



PHYSIOCHEMICAL PROPERTIES OF DRY-CURED HAMS FROM TAIWAN BLACK PIGS AND LYD HYBRID PIGS

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Background

Taiwan black pigs is a local two-way crossed pig breed in Taiwan area, which is crossbred by Taoyuan pigs and Duroc pigs (75%) (Tai *et al.*, 1992). Taiwan black pigs need be fed for 10-12 months and the average marketing live weight is 140-150kg. Meanwhile, LYD hybrid pigs are generally raised for meat pigs in there and need be fed for 5.5-6.0 months for marketing (average live weight: 110-115 kg). According to Tai *et al.* (1997) and Liu and Hsu (2000) the fat content and marbling degree of Taiwan black pigs were higher than that of LYD pigs but the moisture content was lower than LYD pigs.

Dry-cured ham constitutes one of the most traditional meat products, which after a long processing time become a tasty and flavorful products as a consequence of a great number of both physico-chemical and biochemical transformation such as an increase of small peptides, free amino acids and free fatty acids. A clear relationship has been established between the quality of the raw ham from different pig breeds and the sensory quality of the dry cured products (Antequera *et al.*, 1994; Aristoy and Toldrà, 1995; Berdagüe *et al.*, 1993; Gou *et al.*, 1995; Parolari *et al.*, 1994).

Objectives

The purposes of this study was to manufacture dry-cured ham from ham part of Taiwan black pigs (Taoyuan pigs x Duroc pigs (75%), feeding period: 10 months) and LYD hybrid pigs (Landrace x Yorkshire x Duroc (50%), feeding period: 5.5 months) and investigate the change of the physiochemical properties of dry-cured hams during processing and ripening (300 days).

Materials and methods

Ham: twenty Taiwan black pigs hams weighing 12-14kg and twenty LYD crossbreed pigs hams weighing 10-11kg were selected to manufacture dry-cured ham in this study. **Processing:** The hams were refrigerated for one day at 2-4°C and then nitrified with a dry salt mixture of 10g of NaCl, 0.1g of NaNO₂ and 0.15g NaNO₃, per kg of ham. After 24hr they were covered with salt for a period. Afterwards the hams were washed in cold water and hung at 3-5 °C in an atmosphere with a relative humidity between 80-85% for 60 days, increasing the temperature to 13-15 °C and decreasing relative humidity to 65-70% then they remained at these conditions until the end of ripening period (300 days). **Sampling:** three Taiwan black pigs and three LYD crossbreed pigs hams were sampled at each of the following periods: 24hr postmortem, resting (60 days=aging 0 day) and aging (60, 120, 180, 300). When fat and skin had been removed the lean tissue (including *M. rectus femoris*, *M. vastus medialis*, *M. vastus lateralis*, *M. semitendinosus*, *M. semimembranosus*, *M. biceps femoris*) was taken out by a stainless sampling tube (cone diameter: 2.5cm) from meat side of hams, the lean tissues were divided into two parts, one centimeter distance from meat side was external part sample, overpassed one centimeter was internal part sample. **Physicochemical assay:** yield and weight losses of hams were evaluated relative to their initial fresh weight. The proximate contents of raw hams were determined by AOAC (1990). The moisture, NaCl concentration, water activity (*A_w*), protein hydrolysis index of the dry hams were tested in this experiment. Finally, the sensory panel test of dry-cured hams was evaluated after the ripening of 300 days. A scale from seven to zero was employed for all sensory attributes in this study.

Results and discussion

The results showed that the crude fat of raw and the end dry-cured hams from Taiwan black pigs were higher than that of LYD hybrid pigs, but moisture protein and ash content were not significantly different between the two breeds (*p* > 0.05). The yield of dry-cured ham was 62.35% for Taiwan black pigs and 63.43% for



LYD hybrid pigs, respectively. The pH value of dry cured ham from the two breeds significantly increased with ripening time ($p < 0.05$) but no difference was found between the breeds. In the meantime, the moisture, internal and external water activity of dry-cured ham from the two breeds had no significant difference but significantly decreased ($p < 0.05$) during ripening period. The color of raw hams from the two breeds showed light red color, and then became dark red in the end products. The salt content of dry cured ham from the two breeds significantly increased with ripening time ($p < 0.05$) and was 6.97 and 6.90% respectively in the end products. The nitrite residue of dry cured ham from the two breeds significantly decreased with time ($p < 0.05$). The proteolysis index was 25.97% for the end products of Taiwan back pigs, and 24.82% for the end products of LYD hybrid pigs at the ripening 300 day. However, the sensory panel scores of dry cured ham from Taiwan black pigs were better than those of LYD hybrid pigs.

Conclusions

Hams from Taiwan black pigs have some advantages over those from LYD hybrid pigs in dry cured ham production: a higher fat content and marbling and a higher proteolysis index. The only sensory difference between hams was found in flavor trial. The Taiwan black pig is possibly better for dry-cured ham production under the processing condition used in this study.

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Table 1. The chemical compositions of raw meat and the end dry-cured ham from Taiwan black pigs and LYD hybrid pigs

	Moisture (%)		C protein (%)		C fat (%)		Ash (%)	
	Raw	The end	Raw	The end	Raw	The end	Raw	The end
Black	75.86 ^{ax}	48.35 ^{bx}	18.54 ^{bx}	35.85 ^{ax}	3.63 ^{ax}	5.59 ^{ax}	1.14 ^{bx}	7.19 ^{ax}
LYD	75.77 ^{ax}	47.66 ^{bx}	19.59 ^{bx}	36.35 ^{ax}	3.00 ^{bx}	4.42 ^{ax}	1.14 ^{bx}	7.52 ^{ax}

Black: Taiwan Commercial black pig. LYD: Hybrid pig. Mean $\pm$ SD., n = 3.

The end: Ripening for 300 days.

^{a-b}: Means within the same row without the same superscript are significantly different ($p < 0.05$).

^{x-y}: Means within the same column without the same superscript are significantly different ($p < 0.05$).

Table 2. The change of moisture and water activity in external and internal part of dry-cured ham from Taiwan black pigs and LYD hybrid pigs during ripening period

	Raw ham	Ripening time (days)				
		0	60	120	180	300
Moisture		%				
Black	75.86 $\pm$ 1.33 ^{ax}	65.42 $\pm$ 4.28 ^{bx}	58.70 $\pm$ 3.61 ^{cx}	55.17 $\pm$ 3.36 ^{dx}	51.17 $\pm$ 4.44 ^{ex}	45.32 $\pm$ 1.12 ^{fx}
LYD	75.77 $\pm$ 1.82 ^{ax}	63.34 $\pm$ 5.34 ^{bx}	56.00 $\pm$ 2.87 ^{cx}	52.63 $\pm$ 1.99 ^{dx}	48.12 $\pm$ 3.38 ^{ex}	44.22 $\pm$ 2.40 ^{fx}
external part						
Aw						
Black	0.93 $\pm$ 0.01 ^{ax}	0.89 $\pm$ 0.01 ^{bx}	0.88 $\pm$ 0.01 ^{bx}	0.81 $\pm$ 0.03 ^{cx}	0.77 $\pm$ 0.03 ^{ey}	0.79 $\pm$ 0.01 ^{dx}
LYD	0.94 $\pm$ 0.01 ^{ax}	0.88 $\pm$ 0.00 ^{bx}	0.87 $\pm$ 0.01 ^{cx}	0.80 $\pm$ 0.01 ^{dx}	0.79 $\pm$ 0.03 ^{dx}	0.80 $\pm$ 0.01 ^{dx}
internal part						
Aw						
Black	0.97 $\pm$ 0.01 ^{ax}	0.92 $\pm$ 0.01 ^{bx}	0.91 $\pm$ 0.01 ^{bex}	0.91 $\pm$ 0.01 ^{cx}	0.89 $\pm$ 0.01 ^{dx}	0.87 $\pm$ 0.00 ^{ex}
LYD	0.96 $\pm$ 0.01 ^{ax}	0.92 $\pm$ 0.01 ^{bx}	0.91 $\pm$ 0.01 ^{bx}	0.91 $\pm$ 0.01 ^{bx}	0.90 $\pm$ 0.01 ^{cx}	0.87 $\pm$ 0.01 ^{ex}

The foot note was the same as Table 1

Table 3. The change of color (L, a and b value) of dry-cured ham from Taiwan black pigs and LYD hybrid pigs during ripening period

	Raw ham	Ripening time (days)				
		0	60	120	180	300
Black						
L	36.26 $\pm$ 2.90 ^a	34.66 $\pm$ 5.39 ^{ab}	31.70 $\pm$ 6.28 ^c	34.36 $\pm$ 2.43 ^{abc}	32.36 $\pm$ 5.46 ^{bc}	21.15 $\pm$ 2.94 ^d
a	12.71 $\pm$ 4.43 ^{cd}	11.83 $\pm$ 4.52 ^d	12.14 $\pm$ 3.97 ^d	15.97 $\pm$ 4.45 ^b	19.61 $\pm$ 4.69 ^a	15.00 $\pm$ 3.17 ^{bc}
b	7.59 $\pm$ 1.81 ^a	6.92 $\pm$ 1.95 ^{ab}	5.81 $\pm$ 2.05 ^b	6.91 $\pm$ 2.07 ^{ab}	5.96 $\pm$ 2.38 ^b	3.42 $\pm$ 1.24 ^c
LYD						
L	35.31 $\pm$ 2.93 ^a	33.13 $\pm$ 4.49 ^a	34.25 $\pm$ 5.00 ^a	29.35 $\pm$ 2.93 ^b	35.86 $\pm$ 7.30 ^a	24.49 $\pm$ 3.59 ^c
a	8.81 $\pm$ 3.45 ^d	13.09 $\pm$ 5.42 ^c	13.22 $\pm$ 4.39 ^c	16.03 $\pm$ 3.07 ^b	19.91 $\pm$ 7.69 ^a	16.12 $\pm$ 3.17 ^b
b	6.90 $\pm$ 1.73 ^{ab}	7.71 $\pm$ 2.00 ^a	5.68 $\pm$ 2.49 ^b	6.22 $\pm$ 1.61 ^b	6.69 $\pm$ 3.29 ^{ab}	4.42 $\pm$ 1.38 ^c

Black: Commercial black pig. LYD: Hybrid pig. Mean $\pm$ SD., n = 3.

^{a-c}: Means within the same row without the same superscript are significantly different ($p < 0.05$).



Table 4. The change of salt content, pH and nitrite residue of dry-cured ham from Taiwan commercial black pigs and LYD hybrid pigs during ripening period

Raw ham		Ripening time (days)				
		0	60	120	180	300
Salt		----- % -----				
Black	0.76 ± 0.10^{dx}	3.97 ± 0.59^{cx}	4.92 ± 0.34^{bx}	5.13 ± 0.60^{bx}	5.42 ± 0.60^{bx}	6.97 ± 0.69^{ax}
LYD	0.66 ± 0.08^{dx}	3.51 ± 0.23^{cx}	4.88 ± 0.78^{bx}	5.06 ± 0.88^{bx}	5.20 ± 0.79^{bx}	6.90 ± 0.61^{ax}
pH						
Black		6.30 ± 0.19^{cx}	6.63 ± 0.10^{abx}	6.50 ± 0.22^{abex}	6.43 ± 0.05^{bcx}	6.70 ± 0.37^{ax}
LYD		6.36 ± 0.15^{bx}	6.71 ± 0.23^{ax}	6.47 ± 0.06^{bx}	6.44 ± 0.08^{bx}	6.67 ± 0.13^{ax}
Nitrite		----- ppm -----				
Black		10.08 ± 4.44^{ax}	4.17 ± 2.04^{bx}	2.39 ± 1.06^{bcx}	3.05 ± 1.60^{bcx}	1.94 ± 1.06^{cx}
LYD		10.79 ± 1.59^{ax}	4.38 ± 2.02^{bx}	1.74 ± 0.60^{cx}	1.51 ± 0.57^{cy}	0.25 ± 0.41^{cx}

The foot note was the same as Table 1

Table 5. The score of sensory panel test of dry-cured ham from Taiwan black pigs and LYD hybrid pigs

	Color	Flavor	Mouth feeling	Salty	Hardness	Pastiness	Crumbliness	Overall acceptability
Black	4.50 ± 0.85^x	4.71 ± 0.17^x	4.43 ± 0.19^x	4.14 ± 0.46^x	4.00 ± 0.14^x	4.07 ± 0.14^x	4.21 ± 0.12^x	4.71 ± 0.32^x
LYD	4.86 ± 0.86^x	4.14 ± 0.23^y	4.21 ± 0.42^x	4.07 ± 0.20^x	4.29 ± 0.38^x	4.21 ± 0.58^x	3.57 ± 0.50^x	4.29 ± 0.49^x

Black: Commercial black pig. LYD: Hybrid pig. Mean $\pm$ SD., n=14.

^{x-y}: Means within the same column without the same superscript are significantly different ($p < 0.05$).