Brazilian citizen and consumer attitudes and preferences regarding broiler breast PSE (Pale, Soft, Exudative) meat

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Abstract— **The objective of this work was to verify whether Brazilian consumers discriminate the broiler PSE breast fillets from normal and determine your preference, either in point of purchase (fresh) or after cooking. The PSE fillet samples were characterized by a pH=5.61 and an L*=59.26, compared to control samples with a pH=5.96 and an L=49.24, respectively (p≤0.05). In addition, the WHC (water-holding capacity) values in control samples were 14.50% higher, cooking loss was 30.92% lower and shear force was 65.41% lower compared to the PSE samples. The PSE samples were identified by consumers (untrained panelists) as paler, and the preference was for the control samples. Among the attributes of cooked samples, such as tenderness, flavor and juiciness, only flavor was significantly different (p≤0.05). Control samples presented higher acceptance values (p≤0.05) by the consumers.**

Keywords— **tenderness, juiciness, purchasing preference, sensory analysis.**

I. INTRODUCTION

The main quality attributes of meat are appearance, texture, juiciness, flavor, and functional and technological properties. Of these, the initial selection by consumers is based on appearance, which is usually related to color and tenderness. These sensory parameters are observed particularly when meat color is associated with the purchasing decision and the tenderness at the time of consumption [1].

The development of PSE in breast fillet meat has become an economic problem for the poultry industry worldwide. In a recent estimation of Brazilian annual production in 2010, there was an economic loss of over US $30 million because 1.0-1.50% in moisture is lost in weight by carcass due to the development of PSE meat [2]. The fundamental causes of the color abnormality in PSE meat are not fully understood; however, the biological origin of broiler PSE meat is likely caused by an excessive release of Ca^{2+} promoted by a genetic mutation of ryanodine receptors located in the sarcoplasmic reticulum of skeletal muscle cells as reported for pigs [3]. Showering the birds before slaughter at the commercial processing plant calms the birds down and contributes to the re-establishment of muscle Ca^{2+} homeostasis [4]. Transportation conditions from the farm to the commercial abattoir can also influence the formation of PSE meat [5, 6].

PSE meat has pH values generally lower than 5.8 due to rapid post-mortem pH decline while the carcass temperature is still high, resulting in the denaturation of myofibrillar and sarcoplasmic proteins, compromising their functional properties and the final quality of the meat [7, 8].

Some sensory evaluations of PSE broiler meat have been conducted using trained and untrained panelists; no significant differences in several attributes were reported [9, 10]. Recently, Zhuang and Savage [11] reported that the sensory texture profile of fillets categorized as paler was different from the profile of fillets categorized as either normal or dark.

Since studies about perception of untrained subjects publication towards PSE meat is scarce this study aimed to verify whether consumers discriminate the broiler PSE breast fillets from normal and

determine your preference, either in point of purchase (fresh) or after cooking.

II. MATERIALS AND METHODS

A. Sample preparation

Two hundred and sixty-two chickens of the Ross lineage aged 42 days were slaughtered according to the standard industrial plant practice. This consists of a sequence of electrical stunning, bleeding, de-feathering, evisceration, carcass water cooling, deboning and refrigeration as described previously by Guarnieri [4]. The length of time from slaughtering the birds until sample collection was approximately 90 min.

B. pH and color measurement

The pH was measured by inserting electrodes into the breast muscle according to Boulianne and King [12] using a contact pH meter system (Testo 205). Analysis was performed in triplicate at 90min post-mortem. A Minolta CR400 colorimeter was used to evaluate the color, L* (lightness), on the posterior surface of the intact skinless breast muscles at 24h post-mortem [13]. Twenty samples of breast fillets were collected; half of them were PSE meat, and half were normal control samples.

C. Shear force measurement (SF)

Tenderness was measured in fresh and cooked samples based on the methodology as described by Wilhelm [14].

D. Water Holding Capacity (WHC)

WHC was determined based on the original technique of Hamm [15].

E. Cook loss measurement (CL)

This measurement was performed described in Wilhelm [14].

F. Sensory evaluation

The sensory evaluation was performed in two steps employing different panels of consumers (untrained) for each tests. Each panel was composed by members of both sex an different ages. Step 1) at the purchasing point in the supermarket located at the northwest of Parana state carried out the evaluating the appearance of fresh breast samples in order to characterize PSE and normal samples. Directional paired comparison of color and purchasing intention tests were performed. Step 2) cooked PSE and normal samples were evaluated by triangule, attributes directional paired comparison and acceptance tests. Those experiments were carried out in individual booths with white light at Sensory Analysis Laboratory of Embrapa-soy, Londrina, PR, Brazil.

G. Statistical analysis

The results of purchasing intention, paired comparison and triangle tests were analyzed by binomial test [16]. The results of the acceptance test and the physicochemical evaluations were analyzed by ANOVA and Tukey test ($p \leq 0,05$) using the program STATISTICA 7.0 (Statsoft Inc. Corporate Tulsa, OK, USA) [17].

III. RESULTS

Table 1 shows a PSE incidence of 12.60% based on pH and L* values, similar to other reports [9, 10]. This incidence depends on the pre-slaughter management conditions; under extremely stressful conditions, incidences of up to 90.0% have been reported [18]. Table 1 also shows the mean values for WHC, CL and SF. Normal samples had a higher WHC (14.50%), a lower CL (30.92%) and a lower SF after cooking (65.41%) compared to PSE meat ($p<0.05$).

These results confirm the assumption that PSE meat is a consequence of lower pH and higher carcass temperature, which cause myofibril proteins to

denature and impair their functional properties, generating drip loss and paler breast fillet meat [5, 19, 20].

Table 1 Mean values of pH, color L*, water holding capacity (WHC), cook loss (CL), and shear force (SF), performed on fillet broiler PSE and normal breast fillets. N: Newtons.

Sample	pH_{24h}	L* (0 to 100)	WHC (%)	CL (%)	SF (N) fresh	SF (N) – cooked
Control (n=10)	5.96^{a} ± 0.08	49.24^{b} ± 3.47	69.28^{a} ± 5.67	26.84^{b} ± 5.68	14.96^{a} ± 3.35	24.7^{b}±5.7
PSE (n=10)	5.61^{b} ± 0.19	59.20^{a} ± 1.97	59.23^{b} ± 5.09	35.14^{a} ± 2.62	11.98^{a} ± 3.11	40.8^{a}±11.2

Different letters in the same column differ by Student's t-test ($p \leq 0.05$)

At this first step, it was verified the preference of consumer in relation to purchasing intention of PSE meat in relation to normal samples, since 50 out of 58 participants chose the normal samples ($p \leq 0.05$, two-sided). The reasons for this choice were better consistency and tenderness, a more attractive color, a pinkish hue, and a smaller amount of drip loss. In the other test of color paired comparison test and purchase intention , 43 out of 55 participants indicated that the PSE samples were paler ($p \leq 0.05$, one-sided), and 42 participants would purchase the normal instead of the PSE meat ($p \leq 0.05$, two-sided).

The second step was to verify the perception of consumers of the cooked meat. The overall difference was evaluated by the triangle test: there were 38 correct choices out of 68 participants, indicating a sensory difference among the samples ($p \leq 0.05$, one-sided). The main characteristics indicated by the assessors were tenderness (30.5%), flavor (25.3%), juiciness (19%) and others (25.2%). These attributes were selected for evaluation in the directional paired comparison test. The samples differed only in the flavor attribute ($p \leq 0.05$, one-sided), with the normal samples having a more pronounced chicken flavor attribute.

IV DISCUSSION

The panelists did not notice a difference ($p \leq 0.05$, one-sided) in terms of tenderness and juiciness, despite the difference in the SF test. For the untrained assessor, it was easier to perceive differences in the flavor attribute because it represents the sum of perceptions (aromatics, tastes, tactiles and chemicals feelings factors) resulting from stimulation of sense during the tasting [16]. WHC is the main factor influencing these attributes, particularly tenderness. It has been shown that PSE meat, by possessing more concentrated Ca^{2+}, contains higher protease activity and thus more tender meat [14]. In this experiment, the lower juiciness associated with the lower WHC values apparently had more influence than the enzymatic activity, and the meat became tougher. There is also an explanation for the flavor attribute difference for the control samples. Soares and cols [21] found 27.0 % more lipid oxidation in PSE compared to normal meat; rancidity is a problem for meat taste. Other reports of similar experiments conducted with untrained panelists found no significant differences between normal and PSE meat in tenderness, flavor, juiciness, acceptability and overall aspects [9, 10]. The acceptance test, in our experiment showed the consumers had preference for normal samples (mean score = 8.5) in relation to PSE meat (mean score 7.5) ($p \leq 0.05$). All panelists selected scores greater than or equal to 7.0 for normal meat. This was not the case for PSE meat samples since 1.7 % and 7.0 % of them assigned score 2.0 and 6.0 respectively, 8.6% assigned the indifference score (neither like nor dislike) and 82.7 % higher or equal to grade 7.0. The preference of consumers for the control samples indicated that the decrease in functional properties of the PSE meat is reflected in the behavior of the purchaser at the point of sale and during tasting of the cooked meat sample.

V. CONCLUSIONS

Consumer is able to differentiate fresh at the purchase point and cooked broiler chicken breast PSE from normal meat. There is a preference to purchase

refrigerated normal fresh meat and to consume cooked normal meat in relation to PSE breast meat.

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REFERENCES

1. Fletcher, D. L. 2002. Poultry meat quality. World Poult Sci J. 58:131-145.
2. Marchi DF, Oba, A., Ziober IL et al. (2009) Development of a gas chamber for detecting broiler chicken halothane sensitivity and PSE (Pale, Soft, Exudative) meat formation. Braz Arch Biol Techn 52:189-194.
3. Fujii J, Otsu K, Zorzato F, de Leon S, et al. (1991). Identification of a mutation in porcine ryanodine receptor associatedwith malignant hyperthermia. Science 253: 448-451.
4. Guarnieri PD, Soares, AL, Olivo R et al. (2004). Preslaughter handling with water shower spray inhibits PSE (Pale, Soft, Exudative) broiler breast meat in a commercial plant. Biochemical and Ultrastructural observations. J Food Biochem 28:269-277.
5. Simões GS, Oba A, Matsuo T et al. (2009) Vehicle thermal microclimate evaluation during brazilian summer broiler transport and the occurrence of PSE (Pale, Soft, Exudative) meat. Braz Arch Biol Techn 52:195-204.
6. Langer ROS, Simões GS, Soares AL et al. (2010) Broiler transportation conditions in a Brazilian commercial line and the occurrence of breast PSE (Pale, Soft, Exudative) meat and DFD-like (Dark, Firm, Dry) meat. Braz Arch Biol Techn 53:1161-1167.
7. Barbut, S (1996) Estimates and detection of the PSE problem in young turkey breast meat. Can J Animal Sci 76:455-457
8. Kissel C, Soares AL, Rossa A, Shimokomaki M (2009) Functional properties of PSE (Pale, Soft, Exudative) broiler meat in the production of mortadella. Braz Arch Biol Techn 52:213-217.
9. Komiyama CM, Mendes AA, Takahashi SE et al. (2009) Características qualitativas de produtos elaborados com carne de frango pálida e normal. Ciênc Tecnol Alim 29: 38-45.
10. Garcia RG, Freitas LW, Schwingel AW et al. (2010) Incidence and Physical Properties of PSE Chicken Meat in a Commercial Processing Plant. *Braz J Poult Sci* 12:233-237.
11. Zhuang H, Savage EM (2010) Comparisons of sensory descriptive flavor and texture profiles of cooked broiler breast fillets categorized by raw meat color lightness values. Poult Sci 89:1049-1055.
12. Boulianne M and King AJ (1995) Biochemical and color characteristics of skinless, boneless pale chicken breast. Poult Sci 74:1693-1698.
13. Soares AL, Ida EI, Miyamoto S et al. (2003) Phospholipase A2 activity in poultry PSE, Pale, Soft, Exudative, *J Food Biochem* 27:309-319.
14. Wilhelm AE, Maganhini MB, Blazquez FJ et al. (2010) Protease activity and the ultrastruture of broiler chicken PSE (Pale, Soft, Exudative) meat. Food Chem 119: 1201- 1204.
15. Hamm R (1960) Biochemistry of meat hydration. Adv Food Res 10:335-362.
16. Meilgaard M, Civille GV and Carr BT (1999) Sensory evaluation techniques. 3rd ed., Florida: CRC Press – USA
17. STATSOFT. (2006). STATISTICA for Windows**:** computer program manual. Versão 7.1. Tulsa: *Software Inc*.
18. Oba A, Almeida M, Pinheiro JW et al. (2009) Management of transport and lairage conditions on broiler chicken breast meat qualities and DOA (Death On Arrival). Braz Arch Biol Techn 52: 205-211
19. Olivo R, Soares AL, Ida EI and Shimokomaki M (2001) Dietary vitamin e inhibits poultry PSE and improves meat functional properties. J Food Biochem 25:271-283.
20. Shimokomaki M, Soares AL and Ida EI (2010) Protein and poultry meat quality. Pages 327-337 in Secondary Processing. Handbook of Poultry Science and Technology Y. H Hui, ed, New Jersey: John Wiley & Sons, Inc.
21. Soares AL, Marchi DF, Matsushita M et al. (2009) Lipid oxidation and changes in fatty acids profile related to broiler breast meat colour abnormalities. Braz Arch Biol Tech 52:1513-1518.