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THE INFLUENCE OF CYCLIC VACUUMING AND PRESSURING PROCESS ON TENDERIZING *SHEEP PASTRAMI*

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Abstract: *The paper presents the mechanical characteristics of Romanian traditional cured-smoked product "Sheep Pastrami", made by using sheep raw meat tenderized after successive cyclic vacuuming and pressuring process. These characteristics are based on the shear force diagrams obtained by using Werner - Bratzler testing method of the final product, before and after tenderizing process by using cyclic vacuuming and pressuring process. To decrease the duration of curing / marinating period, the performed tenderizing process is represented in 24 min pressuring and vacuuming cyclic processes consisting in successive pressuring and de - pressuring cyclic processing (0...10 bar), followed by vacuuming and de - vacuuming cyclic processing (0...-0,85 bar). The paper presents characteristic shear force amount obtained by using Werner - Bratzler testing method for the tenderized and cured-smoked final product, in comparison with pastrami made with no tenderized sheep raw meat sample.*

Keywords: *cyclic vacuuming and pressuring process, sheep meat tenderizing, Warner-Bratzler test method*

1. INTRODUCTION

Pastrami (Turkish: *pastırma*, Romanian: *pastramă*, Yiddish: *pastróme*) is a popular delicatessen meat usually made from beef, and sometimes from pork, sheep, mutton or turkey.

The raw meat is brined, partially dried, seasoned with various herbs and spices, then smoked and/or steamed. The method for making *pastrami* was originally used to preserve beef from spoiling in a time before modern refrigeration. The word *pastramă* is etymologically rooted in the Romanian *păstra* which means "to keep" or "to preserve". But the word is maybe more ancient and come from the Latin *pastor* who means *shepherd*; so *Pastramă* is *shepherd's meat* of lamb or mutton. The first versions of this preparation

date back to the Ottoman Empire, where Turkish people salted and dried beef and sheep. Beef and sheep plates are the traditional primal cut for making *pastrami*, but these days it is more common to see made from beef's and sheep's brisket and breast [7-9].

The Romanian specialty was first introduced to the United States in a wave of Romanian Jewish immigration from Bessarabia and Romania in the second half of the 19th century, via the Yiddish (pronounced *pastróme*). Early references in English used the spelling "*pastrama*", closer to the Romanian original. Among Jewish Romanians, goose breasts were commonly made into *pastrami* because they were inexpensive.

Beef navels and briskets, and sheep brisket and breast were cheaper than goose meat in America, so the Romanian Jews in America adapted their recipe and began to make the cheaper beef and sheep *pastrami*, as they usually done in Romania [7-9].

Traditional *Pastrami* is a cured meat, that it has been quickly injected with brine usually containing preservation additives (in industrial process) or otherwise infused for long time with brine (in homemade or small enterprise process). Both sheep brisket and sheep breast are tenderless parts of the animal's carcass. Therefore in the industrial process the meat is tenderized 4-6 hours in massaging intermittent vacuum equipment (maximum relative vacuum -0,65 bar) [1]. American and West - European meat tenderizing recent research papers recommend increasing the vacuum level up to -0,95 bar, or high pressure process up to 5000 bar [5].

For the same reason, in homemade or small enterprise process, the meat is tenderized for 1-2 weeks in high concentration brine containing additional flavors added (marinated).

Mechanical tenderization action produces complex modifications of the meat tissues in order to increase the surface area and thereby facilitate extraction and solubilization during the massaging phase. Softening of the muscle is also obtained, making the meat more adaptable for cooking process.

Tenderization, pre-massage and massage are closely interrelated, and not all products require the same mechanical action. Thus the mechanical action must be intensified and adapted in order to compensate for some of the negative consequences that may result in the product's quality. This will depend on the rest of the process and, above all, on the presentation and final quality of the product itself [2,4].

In low-injection products where meat content represents more than 80% of the final composition, meat quality is a determining factor in mastication, while in more highly injected products, this is not as important as the process and technology used [13].

Then, traditional *pastrami* is cold smoked, and finally dried in ventilated cold air [7].

In order to reduce the duration of the wet - curing step as much is possible, and even to eliminate it, in some recent papers are presented considerations concerning the influence of pressuring cyclic process, and vacuuming cyclic process on cured-smoked final product tenderness [7-9].

This paper presents a new tenderizing method based on both pressuring and vacuuming cyclic process.

2. MATERIAL AND METHOD

In order to produce *Sheep Pastrami*, 10 pieces of sheep brisket and breast were used (Animal Slaughter Certificate: 2 sheep, 16 - 18 months, 26 -27 kg in carcass, individual small farm). Two of these pieces were used to produce *Sheep Pastrami* respecting traditional homemade or small enterprise process: the meat was pierced for 4 times (Figure 2), then infused for 5 days in 12% concentration brine, then cold smoked in several steps during 1 day, and finally, dried 24 hours in free ventilated cold air.

The piercing step was realized by using the *Multi-needle piercing device*, that in principle consists in 120 needles ($\varnothing 5$; edge 20° conical sharp) disposed in the same shape and reciprocity distance as into the industrial brine injection equipment (Figure 1) [7-9].

The novel tenderizing method proposed in this paper consists in several cyclic pressuring and de - pressuring step, followed by cyclic vacuuming and de - vacuuming step of the raw meat and brining, too, into a vessel.

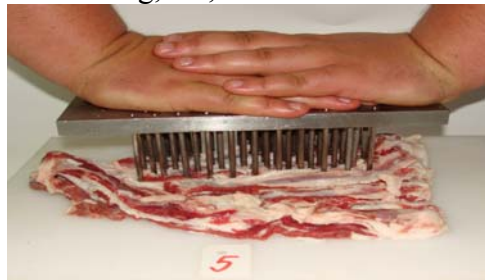


Figure 1. Sheep brisket manually pierced

During the pressuring process, the pressure level is 3-4 times higher than during brine injection in industrial equipment, and 2-3 times than the dynamic pressing during the massaging industrial process.

In order to put in evidence the influence of pressuring cyclic and vacuuming cyclic process



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(PV-CP) on meat tenderization, *Experimental Equipment* (EE- PV-CP) was used.

Experimental Equipment for PV-CP and Multi-needle piercing device were designed and made by Environmental Protection in Industry Laboratory (EPIL) within Faculty of Electrical Engineering, in collaboration with Unconventional Technologies and Equipment for Agro-Food Industry Laboratory (UTEFIL) within Faculty of Agriculture and Horticulture, within the University of Craiova.

In principle, EE-PV-CP is composed in a pressuring and vacuuming process hydraulic cylinder (PV-HC) consisting in a cylindrical vessel (inner \varnothing 80; length 180 mm) made in W1.4571 and a food grade Teflon made piston (Figure 2). PV-HC is provided with a manometer gauge (0...12 bar) for pressuring process monitoring, and a mano-vacuumeter gauge (-1... 1,5 bar) when vacuuming process is actuated. In order to evacuate the liquid / gas excess before and after PV-CP, the piston is provided with G1/4" tap connected to \varnothing 8 Rilsan tube [7-9].

In order to actuate the pressuring and vacuuming process into EE-PV-CP, universal testing machine *LBG 10* (within EPIL), was used.

Pressuring and vacuuming cyclic method consists in the following processing steps:

- The sheep brisket manually pierced (4 times, as was presented above) is introduced into the PV-HC of the EE-PV-CP that contains 12% concentration brine (proportion 1:1 for sheep brisket, and salt brine, respectively).

- Each pressuring and vacuuming cycle lasts 24 min consists in 4 successive steps, each lasting 6 min (Figure 3):

- pressuring cycle (3 minutes): slow pressuring (during 1 min) up to 10 bar; maintaining for 1 min at 10 bar, followed by fast depressuring up to the ambient atmosphere;

maintaining for 1 min at the ambient atmosphere pressure;

- vacuuming cycle (3 minutes): slow vacuuming (during 1 min) up to -0,85 bar; maintaining for 1 min at -0,85 bar, followed by fast de-vacuuming up to the ambient atmosphere; maintaining for 1 min at the ambient atmosphere pressure.

For this paper were used 2, 3, 4 and 5, respectively, pressuring and vacuuming cycles that last 48 min (PV-CP 48), 72 min (PV-CP 72), 96 min (PV-CP 96), and 120 min (PV-CP 120), respectively. For each pressuring and vacuuming cycle process lasting 48 min, 72 min, 96 min and 120 min, respectively, two pieces of sheep brisket were used.

All the eight sheep brisket tenderized by using pressuring and vacuuming cyclic process were smoked and dried in the same time (and technological conditions) with the pieces used to obtain *Sheep Pastrami* by using traditional method.

The most relevant and utilized texture and tenderness tests is Warner - Bratzler shear test. The shear force behavior gives information about tenderness, as well as the bite characteristic products. The shear blade realizes compression for slicing / shearing tests on products [3,6,10-13].



Figure 2. Experimental Equipment for PV-CP

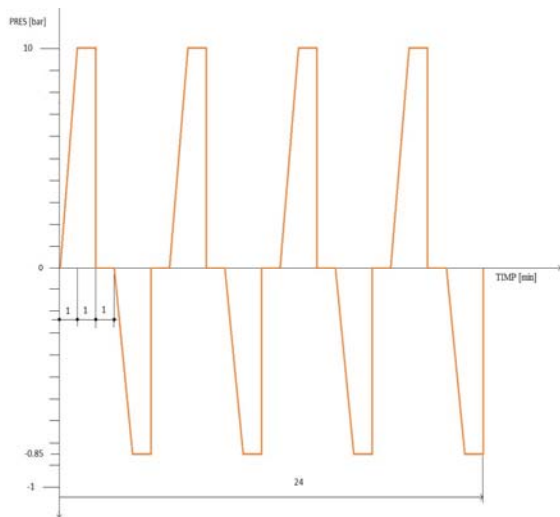


Figure 3. Pressuring and vacuuming cyclic process diagram

To perform interdisciplinary researches concerning general texture and tenderness analysis, universal testing machines *Lloyd Instruments LRXPlus 5* (within UTEFIL), was used since several years ago to perform comparative texture tests [6-9].

Due to collaboration between UTEFIL and EPIL, experimental Warner - Bratzler equipment was made: special rigid frame (made in food-grade Teflon) supporting a shear bar that permits interchangeable Warner - Bratzler shear blades sliding (square plate cut blade made in DIN W1.4571) into the frame [6-9].

During the experiment presented in this paper, 100mm/min cutting speed was used.

Warner - Bratzler testing shear force of *Sheep Pastrami* obtained by using beef brisket tenderized by using PV-CP 96, is presented in Figure 4.



Figure 4. *Sheep Pastrami* obtained by using PV-CP 96, during Warner - Bratzler testing shear force

3. RESULTS AND DISCUSSIONS

In order to determine the influence of tenderizing process on the final product tenderness', *Sheep Pastrami* pieces made by using traditional homemade method, and tenderized pieces by using PV-CP, respectively, were tested by using Warner - Bratzler shear force method. During the Warner - Bratzler shear force tests, each of all 10 pieces of *Sheep Pastrami* were sliced in 6 parts. Warner - Bratzler shear force diagrams are presented in Figure 6 and Figure 7.

In Table 1 are presented: the maximum shear force amount and the shear force average for each of the five of *Sheep Pastrami* types; the decrease of percentage average shear force (in comparison with traditional homemade *Sheep Pastrami*'s tenderness) by using each process method, that demonstrate the tenderness' increase of the final product, that was tenderized by using pressuring and vacuuming cyclic process.

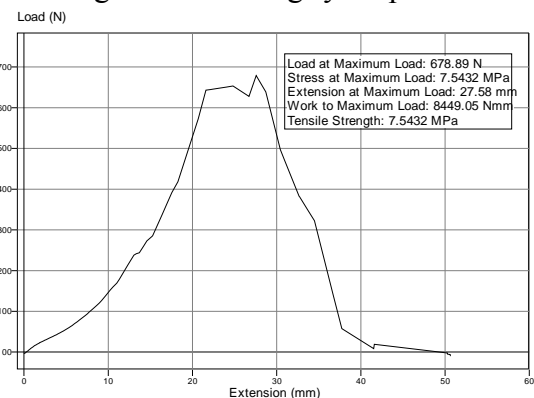


Figure 5. Warner - Bratzler shear force test diagram for *Sheep Pastrami* made by using traditional method

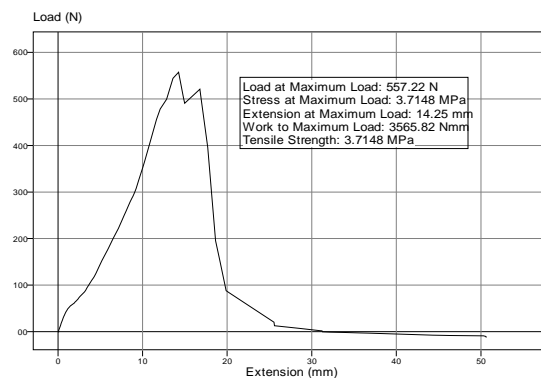


Figure 6. Warner - Bratzler shear force test diagram for *Sheep Pastrami* made by using PV-CP 72 method



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Table 1 presents a synthesis of the influence of pressuring and vacuuming cyclic process on *Sheep Pastrami* final tenderness':

- in comparison with traditional homemade *Sheep Pastrami*'s tenderness, PV-CP 48 method determines a small tenderness' increasing of the final product (7,65%);

- in comparison with traditional homemade *Sheep Pastrami*, an important fast increasing (from 18,97% to 30,98%) of the final product tenderness' is observed when PV-CP 72 and PV-CP 96 were used;

- instead, very large increase (from 30,98% to 36,57%) of the final product *Sheep Pastrami* tenderness' is observed when PV-CP 96 and PV-CP 120, in comparison with traditional home-made *Sheep Pastrami*'s tenderness.

The influence of pressuring and vacuuming cyclic process on raw meat to obtain *Sheep Pastrami* determines 3-7% smaller amounts of the shear force than when pressuring cyclic process is used for tenderizing *Sheep Pastrami* [7].

Warner - Bratzler shear force for *Sheep Pastrami*

Table 1

Sample code	Maximum shear force min...max amount, N	Shear force average, N	Decrease of shear force average, %
TRAD	634,56...718,31	673,34	-
PV-CP 48	587,23...642,78	621,85	7,65
PV-CP 72	502,45...593,56	545,57	18,97
PV-CP 96	447,67...509,11	464,73	30,98
PV-CP 120	385,17...449,82	427,12	36,57

4. CONCLUSIONS

Cyclic pressuring and vacuuming process represents a novel method to obtain increasing of *Sheep Pastrami* tenderness'. Due to pressure and vacuuming amount levels, and fast pressuring and de - pressuring steps, and vacuuming and de-vacuuming, too, cyclic pressuring and vacuuming process effect's

determines much faster osmosis phenomena that realizes the brine infusion into the meat' tissues, and *no other wet salting / brining is necessary*.

The method presented in this paper is better in efficiency term than pressuring cyclic processing and represents a much more intensively tenderizing method than massaging vacuum equipment in industrial processing [7].

As one of the most recommended analyze method, the Warner - Bratzler shear force test offered objective results concerning the influence of cyclic pressuring and vacuuming process on meat final products tenderness'.

The method and the results presented in this paper opens further experimental researches concerning the influence of similar cyclic pressuring and vacuuming process (higher pressure level, shorter or longer pressuring and de-pressuring, vacuuming and de-vacuuming, too) to produce *Sheep Pastrami*, by using other much more tenderless parts of animal's carcass.

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