

# RACTOPAMINE HYDROCHLORIDE AND IMMUNOCASTRATION EFFECTS ON SENSORY CHARACTERISTICS OF ENHANCED PORK CHOPS LOIN

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**Abstract—** Sixty loins from two commercial farms crossbred pigs (Tempo, sire and Topigs 40, dams) and PIC crossbred pigs (G337 sire and CB22 dams) with a total of 12 treatments (n = 5) in a completely randomized design factorial 3 (female, FE, physically castrated male, PC, and immunocastrated, IC) x 2 (7.5 mg/kg ractopamine during 21 days) aiming to clarify the combined effects of these two technologies on sensory characteristics of enhanced pork chops loin, formulated with salt (0.75%) and tripolyphosphate (0.45%) was performed. A Consumer Acceptance (Affective) test was used with a consumer panel comprised of 31 untrained panelists who were frequent consumers of fresh pig meat. Samples were presented to panelists and asked to score their opinions on a 9 point hedonic scale where 1 was 'dislike extremely' and 9 'like extremely'. In general, the scores given were between 'like much' and 'like moderately'. Statistical results showed no significant difference (P > 0.05) among treatments considering texture and flavor of grilled chops loin, showing that both the improved loin FE, PC and IC, with or without RAC was not differentiated by consumers. In conclusion, the present study demonstrated that there was no difference in flavour, texture and appearance among the enhanced pork loins processed from the treatments evaluated in this experiment.

**Keywords—** ractopamine hydrochloride, immunocastration, enhanced pork loin, consumer acceptance test.

## I. INTRODUCTION

Consumer acceptance of entire pig meat is hindered by a strong, objectionable odour in the heated meat [1]. Physical castration of piglets is a procedure commonly used to prevent the occurrence of sexual odour in male meat [2], reducing androstenone and skatole levels under

the threshold values to detect boar taint meat (1.0 and 0.25 µg/g, respectively). On the other side, this method gives rise to deep alteration in their metabolism [3,4], increasing the mortality, chronic inflammations and infections [5].

The immunocastration appears as a possibility to avoid the boar taint and also to take advantage from the naturally produced anabolic steroid from the male's testis during their life [3,5] respecting their welfare. This alternative method of inhibiting sexual development, temporally suppresses the steroid production of testis before the slaughter, stimulating pig's own immune system to produce natural antibody against the gonadotropin-releasing factor (GnRF) [6] and effectively reduces the production and accumulation of both androstenone and skatole in the pig carcass fat.

Ractopamine hydrochloride is a β-adrenergic compound analogous of catecholamines employed in swine feeding as a nutrient repartitioning additive, improving the growing efficacy rate, carcass composition and the cuts yield [7].

The enhancement is an industrial process to add value to the fresh meat by applying injection of low concentrations solution containing phosphates and salt. This procedure promotes an improvement of the sensory attributes like taste, juiciness and softness [8]. The ingredient's injection has been reported by several authors as to augment the palatability [9,10, 11].

The objective of this study was to evaluate the combined effects of these two technologies associated with two commercial crossbred pigs on sensory characteristics (flavour, texture and appearance) of enhanced pork chops loin, formulated with salt (0.75%) and sodium tripolyphosphate (0.45%).

## II. MATERIALS AND METHODS

### A. Animals

Animals (Topigs<sup>®</sup> crossbreed, n=60, Tempo, sire and Topig 40, dams and Agroceres<sup>®</sup>, n=60, AGPIC 337, sire and CB22 dams) from two commercial farms were randomly selected in females (FE, n=10), physically castrated (PC, n=10) and immunocastrated male pigs (IC, n=10), fed or not with RAC (7.5 mg/kg, Ractosuin<sup>®</sup>, Ourofino Agronegócio) for the final 21 days before slaughter. The boars designated to be immunocastrated received two doses of vaccine according to recommendation (Improvac<sup>®</sup>, Pfizer Animal Health). The experiment was carried out as a factorial (2 x 3) arrangement with RAC diet (0 and 7.5 mg/kg) and sex categories (FE, PC and IC). The slaughter procedure followed the current Brazilian practices.

### B. Processing

After slaughter carcasses were chilled during 220 to 24 hours and the *longissimus dorsi* were taken from the selected right half-carcasses, quickly frozen and stored at -31°C for at least two months before processing. The ingredients used on the formulation of the brine injection were sodium tripolyphosphate (Na<sub>5</sub>P<sub>3</sub>O<sub>10</sub>, INS n° E451i, Mw 367.9, Thermphos International B.V., Netherland) and table salt. The ingredients were mixed with cold water under mechanical continuous agitation inside a tank (capacity of 200 liters) and the brine solution was kept at 4° ± 1°C during injection process. After the injection (10%w/w) the pork chops loins from each treatment were tumbled during 15 min at 10 rpm, portioned, packaged under vacuum, identified and stored in a cold room at 0° ± 2°C during 72 h for equalization purpose. Microbiology evaluation from each treatment was carried out to ensure consumer health safety.

### C. Consumer Acceptance (Affective) test

The sensorial evaluation was performed in the Sensory Laboratory from Meat Technology Center / ITAL, located in Campinas, São Paulo, southeast of Brazil. The enhanced pork chop loins were prepared similarly as reported by Prestat et al. [12]. Before grilling to core temperatures of 71.5°±1°C the pork chops loin were wrapped in aluminum foil to reduce any loss of volatile compounds. Samples were cut into cubes of 2.5 cm, individually wrapped in aluminum foil and kept in a warm oven set at 40°C. A glass of water at room temperature was presented to the consumer together

with the cooked meat samples with the instruction to drink some water in between evaluation of each sample.

A consumer panel comprised of 31 panelists who were frequent consumers of fresh pig meat was carried out in two sessions. Samples were presented to panelists in a way monadic and they were instructed to evaluate the meat odour immediately after opening the aluminium foil coverage and afterward the acceptability of flavour and texture. A preference test as well as an intention to purchase assessment was also carried out under laboratory conditions. The age, gender, frequency of pork consumption and economical class of each consumer were recorded. The age distribution of the consumers and the ration of women to men are given in Table 1..

Table 1. Age and gender distribution of the consumers.

Age (%)	Total	Men	Woman
18-25 years	38,7	50,0	33,3
26-40 years	45,2	30,0	52,4
41-59 years	16,1	20,0	14,3
Total (%)	100,0	32,3	67,7
Total (n)	31	10	21

### D. Hedonic scale

Panelists were asked to score their opinions on appearance, odour, texture, flavour and overall using a 9 point hedonic scale where 1 was 'dislike extremely' and 9 'like extremely'. The purchase intention evaluation used a 5 points hedonic scale: definitely not (1), probably not (2), maybe (3), probably would (4) and definitely would (5). For the calculations, the hedonic scales were considered as quantitative (1-9 and 1-5).

### E. Statistical analysis

The procedure GLM of SAS (SAS Institute Inc., Cary, NC, USA) was applied to ascertain if there were significant differences (p<0,05) on all independent variables evaluated in the study. In the model were included sex, ractopamine and crossbreed as fixed effect, taste session was considered as blocking effect and consumer as random effect.

## III. RESULTS AND DISCUSSION

The results of the consumer panel sensory assessment and purchase intention of enhanced cooked pork chops loins are shown in Table 2. In general, the

scores given for both treatments were between ‘like slightly’ and ‘like moderately’. Small but not significant differences ( $P>0.05$ ) were found for all attributes tested considering the sex category (FE, PC and IC), inclusion of RAC in the diet or Crossbred. Regarding the purchase intention, the consumers rated that probably would (4) buy all the treatments and small but not significant differences were found among the treatments ( $P>0.05$ ).

This study found no differences in sensory attributes of the enhanced cooked pork chops loins independent the sex category, RAC and crossbred pigs evaluated. The results are consistent with those reported by [13] who demonstrated that an untrained Filipino consumer panel was unable to detect any sensory quality differences between pork from physical castrates boars, gilts or vaccinated pigs. Similarly, in early studies [4] using a trained sensory panel showed that pork from vaccinated boars was indistinguishable in sensory attributes to pork from female pigs. Others studies [5] also showed that an untrained Japanese consumer panel was unable to distinguish between pork from gilts, physical castrates and immunocastrates.

Regarding immunocastration, spanish consumers weren't able to distinguish difference in odour and flavour between cooked pork meat from immunocastrated, physically castrated and females [1], indicating that the cooking procedure diminishes the differences that may exist between genders for these attributes.

The enhancement technology applied in this study improves the appearance, flavor and texture as reported by others authors [9,10,11,12] due to the depolymerization of myosin filaments driven by synergic action of phosphate and salt, rising protein dissolution and electric charge of the system, culminating in the increase of the water holding capacity [11].

Table 2. Acceptance and purchase intention scores by an untrained panel (n=31).

Attributes	Sex <sup>A</sup>			RAC <sup>B</sup>		Crossbred	
	FE	PC	IC	0	7,5	A	B
Odour	6,5 <sup>a</sup>	6,8 <sup>a</sup>	6,5 <sup>a</sup>	6,7 <sup>a</sup>	6,5 <sup>a</sup>	6,7 <sup>a</sup>	6,5 <sup>a</sup>
Appearance	7,2 <sup>a</sup>	7,2 <sup>a</sup>	7,0 <sup>a</sup>	7,2 <sup>a</sup>	7,0 <sup>a</sup>	7,1 <sup>a</sup>	7,1 <sup>a</sup>
Texture	7,1 <sup>a</sup>	7,2 <sup>a</sup>	7,0 <sup>a</sup>	7,0 <sup>a</sup>	7,2 <sup>a</sup>	7,1 <sup>a</sup>	7,2 <sup>a</sup>
Flavour	6,3 <sup>a</sup>	6,7 <sup>a</sup>	6,3 <sup>a</sup>	6,5 <sup>a</sup>	6,4 <sup>a</sup>	6,5 <sup>a</sup>	6,4 <sup>a</sup>
Overall	6,6 <sup>a</sup>	6,9 <sup>a</sup>	6,6 <sup>a</sup>	6,7 <sup>a</sup>	6,7 <sup>a</sup>	6,7 <sup>a</sup>	6,7 <sup>a</sup>
Purchase intention	3,5 <sup>a</sup>	3,8 <sup>a</sup>	3,5 <sup>a</sup>	3,6 <sup>a</sup>	3,6 <sup>a</sup>	3,6 <sup>a</sup>	3,5 <sup>a</sup>

FE: Females; PC: Physically castrated; IC: Immunocastrated.

Different superscripts within rows indicate significant differences ( $p<0,05$ ).

<sup>A</sup> number of evaluations obtained for sex (n = 124)

<sup>B</sup> number of evaluations obtained for RAC (n = 186)

<sup>C</sup> number of evaluations obtained for crossbred (n=124)

The sensory improvements obtained for pork chops loins as a result of the enhancement applied might partially explain the small differences among the treatments studied. The conclusions from a choice experiment survey of Swedish consumers [16] and the earlier consumer survey from Australia report by [17] signals a positive acceptance for using vaccines to control boar taint compared to physical castration. Despite consumer unease about the use of new technologies in food production, participants in these surveys found vaccination to control boar taint to be acceptable on animal welfare grounds compared with physical castration, as long as there was equivalent taste quality.

#### IV. CONCLUSIONS AND IMPLICARTIONS

In conclusion, the present study demonstrated that there was no difference in flavour, texture and appearance among the enhanced pork loins processed from the treatments evaluated in this experiment.

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## REFERENCES

1. Furnols M F, Gispert M, Guerrero L, et al. (2008) Consumer's sensory acceptability of pork from immunocastrated male pigs. *Meat Sci* 80:1013-1018
2. Anabel E. (2006) Global Control of boar taint Part 3. Immunological castration. *Pig Prog.* 22: 6-9
3. Bonneau M. (1998) Use of Entire Males for Pig Meat in the European Union. *Meat Sci* 49: 257-272
4. Boghossian, V., Hennessy, D., Moseby, J., Salvatore, L., Sali, L., Jackson, P., Reynolds, J. and Mawson, R. (1995). Immunocastration - A strategy to produce taint free high quality pork from intact males. *Proceedings 41st International Congress of Meat Science and Technology August 1995.*
5. Boghossian V., Hennessy D., Reynolds J., and Walker J. (1999). Effect of an Anti-Boar Taint Vaccine on the Sensory Quality of Pork. *Proceedings 43rd International Congress of Meat Science and Technology August 1999.*
6. Oliver W T, McCauley I, Harrell R J. et al. (2003) gonadotropin-releasing factor vaccine (Improvac®) and porcine somatotropin have synergistic and additive effects on growth performance in group-housed boars and gilts. *Anim Sci* 81(8): 1959-1966
7. Dunshea F R, D'Souza D N, Pethick D W. et al. (2005) Effects of dietary factors and other metabolic modifiers on quality and nutritional value of meat. *Meat Sci* 71: 8 – 38
8. Jaros P, Bürgi E, Stärk K D C, et al. (2005) Effect of active immunization against GnRH on androstenone concentration, growth performance and carcass quality in intact male pigs. *Liv Prod Sci* 92: 31–38
9. Stites C R, McKeith F K, Singh . D et al. (1991) The effect of ractopamine hydrochloride on the carcass cutting yields of finishing swine. *J of Anim Sci* 69: 3094-3101
10. Iocca A F S, Catanozi M P L M, Lemos A L S C (2010) Adição de plasma bovino em salmouras para injeção de coxão duro bovino (m. Biceps femoris) e seus efeitos no pH e na carga microbiana de bifes cozidos, embalados a vácuo e mantidos sob refrigeração. *Alim Nutr* 21: 443-452
11. Vote D J, Platter W J, Tatum J D, et al. (2000) Injection of strip loins with solutions containing sodium tripolyphosphate, sodium lactate, and sodium chloride to enhance palatability. *J of Anim Sci* 78: 952-957
12. Sheard P R, Tali A. (2004) Injection of salt, tripolyphosphate and bicarbonate marinade solutions to improve the yield and tenderness of cooked pork loin. *Meat Sci* 68: 305-311
13. Singayan-Fajardo, J. Quizon, M. and Hennessy\*, D. Eating quality and acceptability of pork from Improvac® immunized boars. *Proceedings Int Pig Vet Soc, Copenhagen, 2006.*
14. Xiong Y L. (2005) Role of myofibrillar proteins in water-binding in brine-enhanced meats. *Food Res Int* 38: 281-287
15. Prestat C, Jensen J, McKeith et al. (2000) Cooking method and endpoint temperature effects on sensory and color characteristics of pumped pork loin chops. *Meat Sci* 60: 395-400
16. Lagerkvist, C.J., Carlsson, F and Viske, D. Immunocastration of male pigs by immunization against gonadotrophin-releasing hormone as an alternative to surgical castration or no castration: A choice experiment with Swedish consumers. *AgBioForum* 2006. In press and personal communication 2006
17. Hennessy, D and Newbold R. Consumer attitudes to a boar taint vaccine, Improvac® - A Qualitative Study. *Proceedings Int Pig Vet Soc, Hamburg, Germany, 2004.*
18. Xiong Y L, Gower M J, Li C, et al. (2006) Effect of dietary ractopamina on tenderness and postmortem protein degradation of pork muscle. *Meat Sci* 73: 600-604