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8th March, 1983

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Mr. K. Fitzgibbon,
Secretary,
Commercial Egg Producers Association
STRATHFIELDSAYE 3551

Dear Kevin,

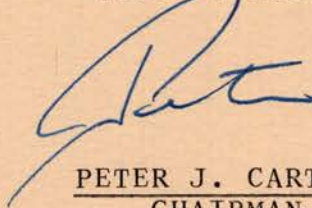
Enclosed please find information regarding the tenderizing of spent hens.

I am circulating it to you in the hope that we may be able to get some advantage by discussion with the producers in this regard.

A similar letter has been sent to A.B. Cambridge and the other producer organizations and if you have any other suggestions as to whom we might circulate this information, please let me know.

Kind regards,

Yours sincerely,



PETER J. CARTER
CHAIRMAN

Enc

551 Chandler Rd.,
Keysborough,
Victoria,
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P.O. Box 141
Noble Park, 3174.
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Department of Animal Sciences
and Industry

Call Hall
Manhattan, Kansas 66506
913-532-5654

March 1, 1983

Dr. David A. McKinna
The Victorian Egg Marketing Board
P.O.Box 141
Noble Park, 3174
Victoria, Australia

Dear Dr. McKinna:

I just received your letter and will answer your question about tenderizing old laying hens as best that I can. Attached is a copy of a paper we published on using a papain-containing marinade. This should answer some of your questions. In answer to your comment about USDA reports, those would have to come from Washington. I do not have USDA submissions or reports concerning the use of tenderizing enzymes, although USDA did approve the use about 1 1/2 years ago.

As a consultant to the food industry, I am currently working with poultry processors here in the US to put the process on a commercial basis. There are readily available automatic injecting machines for almost any type poultry and for any volume operation. Also, papain and other suitable proteolytic enzymes are readily available on the market.

In the event that one of your poultry processors should decide to undertake such a further processing operation, I would be glad to consider working with them, as a consultant, in a technical capacity.

Sincerely,

A handwritten signature in cursive script that reads 'F. E. Cunningham'.

F. E. Cunningham
Professor

Properties of Selected Poultry Products Treated with a Tenderizing Marinade^{1,2}

F. E. CUNNINGHAM and LAVONNE M. TIEDE

Department of Animal Sciences, Kansas State University, Manhattan, Kansas 66506

(Received for publication February 17, 1981)

ABSTRACT Poultry muscles injected with a tenderizing marinade were evaluated for quality characteristics. Turkey drumsticks, baking hens, and roasters were injected with either 3 or 5% (based upon weight of the meat) of a marinade containing .05% papain. After injection, the meat was allowed to equilibrate for 2 hr at 4 C and then oven baked or cooled in a microwave oven.

All meat products injected with papain were significantly more tender (shear press and taste panel) than the controls. Products injected with 5% marinade were more tender than those injected with 3% marinade. Sensory characteristics were unaffected by the papain.

(Key words: poultry, poultry products, injected poultry, tenderizing marinade, marinated poultry, papain)

1981 Poultry Science 60:2475-2479

INTRODUCTION

At present, proteolytic enzymes are approved by USDA for use in several meat products. Several classes of poultry, including certain turkey parts, baking hens, and roasters might have greater consumer acceptability if prepared with a tenderizing marinade. Poultry meat now used mainly for soups or extensively processed food items could be used instead for poultry loaves or filet-type products.

Nelson (1962) received a patent on an instrument to inject compounds postmortem, such as monosodium glutamate and gelatin, into poultry carcasses to improve flavor. Murphy and Murphy (1964) received a patent on a process for antemortem injection of a seasoning and the enzyme hyaluronidase under the skin of fowl to improve flavor and tenderness of the bird. Hogan and Bernholdt (1964) developed a process that involved injecting proteolytic enzymes into the vascular system just before slaughter. Farha (1968) reported a flavoring process whereby poultry was soaked in a barbecue solution, then frozen packaged. Schwall *et al.* (1968, 1971) developed a self-basting poultry product by injecting edible fat into raw muscles. Strandine and Peckenpaugh

(1971) developed a process to improve flavor, tenderness, and juiciness of poultry by injecting a vegetable oil emulsion into the meat tissue of poultry. In *Broiler Industry* (Anonymous, 1974), it was reported that White Tomkins, Ltd., of Reigate, England was marketing a flavor injected poultry product called "Interchicken" or "Interturkey". Stadelman (1975) suggested injecting broilers with fat or broth from mature hens.

Since technology and equipment are available for commercially injecting curing ingredients and flavorings into poultry parts, the objective of this study was to examine the acceptability of tougher poultry muscles treated with tenderizing marinades.

MATERIALS AND METHODS

Turkey drumsticks (from yearling hens, 15 months, weighing from 450 to 525 g each), baking hens (approx. 16 months, weighing from 1700 to 2300 g each), and roasters (16 weeks, females, weighing from 1900 to 2300 g each) were obtained from a local supplier and held at refrigerator temperatures.

A barbecue-flavored marinade was prepared (Table 1) containing .05% papain, and injected into the muscles at 0, 3, or 5% (based upon the weight of the meat), even though FSIS limits the weight gain to the 3% level. The injections were made at 1 cm intervals with perforated needles to insure uniform marinade at different depths.

All meat samples were weighed before and after injection and then held at 4 C for 2 hr to

¹Contribution No. 80-322 j, Department of Animal Sciences, Kansas Agricultural Experiment Station, Manhattan, KS 66506.

²Presented at 69th Annual Meeting of the Poultry Science Association, Purdue University, August 4-8, 1980.

TABLE 1. *Ingredients used in preparing the barbecue-flavored marinade injected into various poultry muscles*

Ingredient	Weight (g)
Liquid:	
Safflower oil	54.1
Water	15.9
Lemon juice	27.1
Solids:	
Tricalcium phosphate	.62
Monosodium glutamate	.62
Salt	12.0
Barbecue seasoning*	14.5
Mustard powder	1.55
Pepper	1.0
Papain	.0635

*Durkee Foods Barbecue Seasoning #4834-A-86, SCM Corp., Cleveland, OH 44115.

allow the marinade to equilibrate. Cooking was by microwave (Sharp Carousel Browning Oven, Model R-8200) or an electric Partlow oven (National Mfg. Co., Lincoln, NE). The meat samples were cooked in the microwave on the roast setting for 16 min/kg of poultry or oven baked at 176 C for approximately 3 hr or until the meat pulled away from the bone. Roasters and baking hens were cooked breast-up for two-thirds of the time required and then turned. Oven-baked samples were covered with an aluminum foil tent to prevent excess browning and drying. After cooking, samples were cooled to room temperature and shear press values were obtained with an Allo-Kramer shear press on 2.5 g samples of meat. An experienced 6-member panel judged the samples for flavor,

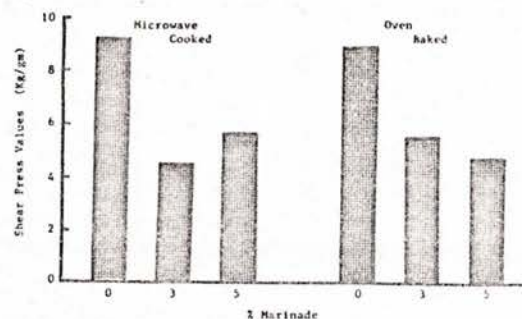


FIG. 1. Shear press values for cooked turkey drumsticks after injection with a marinade containing .05% papain.

juiciness, and tenderness and scored the meat according to the card shown in Table 2.

Each class of poultry and percent marinade were repeated six times and all data were analyzed using analysis of variance procedures (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

The effects of injecting different levels of tenderizing marinade and of cooking methods on shear press values of the cooked meat from turkey drumsticks are shown in Figure 1. All drumsticks injected with the marinade were significantly more tender than the control drumsticks. The noninjected drumsticks (controls) were less tender when microwave cooked than when oven baked (but not significant); however, the drumsticks injected with 3% marinade were more tender when microwave cooked compared to injected oven baked drumsticks. Those differences were significant ($P < .05$).

TABLE 2. *Score sheet for sensory evaluations of cooked poultry products injected with a tenderizing marinade*

Flavor	Juiciness	Tenderness
9 Like extremely	9 Extremely juicy	9 Extremely tender
8 Like very much	8 Very juicy	8 Very tender
7 Like moderately	7 Juicy	7 Tender
6 Like slightly	6 Moderately juicy	6 Moderately tender
5 Neither like nor dislike	5 Neither like nor dislike	5 Neither like nor dislike
4 Dislike slightly	4 Moderately dry	4 Moderately tough
3 Dislike moderately	3 Dry	3 Tough
2 Dislike very much	2 Very dry	2 Very tough
1 Dislike extremely	1 Extremely dry	1 Extremely tough

TABLE 3. Taste panel evaluations of tenderness for cooked poultry products

Amount injected	Tenderness scores			
	Micro-wave		Oven baked	
	--- Turkey drumsticks ---			
Control		4.3		5.8
3%		6.5		5.5
5%		6.5		6.0
	Baking hens			
	(Breast)	(Thigh)	(Breast)	(Thigh)
Control	4.2	3.7	5.2	3.0
3%	4.7	3.7	6.2	6.0
5%	5.3	5.7	6.3	7.0
	Roasters			
	(Breast)	(Thigh)	(Breast)	(Thigh)
Control	4.5	6.5	6.8	7.5
3%	5.5	7.3	7.2	7.3
5%	6.2	7.7	7.5	8.0

Taste panel evaluations of cooked turkey drumsticks for tenderness are shown in Table 3. Panel members generally scored those drumsticks with 5% marinade higher than drumsticks with 0% or 3%. They also judged microwave cooked meat more tender than oven baked

meat. Taste panel judgements for juiciness and flavor of cooked drumsticks are shown in Tables 4 and 5, respectively. Juiciness of injected drumsticks was, in most cases, greater than the control drumsticks, and juiciness of microwave cooked samples was signifi-

TABLE 4. Taste panel evaluations of juiciness for cooked poultry products

Amount injected	Juiciness scores			
	Micro-wave		Oven baked	
	--- Turkey drumsticks ---			
Control		5.7		4.7
3%		6.3		4.3
5%		5.8		4.7
	Baking hens			
	(Breast)	(Thigh)	(Breast)	(Thigh)
Control	5.2	3.8	5.0	5.0
3%	4.8	3.0	5.8	5.5
5%	5.0	5.7	6.0	6.0
	Roasters			
	(Breast)	(Thigh)	(Breast)	(Thigh)
Control	4.0	5.7	6.3	7.3
3%	4.5	6.7	5.8	6.3
5%	5.5	6.7	6.0	7.0

TABLE 5. Taste panel evaluations of flavor for cooked poultry products

Amount injected	Flavor scores			
	Micro-wave		Oven baked	
— Turkey drumsticks —				
Control	5.0		5.7	
3%	7.2		6.3	
5%	6.2		5.7	
— Baking hens —				
	(Breast)	(Thigh)	(Breast)	(Thigh)
Control	5.3	5.0	7.5	5.2
3%	6.8	5.2	7.7	4.8
5%	6.5	6.0	6.2	6.7
— Roasters —				
	(Breast)	(Thigh)	(Breast)	(Thigh)
Control	6.2	5.2	7.3	6.7
3%	5.8	6.0	6.7	5.7
5%	6.5	5.7	6.7	6.0

cantly greater ($P < .05$) than the oven baked samples.

The shear press values of cooked meat from baking hen breast and thighs are shown in Figures 2 and 3, respectively. In almost every case, the meat from the breasts had lower shear press values (tenderness) than meat from the thighs and, without exception, the injected parts were more tender than the control parts. Taste panel evaluations for tenderness, juiciness, and flavor of cooked baking hen parts are given in Tables 3, 4, and 5. Baking hens injected with 5% marinade were consistently judged more tender than those injected with 3% or

those not injected. For flavor, however, panel members preferred those baking hen parts injected with only 3% marinade.

Prusa *et al.* (personal communication) injected baking hens with papain (.001 or .002%) and found that although injected samples were more tender than those without papain, an off-flavor was detectable that increased with level of papain injected. In the present study, the use of the flavor marinade probably masked some of the off-flavor caused by the papain.

Our evaluations showed that thigh meat from roasters was very tender (shear press values in Figure 5 and panel evaluations in

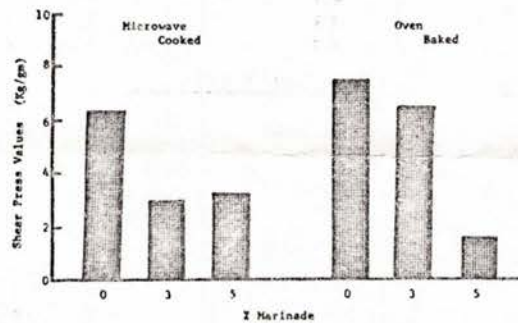


FIG. 2. Shear press values for cooked baking hen breasts after injection with a marinade containing .05% papain.

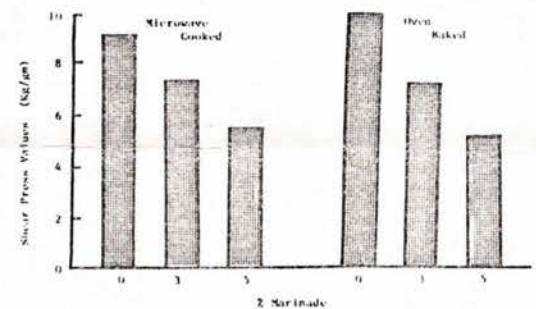


FIG. 3. Shear press values for cooked baking hen thighs after injection with a marinade containing .05% papain.

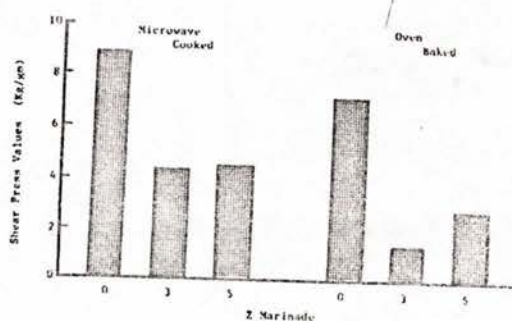


FIG. 4. Shear press values for cooked breast of roasters after injection with a marinade containing .05% papain.

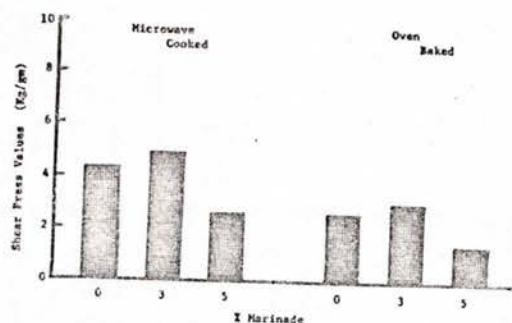


FIG. 5. Shear press values for cooked thighs of roasters after injection with a marinade containing .05% papain.

Table 3) so there was no benefit in injecting the tenderizer. However, the flavor of roaster thigh meat was improved by the marinade, especially for microwave cooking (Table 5).

The breast meat from roasters was less tender than the thigh meat (Fig. 4) but was significantly tenderized by injecting with papain. The marinade was especially effective for oven baked breast meat.

Breast and thighs of roasters were scored very high by our sensory panel for tenderness, juiciness, and flavor (Tables 3, 4, and 5). Thigh meat was judged tenderer than breast meat and, in most cases, juicier. For flavor, however, the breast meat was preferred.

The data presented in this study indicate that acceptability of several classes of poultry can be improved by injecting the muscles with a tenderizing marinade before cooking. Flavor marinades containing papain can improve tenderness and flavor of those classes of poultry generally considered too tough for consumers accustomed to the tender broiler.

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Tenderiser Adds Value To Old Hens

In America old layers may soon be sold at prices equal to broilers now that the use of papain, a tenderiser is approved by the USDA.

When the US Department of Agriculture approved the use of papain injection for the beef industry in the late 1950's, it opened the floodgates for producers of other meat products.

"The injection of papain has been a benefit to the beef industries and we have wanted to use this in other meats," said Dr Frank Cunningham, researcher of the papain-injected chicken and professor of food science in the Department of Animal Sciences and Industry at Kansas State University. "Because of the use of papain, we have a lot of beef on the counter that wouldn't usually be there."

The poultry and pork industries now have the opportunity to benefit from the tenderiser injection.

"We can take those no-profit, 2.7kg roasters and stewing hens, inject them with a marinade containing papain and the consumer will be able to buy a

large, tender, good-tasting, ready-to-prepare chicken," Dr Cunningham said.

The natural enzyme, papain, is a commonly used meat tenderiser which comes from the papaya plant and works by breaking down the collagen



A researcher injects the tenderiser papain into a chicken at Kansas State University, USA.

fibres in the muscles. Collagen fibres form in the muscles as the bird grows older and the meat becomes tough—too tough to sell to the consumer.

With years of research behind him, Dr Cunningham has gathered enough data to show that the poultry and pork industries can also benefit from the papain process. He submitted the proposal for USDA approval and it was published in the *Federal Register* in September 1981.

Without being contested, the proposal ran its 90 day course. On 3 December 1981, the proposal which permits the use of papain by other processors was approved by the USDA.

Before papain was approved for beef industries, the collagen fibres were broken down physically by the consumer with a spiked mallet before cooking the meat. These mallets are quickly becoming collector's items.

The papain process occurs before the meat hits the supermarkets.

In beef, the tenderiser is injected



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Tenderiser Adds Value To Old Hens

into the jugular vein before slaughter, which gives the papain enough time to circulate to all parts of the body. The natural enzyme continues to work, breaking down the collagen fibres through the natural aging process and packaging.

In poultry and pork the papain can be injected directly into the muscles during the last stage of processing. In this 'ready-to-cook' stage the chicken will be run through a machine that injects the meat with needles.

These needles will not only physically break down the collagen fibres, as the spiked mallet did, but will also inject the papain and the marination flavours into the meat. The meat is then packaged and sent to the supermarket.

"The papain continues to work, breaking down the collagen fibres, until the meat is cooked, making the meat so tender that you can cut it with a fork," Dr Cunningham said.

"Our taste panel evaluations were all favourable towards the papain-injected marinated bird," he said.

Although in the original taste evaluations, before marination, the panel objected to the taste of the papain, the mistake was remedied by also injecting a bar-b-que or a Polynesian marination, which masks the objectionable taste of the papain.

"I think once consumers try them, the injected bird will be a desirable product to the housewife because the injected, marinated bird is self-basting and tastes good with the flavourings. We now have a value-added product.

"Currently, these tough old birds are

sold to companies and are used for soups or other products where toughness is not a problem. According to Dr. Cunningham the injection increases the value of the spent fowl."

Poultry producers are selling their broilers at 61 cents a kilo and their spent fowl at 9 cents a kilo. With the injection of the papain and marination, the added value of the spent fowl would be about 52 cents a kilo.

"It might be a little more expensive to buy at the supermarket than its counterpart, the broiler, but it won't be sizeable, less than 2 cents a kilo," Cunningham says.

"It will increase the poultry producer's income because presently, spent fowl have only a limited market potential" Dr Cunningham said. "But once the new product achieves a market value, then the bird's value will increase. The injection of papain and the marinade increase the value of the bird and offers a better market outlet for the spent fowl.

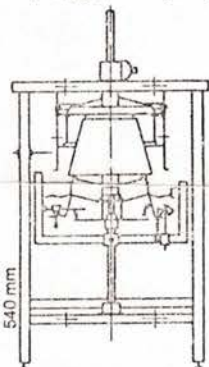
"If consumers approve of the product, which I think they will, then the product will establish a market and give spent fowl an added income to the producer."

After all, the consumers have really enjoyed the butter-injected turkey. The self-basting turkey is much like the injected-fowl, but it doesn't include the bar-b-que or Polynesian marination or papain, Dr Cunningham said.—Pamela Jacobs.

(This article has been abstracted from our sister journal POULTRY TRIBUNE—Editor.)

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