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Quality Attributes of Sectioned and Formed Spent Hens Meat Rolls 2- Effect of Eenzyme Treatment and/or Cool Aging Tenderization

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FEATHERED carcasses of broiler mother hens (18 month age) were enzyme treated (static soak in 0.003% papain sol.) and /or cool aged (4°C, 24 hrs) prior to processing into sectioned and formed meat rolls (SFMR). Breast SFMR's were of higher WHC and lower cook loss as compared to thigh rolls. Cool aging (AG) tenderization resulted in less cook loss (13%), when skin emulsion (SE) was used as a binder, as compared to that containing k- carrageenan (KC) (18%). When enzyme/aged (Enz/Ag) tenderization was applied,cook loss was 20% and 17% with SE and KC respectively as binders. For SFMR binding efficiency and sliceability, samples with (KC) were ranked the best (compared with control and SE samples), for both tenderization methods. Enz/Ag treatment resulted in the best tenderness and juiciness of samples containing (KC) or (SE) respectively. For overall acceptability samples Enz/Ag treated and (KC) binded and made of either breast or thigh cuts were ranked the four top scores.

Pretenderization process of breast and thigh poultry cuts is used to reduce toughness . Karmas (1975) pointed out that, the controlled action of plant proteolytic enzymes has been used to tenderize meat. Inorganic salts, such as sodium chloride, also were used to tenderize spent hen muscles (Oblinger *et al.,* 1977 and Palladino and Ball, 1979). Sosebee *et al.,* (1964) and Fry *et al.,* (1966) used the papain for tenderization of poultry meat. Cantrell and Hale (1974) used aging at 1°C as a method of tenderizing fowl meat. They reported that both thigh and breast muscles that had aged at least 20 hr were significantly more tender than those cooked without aging.

This investigation was designed to determine if low cost , relatively tough meat of spent hens (mother hens) could be used in the production of sectioned and formed meat rolls (SFMR) . the effects of enzyme treatment

and cool aging tenderization on the quality characteristics of the product were specifically studied .

Material and Methods

The tenderization process was carried out on whole carcasses of spent hens (18 months age having live weights of 4 to 4.5 kg) prior to obtaining deboned fresh meat. Control samples were not tenderized. The tenderization was carried out either, by soaking the whole carcasses in 0.003% aqueous papain for 10 minutes at room temperature then aging for 24 hours at 4°C according to the method of Fry *et al.* (1966), or, by aging only without pre-enzyme treatment.

Skinned breast and thigh meats of spent hens were used in processing of sectioned and formed meat rolls (SFMR). The breast or thigh meats were cut into chunks (3×4×3 cm), sprinkled with curing salts (sodium chloride 1.7%, sodium triphosphate 0.7% and mono sodium glutamate 0.5%) according to Booren *et al.*, (1981).

The meat chunks were mixed using a kitchen aid mixer with the paddle attachment (model Braun KM 32) at 200 r.p.m. for 15 to 30 minutes (Pearson and Tauber, 1984). 0.6% seasoning mixture (6%cardamon, 11%nutmeg, 17%cubeb, 22%laurel leaves and 44%black pepper) with all treatments and two kinds of binding materials (1) 0.5% k-carrageenan + 2% starch (Turdso, 1985), or (2) skin/meat emulsion 10% (Pearson and Tauber, 1984) were added during mixing. The mixtures were stuffed into fibrous casings. SFMRs were cooked in a traditional oven at 176°C until the internal temperature of SFMR reached to 82°C (Maesso *et al.*, 1970).They were then cooled with tap water for 30 min., followed by storage at 4°C.

The cooked SFMR were tested for cooking loss (Raharjo *et al.*, 1995), water holding capacity (WHC) and plasticity (Soloviev, 1966) and chemical composition (A.O.A.C., 1990). Binding efficiency, sliceability, tenderness, juiciness, flavour and overall acceptability were evaluated by 20 assessors according to the method by Basker (1988). The results were statistically analyzed according to Basker (1988).

Results and Discussion

No obvious differences in gross chemical composition were found between tenderized and control samples (Table 1). Generally, breast samples contained higher crude protein and moisture contents as compared with corresponding values of thigh meat rolls. A higher level of ether extract content was found with thigh samples.

TABLE 1. Chemical composition of spent hens meat rolls affected by different treatments

Binding materials	K. carrageenan						Skin emulsion					
Treatment	*Tenderized*						*Tenderized*					
	control		*Cool- aged*		*Enzyme treated / cool- aged*		*control*		*Cool- aged*		*Enzyme treated /cool- aged*	
Meat cut**	B	T	B	T	B	T	B	'T	B	T	B	T
Component (%)												
Moisture	66.34	65.25	67.57	66.40	67.33	64.93	67.25	64.81	65.40	67.07	67.83	56.70
Crude protein	25.70	24.51	25.55	23.28	24.53	24.12	25.77	24.84	25.55	21.93	23.28	24.53
Ether extract	2.33	5.12	2.36	5.70	2.84	4.94	3.42	6.36	3.96	5.90	4.00	5.80
Ash	3.01	3.01	3.03	3.40	3.30	3.50	3.20	3.03	3.30	3.50	3.38	3.09
T. carbohydrates	2.61	2.11	1.49	1.22	2.00	2.51	1.49	1.22	1.79	1.60	1.51	0.88

** Meat cut : B = breast, T = thigh

Breast meat exhibited higher water retention than thigh meat in all treatments (Table 2). This might be attributed to the higher crude protein of breast samples. The WHC values for all cooked samples were within the range of 77-79% with higher levels for breast meat (Table 2).

This indicated that, the tenderized samples did not result in improved WHC compared to the controls.

Results presented in Table (3) indicate the cooking losses of pre-tenderized, cooked meat rolls. Generally, breast SFMRs were characterized by lower cooking losses than thigh SFMRs in all samples. From these results, control and cool-aged breast samples containing skin/meat emulsion were of lower cooking loss (13-14%) compared to carrageenan samples (about 18%). These observation appear to be associated with higher levels of both yield and juiciness with the skin / meat binder compared to carrageenan (Theil *et al.*, 1986). On the contrary, enzyme treated, skin/meat emulsion samples lost about 20% of weight as compared to 17% for enzyme treated, carrageenan samples. This may be due to the hydrolytic effect of papain on the skin/meat emulsion (Karmas, 1975).

TABLE 2. Effect of tenderization method on water holding capacity (WHC) of cooked hens meat rolls, containing selected binding materials .

*WHC * (% bound water)*						
Binding materials		K. carrageenan		Skin emulsion		
Treatment		*Tenderized*		*Tenderized*		
		Enzyme treatment	*Enzyme treated +*	*Enzyme treated +*		
control		*Cool- aging*	*cool- aging*	*control*	*Cool- aging*	*cool- aging*
Meat cut :						
Breast	79.31	78.74	78.12	79.80	78.72	78.86
Thigh	78.45	78.28	77.23	79.00	78.37	77.24

* Calculated as percent retained water after sample pressing

TABLET 3. AbleEffect of tenderization method on cooking loss of hens meat rolls containing selected binding materials .

Cooking loss (%)						
Binding materials	K. carrageenan / starch			Skin/meat emulsion		
Tenderized				*Tenderized*		
Treatment	*Enzyme treatment +*			*Enzyme treatment +*		
	control	*Cool-aging*	*cool-aging*	*control*	*Cool-aging*	*cool-aging*
Meat cut :						
Breast	17.75	17.88	16.66	13.90	13.10	19.20
Thigh	19.33	19.44	19.60	19.46	17.90	19.72

The best rank of binding efficiency was given to enzyme-treated samples containing carrageenan (breast and thigh respectively) (Table 4). In contrast, enzyme-treated samples containing skin/meat emulsion gave the least binding efficiency values between all tested samples. These results may be due to the effect of papain on the skin/meat emulsion resulting in low binding efficiency.

For sliceability evaluation (Table 5), all samples containing carrageenan were on the top of the preference evaluation. Enzyme-treated samples containing skin/meat emulsion were given the least values.

TABLE 4. BLERank sums of pre-tenderized breast and thigh meat rolls containing selected binding materials ranked for binding efficiency . The rank sums are arranged in decreasing order of preference.

Significancy level		P = 0.05		
Critical difference		73.8		
Treatment*	Binder**	Meat cut***	Rank sum ****	
Enz/Ag	KC	B	53	a
Enz/Ag	KC	T	85	ab
Ag	KC	B	85	ab
C	SE	B	115	ab
Ag	KC	T	116	ab
Ag	SE	B	126	ab
C	KC	B	130	bc
C	KC	T	150	bc
C	SE	T	150	bc
Ag	SE	T	150	bc
Enz/Ag	SE	B	200	c
Enz/Ag	SE	T	200	c

* Treatment : C, control; Ag, cool-aged; Enz/Ag, enzyme-treated / cool-aged.
** Binder : KC, k. carrageenan; SE, skin emulsion.
*** Meat cut : B = breast, T = thigh.
**** Rank sums followed by the same letter were,, not significantly different.

With the enzyme-treated meat rolls, breast samples containing carrageenan and skin/meat emulsion respectively were given the best tenderness values among all samples (Table 6). Enzyme tenderization of red meat (Karamas, 1975) or poultry (Fry *et al.*, 1966) has been shown to result in good quality attributes especially for tenderness. On the other hand, thigh samples containing the same binding materials were significantly lower in tenderness.

Results presented in Table (7) indicate that, juiciness values are in agreement with that of tenderness (Table 6), *i.e* the higher the tenderness the higher the juiciness.

The enzyme-treated (breast and thigh) samples containing carrageenan were given the best sensory evaluation values for flavour (Table 8), while those containing skin/meat emulsion (breast and thigh) were the next in preference with no significant difference.

TABLE 5. Rank sums of pre-tenderized breast and thigh meat rolls containing selected binding materials ranked for sliceability. The rank sums are arranged in decreasing order of preference.

Significancy level			P = 0.05	
Critical difference			73.8	
Treatment*	Binder**	Meat cut***	Rank sum ****	
Enz/Ag	KC	B	50	a
Enz/Ag	KC	T	50	a
Ag	KC	B	98	ab
Ag	KC	T	98	ab
C	KC	T	98	ab
C	SE	B	124	bc
Ag	SE	B	147	bc
Ag	SE	T	147	bc
C	SE	T	172	c
C	KC	B	182	c
Enz/Ag	SE	B	197	c
Enz/Ag	SE	T	197	c

* Treatment : C, control; Ag, cool-aged; Enz/Ag, enzyme-treated / cool-aged.
** Binder : KC, k. carrageenan; SE, skin emulsion.
*** Meat cut : B = breast, T = thigh.
**** Rank sums followed by the same letter were, not significantly different. Rank sums values are significantly correlated (r= 0.93) with these of binding efficiency.

TABLE 6. Rank sums of pre-tenderized breast and thigh meat rolls containing selected binding materials ranked for sliceability. The rank sums are arranged in decreasing order of preference.

Significancy level			P = 0.05	
Critical difference			73.8	
Treatment*	Binder**	Meat cut***	Rank sum ****	
Enz/Ag	KC	B	58	a
Enz/Ag	SE	B	58	a
C	SE	B	88	a
Ag	KC	B	115	ab
C	SE	T	115	ab
Ag	SE	T	115	ab
Enz/Ag	SE	T	115	ab
Enz/Ag	KC	T	163	bc
C	KC	B	173	bc
Ag	SE	B	173	bc
Ag	KC	T	173	bc
C	KC	T	214	c

* Treatment : C, control; Ag, cool-aged; Enz/Ag, enzyme-treated / cool-aged.
** Binder : KC, k. carrageenan; SE, skin emulsion.
*** Meat cut : B = breast, T = thigh.
**** Rank sums followed by the same letter were, not significantly different

TABLE 7. Rank sums of pre-tenderized breast and thigh meat rolls containing selected binding materials ranked for juiciness. The rank sums are arranged in decreasing order of preference.

Significancy level			P = 0.05	
Critical difference			73.8	
Treatment*	Binder**	Meat cut***	Rank sum ****	
Enz/Ag	KC	B	57	a
Enz/Ag	SE	T	57	a
Ag	KC	B	111	ab
Enz/Ag	SE	B	111	ab
Enz/Ag	KC	T	111	ab
Ag	KC	T	129	ab
C	KC	T	138	b
C	SE	B	166	b
Ag	SE	B	166	b
C	SE	T	166	b
Ag	SE	T	166	b
C	KC	B	182	b

* Treatment : C, control; Ag, cool-aged; Enz/Ag, enzyme-treated / cool-aged.
** Binder : KC, k. carrageenan; SE, skin emulsion.
*** Meat cut : B = breast, T = thigh.
**** Rank sums followed by the same letter were, not significantly different.

TABLE 8. Rank sums of pre-tenderized breast and thigh meat rolls containing selected binding materials ranked for flavour. The rank sums are arranged in decreasing order of preference.

Significancy level			P = 0.05	
Critical difference			73.8	
Treatment*	Binder**	Meat cut***	Rank sum ****	
Enz/Ag	KC	B	60	a
Enz/Ag	KC	T	89	ab
Enz/Ag	SE	B	119	abc
Enz/Ag	SE	T	119	abc
C	KC	T	119	abc
Ag	KC	T	119	abc
Ag	SE	T	119	abc
Ag	SE	B	119	abc
C	SE	B	159	bcd
Ag	KC	B	165	cd
C	SE	T	177	cd
C	KC	B	196	d

* Treatment : C, control; Ag, cool-aged; Enz/Ag, enzyme-treated / cool-aged.
** Binder : KC, k. carrageenan; SE, skin emulsion.
*** Meat cut : B = breast, T = thigh.
**** Rank sums followed by the same letter were, not significantly different.

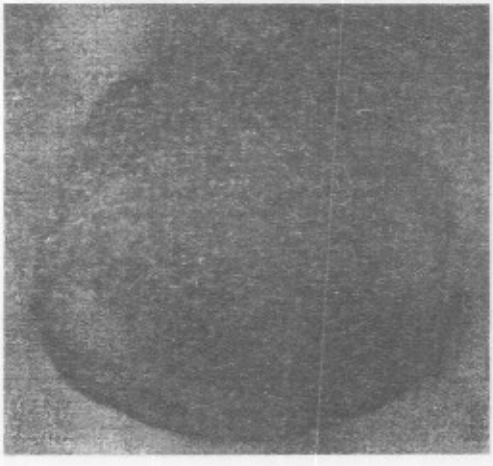
From the data presented in Table (9) and Figs. (1 and 2), the enzyme-treated samples containing carrageenan (breast and thigh respectively) resulted in the highest levels of acceptability. These results indicate the importance of enzyme treatment before cool-aging which is an effective method for tenderization (Karmas, 1975). On the other hand, the enzyme-treated, skin/meat emulsion containing samples (Table 9 and Figs. 3 and 4) yielded the poorest overall acceptability. The low acceptability of skin/meat emulsion samples may be attributed to the hydrolytic effect of the enzyme on the skin/meat emulsion which resulted in poor binding efficiency and sliceability (Karmas, 1975) (Tables 4 and 5).

TABLE 9. Rank sums of pre-tenderized breast and thigh meat rolls containing selected binding materials ranked for overall acceptability. The rank sums are arranged in decreasing order of preference .

Significancy level			P = 0.05	
Critical difference			73.8	
Treatment*	Binder**	Meat cut***	Rank sum ****	
Enz/Ag	KC	B	54	a
Enz/Ag	KC	T	100	ab
Ag	KC	B	113	ab
Ag	KC	T	125	ab
C	SE	B	129	b
C	KC	T	140	b
Ag	SE	T	140	b
Enz/Ag	SE	T	140	b
Ag	SE	B	146	b
C	SE	T	152	b
C	KC	B	162	b
Enz/Ag	SE	B	162	b

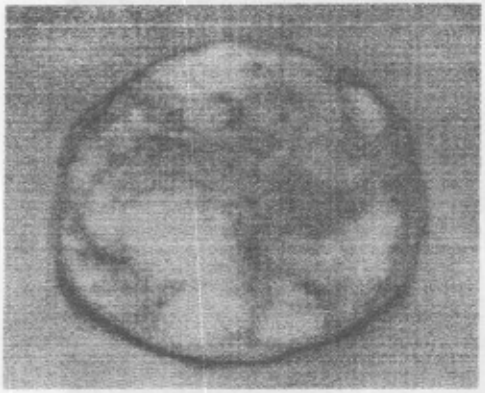
* Treatment : C, control; Ag, cool-aged; Enz/Ag, enzyme-treated / cool-aged.
** Binder : KC, k. carrageenan; SE, skin emulsion.
*** Meat cut : B = breast, T = thigh.
**** Rank sums followed by the same letter were, not significantly different.

(A)

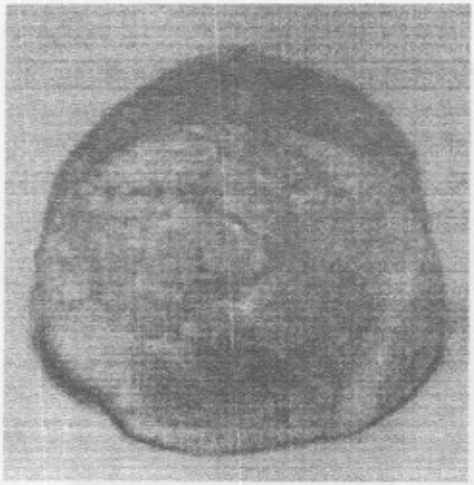


(B)

Fig 1. Photographs showing cut through center of enzyme treated / cool – aged breast (A) and thigh (B) meat rolls containing k.carrageenan.

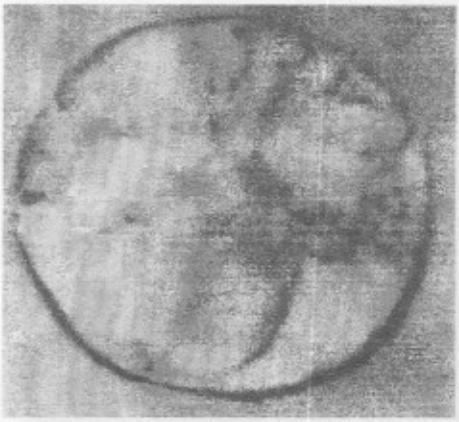


(A)

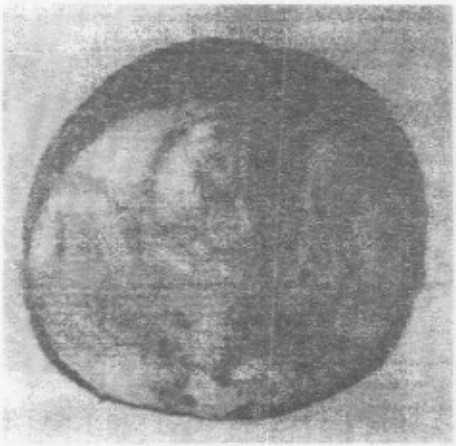


(B)

Fig 2. Photographs showing cut through center of cool-aged breast (A) and thigh (B) meat rolls containing k.carrageenan .

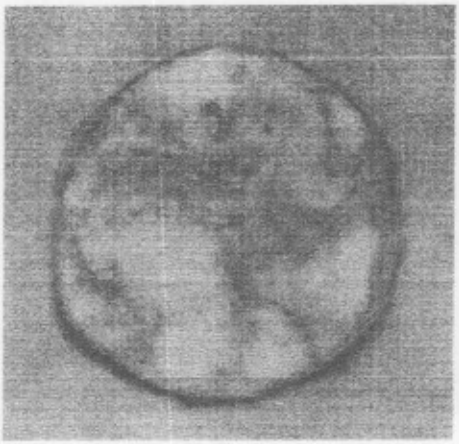


(A)

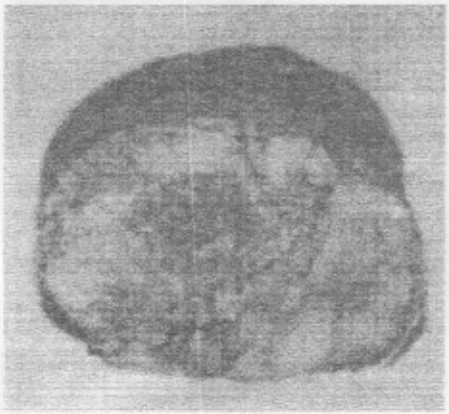


(B)

Fig 3. Photographs showing cut through center of cool-aged breast (A) and thigh (B) meat rolls containing skin emulsion.



(A)



(B)

Fig 4. Photographs showing cut through center of enzyme treated / cool-aged breast (A) and thigh (B) meat rolls containing skin emulsion.

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صفات الجودة للفائف لحوم أمهات الدجاج المجزأة والمشكلة . ٢- تأثير التطرية بالمعاملة الإنزيمية و/ أو الإنضاج المبرد

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ذبائح أمهات الدجاج المنزوعة الريش (عمر ١٨ شهر) تم معاملتها إنزيميا (بالنقع في محلول باباين ٠,٠٠٣%) و / أو بالتعتيق المبرد (٤°م لمدة ٢٤ ساعة) قبل تصنيعها في صورة لفائف لحوم مجزأة ومشكلة. وكانت لفائف لحوم الصدر أعلي في قدرتها علي الإحتفاظ بالماء وأقل في الفقد الناتج عن الطهي وذلك بالمقارنة بلفائف لحم الفخذ.

والتطرية بالتعتيق المبرد أنتجت فقد طهي أقل (١٣%) عند إستخدام مستحلب اللحم والجلد كمادة رابطة عند مقارنتها بتلك التي تحتوى علي كابا – كاراجينان (٨%) والعكس صحيح (٢٠% و ١٧% علي التوالى) عند إستخدام التطرية بالإنزيمات والتعتيق معا وبالنسبة لكفاءة الربط والقابلية للتقطيع في صورة شرائح كانت العينات التى تحتوى على كابا – كاراجينان الأفضل (بالمقارنة بالكنترول والعينات المحتوية على مستحلب اللحم والجلد) لكلا طريقتى التطرية. التطرية بالإنزيمات والتعتيق معا أنتج أفضل طراوة وعصيرية للعينات المحتوية على الكاراجينان ومستحلب اللحم والجلد على التوالى. وبالنسبة للتقبل العام كانت العينات المعاملة بالإنزيمات والتعتيق معا والمحتوية على كاراجينان والمصنعة من لحوم الصدر أو الفخذ هى الأفضل.