

# PRODUCTION OF ARTISAN DRY-CURED HAM IN CHILE: EVALUATION OF SENSORY AND SANITARY QUALITY

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**Abstract - In Chile, the interest in improving meat quality characteristics in pork carcasses from pigs reared in outdoor systems through the production of artisan dry-cured ham is growing and it is resulting in a better economic return for the producers. This work aims to assess the dry cured ham production method in terms of technical feasibility, food safety and organoleptic characteristics and qualities. Five pig's legs from pigs reared in outdoor pastures in south central Chile were processed. The dry-cured ham production system included the steps of salting, post salting, drying and ripening. At the end of the process weight losses reached 33.7%. Microbiological assessment showed that the product fulfilled Chilean food safety regulations for this kind of food product. There was no evidence of spoilage on the food product. Finally, results of sensory analysis showed the product was acceptable to the consumer. Considering the production process and the assessed quality aspects, it was demonstrated that the artisan dry-cured ham had characteristics that can make the product potentially competitive; hence it could establish itself in the current niche market for charcuterie in Chile.**

**Key Words - Charcuterie, Pigs, Preservation**

## I. INTRODUCTION

In Chile, pork production is run almost entirely under intensive conditions, with almost 98% of the 2,8 millions of pigs reared under these conditions [1]. The remaining 2% are reared by small producers either for their own consumption (backyard pigs or subsistence farmers) or for the production of sausages for local markets [2]. These low proportion of pigs are fed on natural or sown pastures in a low cost production system. Chilean imports of dry-cured meat products have risen about 80% in the last decade, reaching a peak return of US\$ 1,6 million on 2012 [3].

The aim of this project was to produce an artisan dry-cured ham taking advantage on the growing interest for dry-cured meats in the local market; hence, giving an added value to pigs non-commercially reared. For that purpose dry-cured hams were produced locally on farm and the resulting produce was characterised according to their dehydration patterns under the proposed production system, and were also assessed in their microbiological and sensory qualities.

## II. MATERIALS AND METHODS

### *Production of artisan dry-cured ham*

Five hind legs from pigs reared on pasture in the province of Parral, Maule region, Chile were processed in order to produce dry-cured ham. Pigs were slaughtered at a local abattoir hence following all local legislation regarding animal welfare and food safety (including *T. spiralis* testing).

The average weight of the hams were  $10,28 \pm 0,46$  Kg. The production of dry-cured ham was performed in four steps. Firstly, during salting, the produce were covered with salt for 1,5 days/kg of weight and stored at 3°C. Secondly, during the post salting period, salt was removed and the hams were washed and dried. Once that process was finished hams were stored at 3°C for 95 days. Finally, during the drying and ripening steps, hams were stored on shelves under constant room temperature for 280 days. During the production process legs were weighed weekly and the recorded data were analysed for descriptive statistics.

### *Microbiological evaluation of the product*

At the end of the ripening period samples were taken aseptically from tissues surrounding the

coxo-femoral joint, including both surface tissue and deeper tissue. Samples were analysed according the Chilean Ministry of Health's regulations for foodstuffs and involved analysis for *Staphylococcus aureus*, *Salmonella* spp., *Escherichia coli* and *Listeria monocytogenes*.

#### *Sensory evaluations of the product*

Organoleptic characteristics and acceptability of the artisan dry-cured ham were assessed and compared against imported Spanish dry-cured ham available in the Chilean market. Fifty panellists took part in the study and the assessment was carried out at the Laboratory of Sensory Evaluation, University of Bio-Bío, Chillán, Chile.

Ham samples were cut in pieces of 2 mm in thickness, 4 cm in height and 3 cm in width and later identified by a random code number. Each panellist received one sample of each ham separately, allowing from one to 3 minutes between samples as a period to cleanse the palette (using water as palette cleanser).

Because global acceptability reflects the interaction of all sensorial characteristics of a food product in the consumer, this item was included in the sensory evaluation of both hams (artisan and commercial). Additionally aroma, flavour, texture and colour were assessed according to a sensory test with a hedonic scale of acceptance with five points (1. very unpleasant, 2. unpleasant, 3. neither pleasant nor unpleasant, 4. pleasant, and 5. very pleasant). Data were organised by sets for each entry and statistically analysed by ANOVA ( $\alpha=0.05$ ) in order to determine whether all the sensory attributes were equally accepted in the artisan dry-cured ham.

Additionally, acceptability was defined as favourable and unfavourable, according to the frequency of choices of each attribute and it was evaluated for each ham and between hams. Choices from three (neither pleasant nor unpleasant) to five (very pleasant) were considered as favourable, while choices between one (very unpleasant) and two (unpleasant) as

unfavourable. Data obtained for colour, texture and overall acceptability were analysed through Chi square. Data on flavour and aroma were analysed through accurate Fisher test.

### III. RESULTS AND DISCUSSION

Neither partial nor total product losses occurred during the production of the artisan dry-cured ham at the end of the dry-cured ham production process; however, since temperature and moisture were not controlled during the drying and ripening processes the formation of a crust (Fig. 1) also called “crusting” developed on the surface of the product. Crusting can be defined as the development of a superficial layer on dry-cured product extremely harder than the rest of the product [4, 5]. That is a phenomenon most commonly associated to hams with long ripening periods [6], and its occurrence is one of the most important technological problems in dry-cured hams products [4,5].



Figure 1. Crust formation on the meat surface.

As previously described in literature [7, 6, 8], in order to prevent excessive dehydration of meat in the ham piece, halfway of the drying and ripening process a thin layer of lard was applied on the product and that was kept until the end of the production process.

The current study did use a similar production facilities as the one the ones that could be found in local small pig farms. Dehydration during the four steps of the process was 8% for salting, 22.5% for post salting and 33.7% for drying and ripening. All the production stages showed dehydration patterns clearly distinguishable from each other. These dehydration patterns could be used as an alternative method to determine the start and end of each of the four steps in dry-cured ham production process for artisan producers, whom due to economic constrains may not have technology available to fully control environmental conditions (temperature and humidity).

Commercial interest in using natural curing method, adding salt only, has grown [9] due to the potential detrimental effects of nitrates and nitrites [10], which are normally added in these meat products in order to control bacterial development. In this study the food product showed microbial levels in the accepted ranges according Chilean food safety legislation, which demonstrates the efficiency of salting in order to control relevant bacterial food-borne pathogens

Curing is an effective meat preservation method as it is unlikely for bacterial pathogens to survive after ripening [6]. Absence of *Enterobacteriaceae* 12 moth after production of Iberian dry-cured ham has been reported [11]. However, due to poor hygiene practices during handling and/or cross-contamination in further steps in the process such as storing bacteria can re-harbour the product [12]. Once re-colonising the food product, and despite the low activity water ( $a_w$ ) of dry-cured ham, these bacterial microflora can increase in number and reach unacceptable levels that could compromise food safety [13].

Microbial development can also negatively affect the quality of the product due to food spoilage. Overgrowth of bacterial spoilers can translate in unpleasant features to consumers due physical defects such as unwanted colour and texture changes and off odours [14], resulting in important economic losses to the dry-cured ham industry [15]. In this study all the hams

produced were carefully inspected and no spoilage due to bacterial development was observed.

There were no statistic differences in acceptability between the attributes aroma, colour, flavour, texture and global acceptability for the artisan ham. Additionally, point 4 (pleasant) had the highest frequency selection for the artisan dry-cured ham across the sensory panel. Data on global acceptability between the artisan and the Spanish commercial hams were compared and the results showed no statistic differences.

For artisan and Spanish commercial dry-cured ham every sensory attribute was compared using the favourable and unfavourable sensory criteria. No statistic differences were found for any of the five attributes evaluated (global acceptability,  $p=0.095$ ; texture,  $p=0.678$ ; colour,  $p=1.000$ ; flavour,  $p=0.461$ ; and aroma,  $p=0.062$ ).

#### IV. CONCLUSION

Through standardising both rearing of the animals as well as the manufacturing process it is possible to produce artisan dry-cured ham of high sanitary and organoleptic qualities. By using only salt as an ingredient the method used in this study could allow farmers who only rear pigs in extensive conditions to implement dry-cured ham production systems at low cost, hence giving a higher added market value to their produce.

#### ACKNOWLEDGEMENTS

The authors thank the Laboratory of Sensory Evaluation and the Laboratory of Food Microbiology of University of Bío-Bío, Chillán, Chile for their technical assistance.

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