Development of dry-cured sausages using spent-hen meat: manufacturing practices and product physical, chemical and microbiological quality

Mise au point d'une saucisse fermentée à base de chair de poule de réforme : procédé de fabrication et qualités physico-chimiques et microbiologiques du produit fini

Desarrollo de embutidos curados a base de carne de gallinas de desecho: técnicas de fabricación y características físico-químicas y microbiológicas del producto final

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Laying hens that complete their egg production cycle in one year constitute one important by-product of the egg industry. They are referred to as spent-egg laying hens, spent layers, or spent hens. Locally, the meat of these spent hens is mainly sold on the fresh market and fetches a significantly lower price than fresh broiler meat. One of the avenues to improve the utilization of spent-hen meat is to process it into higher value-added products that are palatable and reasonable in cost. The food processing technique that has been chosen is fermentation and drying to produce dry-cured fermented sausages.

The research hypotheses were as follows: the meat, skin and abdominal fat of spent-hen meat are technologically suitable for making dry-cured sausages; fermentation/drying can lead to a safe, shelf-stable and quality poultry sausage. Thus, this study was conducted to develop and evaluate a fermented/dried 100-percent-poultry sausage made from spent-layer meat and fat.

Sausages were prepared using ground meat (breast, thigh and drumstick), skin, and abdominal fat at 10, 15 and 25% levels, salt, sodium nitrite, garlic, and glucose. The mix was inoculated with *Lactobacillus plantarum* at a rate of ~5.0 $\log_{10}$ colony-forming units (CFU/g). The sausages were stuffed in non-edible cellulose casings. They were dried at 30°C and 85% relative humidity for 15 days, and sampled at 0, 3, 6, 9, 12 and 15 days for analysis of protein and fat contents, color, pH, water activity, total viable count, *Salmonella* spp., *Staphylococcus* spp., and *L. plantarum* counts. Each treatment (25 sausages) was replicated three times.

Irrespective of fat levels, pH sharply declined in all batches from an initial value of 6.0–6.3, to 5.3 at day 3, and finally to 4.8–4.9 at day 15 of drying. The average initial moisture content of the sausages was 70% (wet basis). It decreased gradually during the fermentation/drying period to about 51–53% on day 6, and 35% on day 15, irrespective of fat levels. All experimental batches showed similar mass loss over drying time. Mass loss was more pronounced during the first six days (50–55%) and was mainly attributed to moisture loss, as fat drip losses were negligible. Water activity gradually declined from an initial value of 0.97 to 0.71 for the three fat levels. The sausage color changed to reddish brown as from day 3. This translated in decreasing L* (lightness) and positive b* (yellowness) values, and increasing positive a* (redness) values (Figure 1 and Table I).

No *Salmonella* was detected in any samples analyzed. Counts of *Staphylococcus* spp. were high with 10^4/g to 10^8/g at the end of the fermentation/drying period. *L. plantarum* counts increased

Figure 1: *Color of sausages (left) at day 0 and (right) at day 15 of fermentation/drying.*

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Table I

Physico-chemical characteristics and meat color attributes of dry-cured chicken sausages made with spent-layer meat and three levels of fat at the end of fermentation/drying[1]

	Fat content (mean ± SI of three replicates)		
	Low (10%)	**Medium (15%)**	**High (20%)**
Physico-chemical parameter			
pH	5.68 ± 0.31[a]	5.82 ± 0.69[a]	5.95 ± 0.69[a]
Titratable acidity (% lactic acid dry basis)	4.50 ± 0.44[b]	4.34 ± 0.93[b]	3.81 ± 0.67[b]
Water activity (a_w)	0.800 ± 0.010[c]	0.803 ± 0.011[c]	0.812 ± 0.008[c]
Mass loss (%)	61.75 ± 1.14[d]	60.88 ± 1.35[d]	60.37 ± 1.39[d]
Moisture content (g/100 g dry basis)	32.79 ± 3.35	34.34 ± 5.70	33.21 ± 2.04
Color parameter			
Lightness (L*)	54.50 ± 2.22[e]	52.26 ± 1.600[e]	51.78 ± 1.28[e]
Redness (a*)	9.41 ± 0.29[f]	9.50 ± 0.40[f]	9.19 ± 0.42[f]
Yellowness (b*)	12.13 ± 1.68[g]	10.83 ± 0.85[g]	10.49 ± 1.47[g]

[1] At 15 days, 30°C, 85% RH

SI: Standard deviation

[a,b…g] Means with the same letter superscript in a row are not statistically different ($p > 0.05$).

L*a*b*: As defined by the Commission internationale de l'éclairage (CIE)

during the first five days of fermentation from 4.9 to 8.7 $\log_{10}$ CFU/g and remained practically at this level for the rest of the drying period. There was unwanted mould growth on the cellulose casings as from day 3. In all cases, the sausages lacked the compactness typical of dry-cured sausages. The meat and fat particles in the final sausages were not uniformly distributed. This may be due to the low melting point of the fat thereby causing smearing of fat particles.

Overall, the potential of using spent-layer meat for the manufacture of dry-fermented sausage was shown to be technologically feasible. However there is a need to optimize the processing steps, especially with regard to the starter culture, and the temperature and relative humidity of fermentation/drying, to improve the safety and quality of the sausages.

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