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APPLICATIONS OF PICKLE CURING IN THE PRODUCTION OF SPANISH-TYPE CURED HAM

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INTRODUCTION

Increasing the protein consumption in semitropical countries such as Mexico implies not only higher and more efficient production of protein-rich foodstuffs such as meat, but also an increase in their shelf-life. In many cases, refrigeration is not readily available and alternative methods must be used. Curing of Spanish-type hams has proven to be a very successful method for increasing the shelf-life of meat. However, the time spent in processing increases the cost of producing this type of meat product. The objective of the present work was to evaluate the effect of a combination of pickle and dry curing, as well as time of ripening, on the reduction of the processing time of Spanish-type cured ham using two different curing mixtures.

MATERIALS AND METHODS

Experiment 1

Twenty-two hams from Duroc sows (no age or nutrition was recorded) were excised and kept under refrigeration at 2°C until used. Each ham weighed about 10kg. They were randomly assigned to six treatments (Table 1), in which dry and pickle curing treatments were applied at different times. Pickle curing brine was made of 70g salt, 50g sugar, 40g nitrate curing or commercial curing and 330ppm sodium ascorbate per litre of water. The brine was applied to the hams by multiple injection; they were later immersed in the brine (12°Bé) until curing was completed. Dry curing consisted of rubbing the dry mixture (70g salt, 15g nitrate curing or commercial curing and 5g pepper/10kg ham) on the ham surface. Storage was at 3 to 5°C and 85 to 95%RH. Ripening was achieved at 14 to 16°C and 75 to 80%RH. The experimental design is outlined in Table 1.

The treatments were compared against a control (0 days of pickle curing, 31 days dry curing and 30 days ripening, using only commercial curing). The response variables were: pH, water activity (measured in a Decagon water activity measurement system, model CX-1, Pullman, Wa.), colour (measured as L*, a*, b* coordinates in a Hunter Lab colour measurement system (Reston, Va.) using a white tile as standard and a type C illuminate.

Experiment 2

From the results of Experiment 1, it was decided to test only nitrate curing in different percentages, taking as 100% the formulation of Experiment 1. Twenty two hams of approximately 10kg were randomly assigned to the treatments shown in Table 2.

Brine for pickle curing was made of 90g salt; 22g sugar; 6g nitrate curing; and 480ppm sodium ascorbate. The dry

curing mixture consisted of 70g salt; 11g nitrate curing; 33g sugar; 3g pepper; and 1000ppm sodium ascorbate. Pickle and dry curing were applied as in Experiment 1. Hams were stored at 1.5 to 3.5°C and 85 to 90%RH during dry curing. Ripening was carried out as in Experiment 1. The response variables were: water activity, pH, colour (by Hunter Lab), residual nitrite and degree of oxidation (TBA) values, analyzed as described by Ockerman (1980). The last two were analyzed only for two days of ripening.

The data were subjected to an analysis of variance procedure and Duncan multiple comparison tests using a SAS package.

RESULTS AND CONCLUSIONS

Hams in Experiment 1, treated with 50 and 100% nitrate curing, and subjected to six days of pickle curing and 17 of dry curing showed the best red colour development and a pleasant odour. The rest of the samples underwent pigment oxidation, shown by the development of brown coloration. Significant differences were observed in all response variables (Table 3) between percentage of nitrate curing, and time of pickle curing, dry curing and ripening (data not shown). Levels of significance (Table 4) showed that all factors had a significant effect on pH, water activity and colour, with the exception of salt content on L and b*-values, and time of ripening on b*-values.

From the results of the first experiment, it was concluded that the use of nitrate curing resulted in a better product than that using the commercial curing, and it reduced the processing time without considerably affecting the quality of the product.

Hams in Experiment 2, treated with 75% of the curing mixture of Experiment 1 with curing times of three days for pickle curing; seven days for dry curing, and three days pickle curing; seven days dry curing had the best colour development. Samples with no pickle curing showed a fast oxidation development (data not shown). From Table 5 it can be concluded that there was a significant difference among treatments for pH and b*-values, due to the treatment and ripening ($P>0.0045$ and 0.0781 for pH), and to the treatment ($P>0.084$ for b*-values).

REFERENCES

Ockerman, H. W. 1980. *Quality Control of Post-mortem Muscle Tissue.* Vol. 1. Meat and Additive Analysis. Ohio State University. Columbus.

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Table 1. Experimental design, Experiment 1.

Compositions of curing mixtures*:		
50%:50% nitrate : commercial curing 100% nitrate curing		
Curing time (days):		
Pickle curing	Dry curing	Ripening
2	24	36
6	17	36
11	12	36

*Nitrate pickle curing: K+Na curing salt: salt (NaCl); Sugar; Na+K nitrates; sodium ascorbate
Commercial pickle curing: salt (NaCl); sugar; commercial curing mixture ("Premier", PESA, Mexico City); sodium ascorbate
Nitrite dry curing: salt, Na+K nitrates; pepper.
Commercial dry curing: salt; commercial curing mixture ("Premier", PESA, Mexico City); pepper.

Table 2. Experimental design, Experiment 2.

% Nitrate curing of Experiment 1	Days Pickle curing	Dry curing	Ripening
75	3	4	24
75	3	7	24
100	3	4	24
100	3	7	24
150	3	4	24
150	3	7	24
100	0	12	24

Table 3. Experiment 1: Analysis of variance.

Response variable	Error df	MS	P> model	R^2	CV
pH	71	0.027	0.0001	0.588	2.851
aw	71	0.0003	0.0001	0.632	2.027
L-values	71	1.158	0.0001	0.952	3.017
a-values	71	1.670	0.0001	0.588	3.001
b-values	71	0.515	0.0001	0.444	9.877

Table 4. Experiment 1: Levels of significance (P>).

Response variable	Source of variation % curing mixture	dry curing time	pickle curing time	ripening time
pH	0.001	0.0203	0.0207	0.0001
aw	0.007	0.0001	0.0001	0.0001
L-values	0.239	0.0001	0.0001	0.0001
a-values	0.001	0.0001	0.0001	0.0001
b-values	0.683	0.0001	0.0001	0.623

Table 5. Analysis of variance data for Experiment 2.

	Error df	MS	P> model	R^2	CV	P> treatment day
aw	6	0.0001	0.844	0.640	0.870	0.779 0.948
pH	6	0.0057	0.005	0.924	1.276	0.004 0.078
L-values	6	4.309	0.284	0.655	6.415	0.238 0.575
a-values	6	1.324	0.156	0.734	2.405	0.168 0.141
b-values	6	0.184	0.079	0.798	1.515	0.084 0.102