gumminess and chewisiveness in restructured beef. Hardness of restructured beef was increased by the press treatment.

Literature

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Table 1. Color changes of restructured raw beef by packaging methods

Items	B.B.	AP	TGA	TGV	TGAP	TGVP
L	39± 1.19[b]	39.98±1.14[b]	44.6±2.52[a]	41.74±0.91[b]	42.84±0.92[ab]	42.51±1.34[ab]
A	23.81± 1.61[a]	17.52±3.8[b]	19.97±1.84[b]	19.96±1.12[b]	18.85±1.13[b]	20.49±1.54[b]
B	9.92 ± 1.46[a]	8.77±1.72[ab]	9.66±1.17[ab]	7.73±1.45[b]	9.45±0.49[ab]	8.18±1.38[ab]

B.B. : Before binding (raw beef), AP : air packaged by press without TG, TGA : air packaged with TG no-press,
TGV : vacuum packaged with TG no-press, TGAP : air packaged with TG by press, TGVP : vacuum packaged with TG by press.
a b Different characteristics in the same line differ significantly($p<0.05$).

Table 2. Press and cooking loss of restructured beef by packaging methods

Items	AP	TGA	TGV	TGAP	TGVP
Press loss	5.94±0.87[b]	2.15±0.28[c]	5.18±0.93[b]	5.69±1.74[b]	8.49±1.04[a]
Cooking loss	33.78±1.2[a]	28.89±0.9[ab]	27.7±2.01[b]	29±0.37[b]	30.8±1.97[a]

a b Different characteristics in the same line differ significantly($p<0.05$).

Table 3. Tensile strength of restructured raw and cooked beef by packaging methods

Items	AP	TGA	TGV	TGAP	TGVP
Raw	-	109.7±19.7	129.9±24.0	145.4±42.5	150.5±41.8
Cooked	-	180.7±51.3[b]	251.7±72.4[ab]	333.7±136.2[a]	304.0±42.8[a]

a b Different characteristics in the same line differ significantly($p<0.05$).

Table 4. Texture of restructured raw and cooked beef by packaging methods

	Items	AP	TGA	TGV	TGAP	TGVP
Raw	Hardness	2342±546[b]	4907±1791[a]	3366±943[ab]	2836±610[ab]	4532±1516[ab]
	Cohesiveness	0.33±0.02	0.38±0.04	0.38±0.05	0.42±0.05	0.41±0.08
	Gumminess	764±164[b]	1748±585[a]	910±552[ab]	1151±261[ab]	1704±555[ab]
	Chewisiveness	480±141	1109±386	551±349	701±146	1021±371
Cooked	Hardness	11596±2115[ab]	11074±1902[b]	11499±1493[ab]	12161±2552[ab]	15825±3239[a]
	Cohesiveness	0.49±0.05[b]	0.49±0.02[ab]	0.57±0.07[a]	0.53±0.04[ab]	0.49±0.01[b]
	Gumminess	5353±1232[b]	5467±1079[ab]	6029±902[ab]	6274±1160[ab]	7698±1493[a]
	Chewisiveness	3504±979[b]	3978±637[ab]	4427±779[ab]	4644±852[ab]	5659±1466[a]

a b Different characteristics in the same line differ significantly($p<0.05$).