THE INFLUENCE OF PRESSURING AND VACUUMING CYCLICPROCESSON TENDERIZING *BEEF PASTRAMI*

Prof. univ. Phd. ROŞCA DANIELA,
University of Craiova, Faculty of Electrical Engineering
Assist. Prof. Phd. ROŞCA ADRIAN
University of Craiova, Agriculture and Horticulture Faculty

Keywords: pressuring and vacuuming cyclic process, beef meat tenderizing, Warner - Bratzler method

ABSTRACT

The paper presents the mechanical characteristics of Romanian traditional cured-smoked product "Beef Pastrami" type, made by using beef rawtenderized after successive pressuring and vacuuming cyclic 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 pressuring and vacuuming cyclic 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 vacuumingand de - vacuuming cyclic processing (0…-0,85 bar). The paper presents characteristic shear force amount obtained by using Werner - Bratzler testing method for thetenderized and cured-smoked final product, in comparison with the no tenderized meat sample.

INTRODUCTION

The word *pastramă* is etymologically rooted in the Romanian *a 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.

Pastrama is a popular meat in Romania, traditionally made from lamb, sheep, mutton, goat and also from pork and beef. *Pastramă* was originally created as a way to preserve meat before modern refrigeration. For pastrami, the raw meat is brined, partly dried, seasoned with various herbs and spices, then smoked and steamed.

Pastrami is made from beef brisket (which comes from the lower chest of the steer), or from beef navel (a small piece cut from the muscle known as the plate).

Traditional industrial made *Pastrami* is cured meat, meaning that it has been quickly injected with brine usually containing preservation additives (in industrial process) or otherwise infused for long time with brine (several weeks in homemade or small enterprise process) [13].

Both beef brisket and beef navel are tenderless parts of the animal's carcass.

Therefore in the industrial process, after brine injection process, the meat is tenderizedfor 6-8 hours in massaging vacuum equipment (maximum relative vacuum up to -0,7 bar).

For the same reason, in homemade or small enterprise process, the meat is tenderized for 1-3 weeks in high concentration brine containing additional flavours added. Then, traditional *pastrami* is cold smoked, and finally dried in ventilated cold air [1,2,8,13].

Mechanical tenderization actions produce multiple cuts in the meat muscle 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 to the cooking moulds. Tenderization, pre-massage and massage are closely inter-related, 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.

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 [2,8,9,10].

In order to reduce the tendering process as much is possible, this paper presents a novel tenderizing method based on pressuring and vacuuming cyclic process.

MATERIAL AND METHOD

Processing method and equipment

In actual massaging vacuum processing equipment the vacuum level do not exceed - 0,7 bar. American and West-European meat tenderizing recent research papers recommendincreasing the vacuum level up to - 0,95 bar, or high pressure process up to 5000 bar [1,3,9]. In previous recent papers are presented new contributions concerning the influence of cyclic pressuring, and cyclic vacuuming, respectively on *Beef Pastrami* and and other romanian traditinal meat roducts tenderness' [6,7].

In order to produce *Beef Pastrami*, 10 pieces of commercial beef brisket was used (according Animal Slaughter Certificate: cow, 13 years, individual small farm).

Two of these pieces were used to produce *Beef Pastrami* respecting traditional home-made or small enterprise process: the meat was 6 times manually pierced (Figure 1), then infused for 12 days in 12% concentration brine, then cold smoked in several steps during 24 hours, and finally, dried 12 hours in ventilated cold air.

The piercing step was realized by using the *Multi-needle piercing device* (Figure 2), that in principle consists in 120 needles (ø5, 20^0 conical sharp) disposed in the same shape and reciprocity distance alike into the industrial brine injection equipment [4,5,7].

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 the brine, too, into a pressure vessel. 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 (PV-CP) on meat tenderization, *Experimental Equipment* (EE-PV-CP) was used.

Figure 1. Sheep brisket manually piercing

Figure 2. Multi-needle piercing device

Experimental Equipment for PV-CP and *Multi-needle piercing device* were designedand made by Unconventional Technologies and Equipment for Agro - Food Industry Laboratory (UTEFIL) within Faculty of Agriculture and Horticulture, in collaboration with Environmental Protection in Industry within Faculty of Electrical Engineering (EPIL), 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 ø 80; length 180 mm) made in stainless steel W1.4571 and a food grade Teflon made piston (Figure 3).

PV-HC is provided with a manometer gauge (0…12 bar; 1,6 class), and a mano-vacuumeter gauge (-1…1,5 bar; 2,5 precision class) 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 ø8 Rilsan tube [4,5,7].

In order to actuate the pressuring process into EE-PV-CP, universal testing machine *LBG 10* (within Environmental Protection in Industry within Faculty of Electrical Engineering), was used (Figure 3).

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

- The raw beef brisket 6 times manually pierced (as was presented above) is introduced into the PHC of the EE-PV-CP that contain 12% salted concentration brine (proportion 2:1 for raw beef brisket, and salt brine, respectively).

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

- pressuring cycle (3 minutes): slow pressuring (during 1 min) up to 10 bar; maintaining for 1 min at 10 bar, followed by fast de-pressuring 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 raw beef brisket were used.

All the eight raw beef brisket tenderized by using pressuring and vacuuming cyclic process were smoked and dried in the same time (and techno-logical conditions) with the pieces used to obtain *Beef Pastrami* by using traditional method.

Figure 3.Experimental Equipment for PV-CP

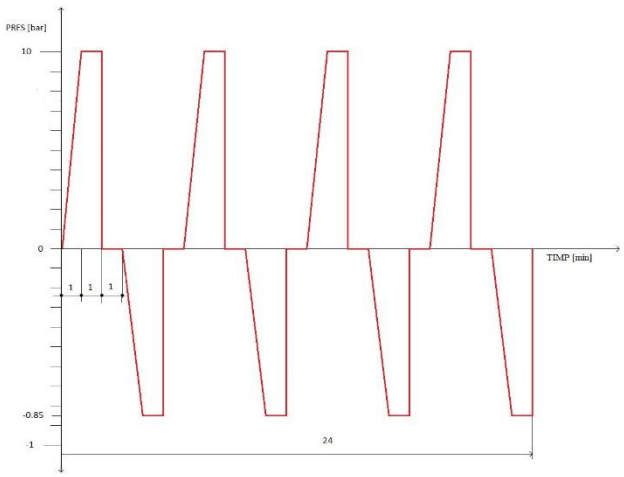

Figure 4. Pressuring and vacuuming cyclic process diagram

Tenderness evaluation by using Warner - Bratzler method

The most relevant and utilized texture and tenderness tests are puncture / penetration test, compression test, and Warner-Bratzler shear test. The shear force behavior gives information about tenderness, as well as the bite characteristic products. The shear blade in direct compression for slicing / shearing tests on products [1,4,58,9,11].

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 [4,5,6].

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 - Bratzlershear blades sliding (V and square plate cut blade made in stainless steel DIN W1.4571) into the frame [4,5,6].

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

Warner - Bratzler testing shear force of *Beef Pastrami* obtained by using beef brisket tenderized after PV-CP 96 and PV-CP 120, are presented in Figure 5.

a b

Figure 5. Beef Pastrami during Warner - Bratzler testing shear force (a - PV-CP 96; b - PV-CP 120)

RESULTS AND DISCUTIONS

In order to determine the influence of tenderizing process on the final product tenderness', *Beef Pastrami* pieces made by using traditional homemade method, and tenderized by using PV-CP, respectively,were tested by Warner - Bratzler shear force method. During the Warner - Bratzler shear force tests, each of all 10 pieces of *Beef 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 *Beef Pastrami* types; the decrease of percentage average shear force (in comparison with traditional homemade *Beef 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.

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

- in comparison with traditional homemade *Beef Pastrami*'s tenderness, PV-CP 48 method determines a small tenderness' increasing of the final product (11,38%);

- in comparison with traditional homemade *Beef Pastrami*, an important fast increasing (from 22,04% to 28,64%) of the final product tenderness' is observed when PV-CP 72 and PV-CP 96 were used;

- instead,large increase (from 28,64%...to 35,11%) of the final product *Beef Pastrami* tenderness' is observed when VP-CP 96 and VP-CP 120, in comparison with traditional home-made *Beef Pastrami*'s tenderness.

Table 1

Warner - Bratzler shear force for *Beef Pastrami* types

Sample code	Maximum shear force min…max amount, N	Shear force average, N	Decreaseof shear force average, %
TRAD	778,34…893,82	843,32	-
PV-CP 48	699,38…776,52	747,68	11,38
PV-CP 72	637,11…721,63	657,57	22,04
PV-CP 96	572,65...652,43	601,75	28,64
PV-CP 120	521,19…591,87	547,93	35,11

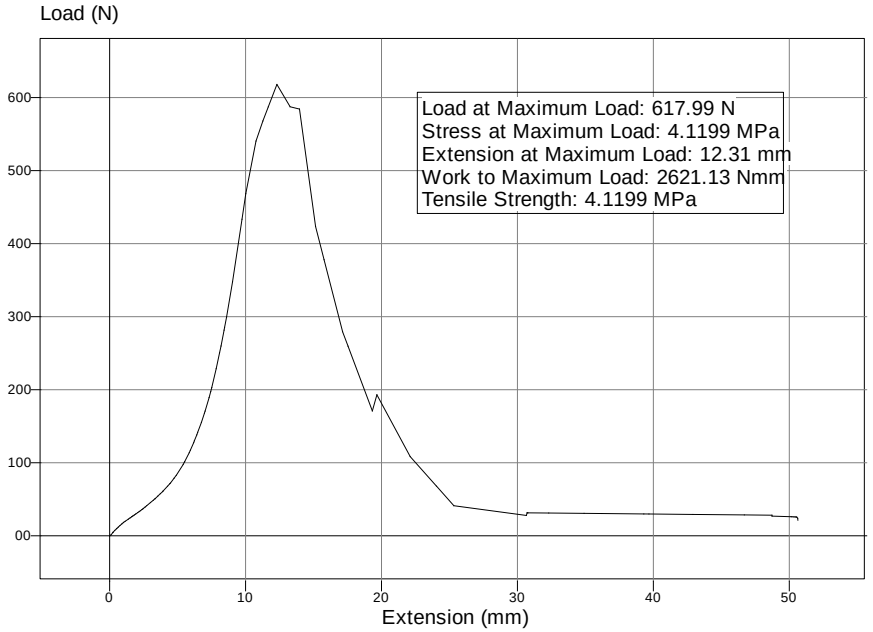

Figure 6. Warner - Bratzler shear force test diagram for Beef Pastrami made by using PV-CP 96 method

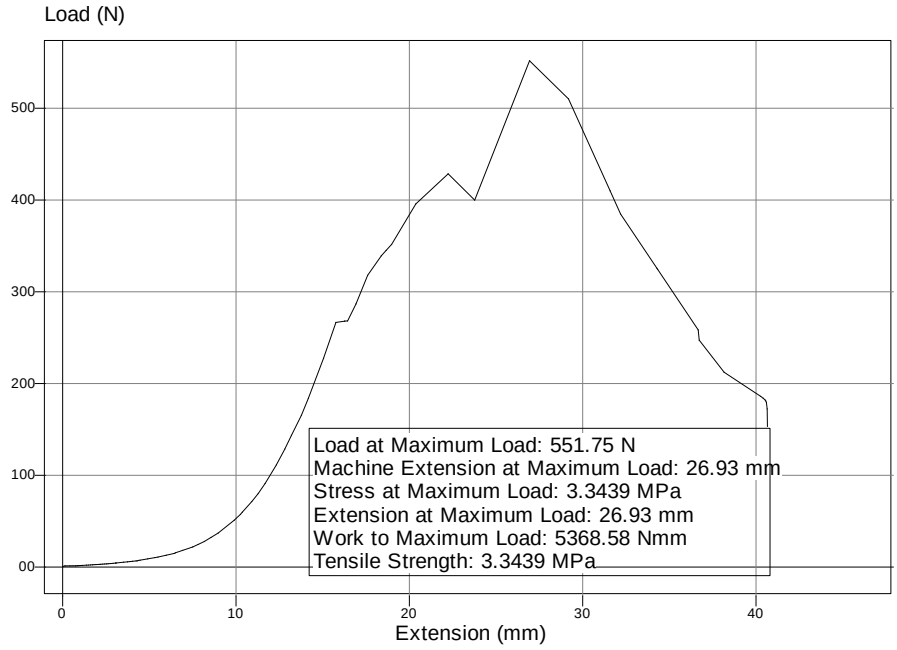

Figure 7. Warner - Bratzler shear force test diagram for Beef Pastrami made by using PV-CP 120 method

CONCLUSIONS

Cyclic pressuring and vacuuming process represents a novel method to obtain increasing of *Beef 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 vacuuning process effect's concerning much faster osmosys phenomena that determine the brine infusion into the meat' tissues, and no other wet salting / brining is necessary.

The method presented in this paper is similar in efficiency term with vacuum 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'.

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 *Beef Pastrami*, by using other much more tenderless parts of animal's carcass.

BIBLIOGRAPHY

1.**Institute of Food Technologists**, 1981 - *Sensory evaluation guide for testing food and beverage products*, Food Technol., 35 (11), pp. 50-59.
2.**McGee H.**, 2004,*On food and cooking, the science and lore of the kitchen,* Scribner, pp. 155 (ISBN 978-0-684-80001-1).
3.**Roşca A., Roşca Daniela**, 2012 - *Considerations concerning the influence of high pressure and low vacuum processing on candy fruits preservation,*Annals of the University of Craiova, Biology, Horticulture, Food produce processing technology, Environmental engineering Series, Vol. XIII (XLIX), pp. 413- 417 (ISSN 1435-1275).
4.**Roşca A., Roşca Daniela** - 2013, *Instrumental texture evaluation - An objective method to evaluate fresh vegetables quality.* Journal Progress of Cryogenics and Isotopes Separation, ICSI-ICIT Rm. Valcea, Vol. 16, issue 1/ 2013.
5.**Roşca A.**, 2014 - *Food industry equipments. Course Support*, Agriculture and Horticulture Faculty, University of Craiova.
6.**Roşca A., Roşca Daniela, Simion A.D.**, 2014 - *Tenderizing machines for traditional meat products processing*,Journal Progress of Cryogenics and Isotopes Separation, ICSI-ICIT Rm. Valcea, Vol. 18, issue 1/ 2014.
7.**Roşca A., Roşca Daniela**, 2014 - *The influence of vacuum cyclic process on tenderizingBeef Pastrami,* Proceedings of the 20-th ICIT National Conference "Progress in Cryogenicsand Isotopes Separation", Calimanesti, Romania, October 25 (ISBN 978-973-750-249-00).
8.**Tyszkiewicz I., Klossowska B.M.**, 1996 - *Mechanical Tenderization of Pork Meat: Proteinand Water Release due to Tissue Damage*, Journal of the Science of Food and Agriculture, Vol. 73(2), pp. 179 - 185.
9.**Xargayó M., Lagares J., Fernández E., Borrell D., Sanz D.**, 2011 - *The impact of tenderization on increased slicing yield,*http://en.metalquimia.com/upload/document/article.
10.**Xianzhong Xu, Shaofang Yuan**, 2011 - *An examination of the force generated from incisor penetration into foods with different textural properties part I: Experimental observation,*Journal of Texture Studies, Special Issue, Vol. 42, Issue 3, pp. 228-235.
11.www.lloyd-instruments.co.uk
12.http://en.wikipedia.org/wiki/Pastrami
13.http://en.wikipedia.org/wiki/Tenderizing