MEAT QUALITY COMPARISON BETWEEN FAST GROWING BROILER ROSS 308 AND SLOW GROWING SASSO LAYING MALES REARED IN FREE RANGE SYSTEM

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ABSTRACT

In chick hatcheries, males of laying hybrids are considered as the "waste" products and the majority of the males is killed just after hatching. However, the demand of consumers for products from alternative systems such as organic, free-range system is increased. Instead of transfer day-old laying males to the feed mill, the idea of rearing them in free range system was tested. The study was carried out on 2 chicken breeds: slow-growing line of feather Sasso (SA) and fast-growing Ross 308 broilers (RS). Sixty one-day-old chicks of each breed were kept in pens up to 21 days with density 6 birds/m^2 and then free range reared in the garden with natural grasses and fruit trees with density 5 m^2/bird. Data collection was conducted at 49 and 90 days of age for measurng meat quality parameters. The results showed that the live weight, carcass yield, breast meat yield and the proportion of abdominal fat were significantly higher ($P > 0.001$) in RS at both ages. The proportions of fat in the breast meat were significantly lower ($P > 0.01$) in SA at both ages. Themeat pH value at 24 h was significantly higher in SA and the meat was darker ($P > 0.001$) in these chickens. The overall acceptability was significantly better ($P > 0.01$) in SA at 90 days of age. The laying males are acceptable for an alternative system of poultry meat production in terms of meat quality. Meat quality of Sasso males was comparable or even higher than that of fast-growing chickens.

Keywords: Fast growing, free range system, meat sensory quality, slow growing.

So sánh chất lượng thịt của gà thịt Ross 308 và gà trống hướng trứng Sasso nuôi thả vườn

TÓM TẮT

Trong chăn nuôi gà đẻ trứng, gà trống thường bị loại thải ngay khi vừa mới nở. Tuy nhiên, để đáp ứng xu hướng sử dụng các sản phẩm sạch của người tiêu dùng ngày nay, thay vì loại thải, gà trống mới nở được đưa vào nuôi chăn thả. Với ý tưởng như vậy, chúng tôi tiến hành thử nghiệm nuôi gà trống hướng trứng Sasso (dòng lớn chậm) và gà hướng thịt Ross 308 (dòng lớn nhanh) trong trong điều kiện thả vườn và so sánh chất lượng thịt của chúng. Sáu mươi gà của mỗi giống nuôi nhốt đến 21 ngày tuổi với mật độ 6 gà/m^2, sau đó gà được nuôi chăn thả với mật độ 5 gà/m^2. Gà thí nghiệm được nuôi theo quy trình của Bộ NN & PTNT(2010). Tại hai thời điểm 49 và 90 ngày tuổi, tiến hành mổ khảo sát để phân tích, so sánh chất lượng thịt gà trong hai lô thí nghiệm. Đánh giá chất lượng cảm quan thịt gà sau khi chế biến bằng cách chấm điểm dựa trên 6 tiêu chí: màu sắc, mùi, độ mịn thớ thịt, độ giữ nước, vị và sự chấp nhận tổng thể của người nếm. Kết quả cho thấy các chỉ tiêu về khối lượng sống, khối lượng thịt xẻ, khối lượng thịt ngực và tỷ lệ mỡ bụng ở gà hướng thịt Ross 308 cao hơn so với gà trống hướng trứng Sasso ở tất cả các giai đoạn tuổi ($P > 0,001$). Độ pH của thịt gà Ros 308 tại thời điểm 24 giờ cao hơn pH thịt gà trống Sasso. Về mầu sắc, thịt gà trống Sasso được đánh giá đậm hơn so với gà trống Ross 308 ($P > 0,001$). Kết quả đánh giá cảm quan cho thấy thịt gà trống hướng trứng Sasso ngon hơn thịt gà Ross 308 ($P > 0,01$) tại thời điểm 90 ngày tuổi.

Từ khóa: Chất lượng thịt cảm quan, chăn thả vườn, gà hướng thịt, gà hướng trứng.

1. INTRODUCTION

In recent years, the interest of consumers in products from organic (free-range) systems is increasing mainly because these systems are environmentally friendly, sustaining animals in good health with high welfare standards and resulting in higher quality products (IFOAM, 2014) and more flavor products (Hoan, 2014). However, some assessors preferred breast fillets from a standard system to free-range or organic system (Brown et al., 2008). The free-range production of chicken meat is regulated by Ministry of Agricultural and Rural Development of (MARD, 2010) in National Technical Regulation Conditions for biosecurity of poultry farms. Among others in organic production, the minimum age at slaughter should be at 70 days of age. In France, chickens reared under carefully specified conditions may be accorded the Label Rouge or Label Fermier quality marks. There are strict rules in the Label Rouge systems; among others, slow-growing genotype and age at slaughter not less than 84 days (Lewis et al., 1997). Fast- growing commercial hybrids are not suitable for these production systems, because they are slaughtered between 5 and 7 weeks and at 81 (84) days of age they are too heavy. However, in the United States, organic and other specialty poultry production mostly utilizes the same fast-growing broiler genotype as in conventional production systems (Fanatico et al., 2005a).

The antagonistic relationship between meat and egg production led to the separation of the meat and egg-type strains of fowl. Consequently, day-old male layer chickens have been used in the pet feed industry as a high quality animal protein source for predators, reptiles, falcons, hawks and zoo animals. Moreover, in hatcheries the male chickens of layer breeds have to be killed due to their poor fattening performance and consequent high fattening costs. In addition, consumers do not normally accept this type of bird as chicken meat.

The superiority and genetic improvement of meat-type chickens in terms of growth are well documented (Gerken et al., 2003); (Havestein et al., 2003); (Lonergan et al., 2003). However, there are only a few studies concerning the carcass composition and meat quality of commercial layer males in comparison with broilers at the same age (Gerken et al., 2003). Lewis et al. (1997) and Fanatico et al. (2005a) evaluated the effect of genotypes on the carcass quality, but they compared fast and slower growing broilers, but no layer males. Lewis et al. (1997) compared the carcass quality of slower and faster growing birds at the same live weight (different age) and Fanatico et al. (2005b) compared the carcass quality of slower and faster growing birds at the same carcass weight (different age and different live weight). Grashorn and Clostermann (2002) conducted a very extensive study concerning the performance and slaughter characteristics of broiler breeds for extensive production, although slow-growing chickens was used, however, this experiment did not carry out in free range system.

The aim of this study was to evaluate the meat quality of laying males under free range system and to compare the physical and sensory quality of meat with fast-growing broilers at the same age when they were reared to 49 and 90 days of age and to look at the suitability of laying males for an alternative system with regard to meat quality.

2. MATERIAL AND METHODS

The experiment was conducted from July to November 2014 at Hai Yen farm, Song Cong town, Thai Nguyen province, Viet Nam. Two chicken breeds were used, viz. slow-growing line of colored feathers Sasso (SA) and fast-growing of Ross 308 broilers (RS). Each breed consisted of 60 one-day-old chicks reared in pens up to 21 days with density of 6 birds/m^2, and then backyard free range reared with density of 5m^2/bird. Birds were monitored up to 90 days of age. They were raised in compliance with MARD (2010) standards. Temperature was maintained at 30°C during the start of brooding period and gradually decreased to 22°C. Outdoor access to a

grass paddock was provided during daylight hours. The birds were confined to indoor pens at night. The birds had free access to feed and water at all times (both outside and inside). All birds received the same diets (Table 1) *in ad-libitum* (1 to 14 days: starter; 15 to 44 days: grower; 45 to 90 days: finisher). Diet formulations and calculated analyses are given in Table 1. Birds were individually weighed at weekly intervals.

Physical and chemical analyses were performed at 49 and 90 days of age. Ten birds from each group were slaughtered. The birds were killed by manual exsanguinations. The plucked carcasses were eviscerated and chilled for 24 h at 5°C before dissection. Boneless thighs and drumsticks with skin, breast meat and abdominal fat were weighed. The right sides of breast meat were individually wrapped in tinfoil and put to a -24°C freezer before sensory evaluation. The left sides of breast meat were evaluated for color, pH, drip loss and chemical analysis. Breast meat (4 to 5 g) of SA in 49 days and 10 to 12 g of other samples (RS 49 days, SA and RS 90 days) were carefully weighed, then kept in refrigerator (5°C) for 24 h and then dried with filter paper and precisely weighed again. Drip loss was expressed as a percentage of the initial muscle weight.

The pH values were measured with a digital pH meter PORTAMESS 911 Ph KNICK (Knick Elektronische Messgeriite, Berlin), 1 cm from the sternum in the middle part of the muscle and at a depth of 1 cm at 0.5, 1.0, 1.5, 2.0 and 24 hrs intervals. The color parameters (L*, a*, b*) were measured on raw muscles and on the skin of thigh using a spectrophotometer (CM-2600d, Konica Minolta, Osaka). In this method, higher L* values are light, higher a* values are red, and higher b* values are yellow. Color measurements were taken on the cross-section of the breast muscle. Chemical analyses of the breast meat were done as follows: Moisture was determined by drying at 105°C for 6 h and total lipids were analyzed by extraction with petroleum ether (Soxtec method).

To evaluate the meat quality, a trained panel of 10 experts divided in five sections. The taste panelists were trained in two phases. The first phase based on an individual evaluation of cooked breast meat samples from 5 other different chicken species, and the second phase to adapt the panel elements to scales and sensory descriptors.

Sensory evaluations were conducted in a specific tasting room to ensure no environmental interferences as the room temperature and humidity were controlled at 20-22 °C and 60-70%, respectively. Room light was in bright white color and in each taste sample booth red light was used to mask the taste samples. The breast samples were stored at 4°C in the refrigerator 1 day prior to tasting session, then wrapped in aluminum foil and cooked in a conventional oven until the internal temperature of sample each 90°C. The internal temperature was measured by a thermometer inserted into sample center. After reaching the desired temperature, samples were cut into small pieces of 2 x 2 x 0.5 cm, perpendicularly to muscular fibers. Again, cut samples were wrapped with aluminum foil and put in small ovens to maintain their temperature. Samples were given to sensory analysis panelists in the same conditions, masked by red light, in a random and balance distribution order, coded with 3 digits numbers. Each panelist had enough time to evaluate each sample and between samples, neutralized the left over taste from previous tasted samples in their mouths by water and fruit.

The tasting parameters evaluated were odor intensity, toughness, and juiciness and flavor intensity.

In each session panelists evaluated 4 samples using an unstructured line scale of 100mm with interval but not numbered, representing at the extremes the minimum (sensation absence) and the maximum (extremely intense sensation). Panelists were asked to indicate a point on the scale corresponding to the intensity of their different feelings for each attribute.

Table 1. Experimental Diet

Ingredient	Starter (1-14 days)	Grower (15-44 days)	Finisher (45-90 days)
Metabolic energy (Kcal/kg)	2692	2808	2712
Crude protein (%)	22.86	18.69	16.55
Methionine (g/kg)	5.14	4.26	3.92
Lysine (g/kg)	10.9	9.31	8.06
Calcium (g/kg)	8.57	9.24	8.09
Avalable phosphorus (g/kg)	2.67	5.63	6.09

Data on live weight and sensory assays were analyzed by £-test and the chemical and physical characteristics were analyzed by the nonparametric Mann-Whitney U-Test using the software package Unistat 5.1, England.

3. RESULTS AND DISCUSSION

3.1. Birds performance

The results in Table 2 showed that due to meat selective breeding the live weight of RS was significantly higher (P > 0.001) than in SA both of 49 and 90 day of age, as it was already reported by a number of researchers (Gerken et al., 2003; Lonergan et al., 2003). Survival rate up to 90 days of age was higher in SA 92.36% and 90.77% in RS (P > 0.05). The feed conversion ratio up to 90 days of age was 3.12 in RS, better than that of SA, which was 3.76 (P > 0.05).

The carcass characteristics and meat quality are shown in Table 3.

As expected, carcass weight and carcass yield percentages were also significantly higher (P > 0.001) in RS. Regardless of the age, breast yield was significantly higher (P > 0.001) in fast-growing RS than in slow-growing SA. Our results were supported by the findings from (Lewis et al., 1997; Gerken et al., 2003; Fanatico et al., 2005a). This is the result of intensive selective breeding for meat production in broilers. The heavier weight of RS resulted in all their components being heavier than those of SA. But there were no significant differences between the genotypes in the percentage of leg muscle plus. However, age (maturity) significantly affected the content of dry matter in breast meat. At both ages, the content of fat was significantly higher (P > 0.01) in RS, which corresponds with the findings of Castellini et al. (2002b). According to Lonergan et al. (2003), the breast meat of modern fast-growing broilers also contained a higher percentage of lipids and a lower percentage of proteins compared to the slow-growing strains. Havestein et al. (2003) suggested that the selection of birds based on their body weight concomitantly promoted fat accretion. On the other hand, Blair (2008) did not observe any increase in age dependent breast fat content in fast-growing broilers, but in slow-growing chickens (P > 0.01).

Table 2. Survival rate, growth and feed conversion

Targets	Day of age	SASSO	ROSS 308	Significance
Survival rate (%)	49	94.79	93. 84	NS
	90	92.36[a]	90.77[b]	*
Average body weight (g)	49	824.12 [a]	2123.45[b]	***
	90	1919 .01[a]	5318.10[b]	***
Feed conversion ratio (kg/kg)	49	4.14	3.59	*
	90	3.76	3.12	*

*Note: NS: not significant, *P > 0.05 and ***P > 0.001*

Table 3. Slaughter traits, chemical and physical characteristics of breast meat

Carcass quality	Day of age	SASSO (n = 10)	ROSS 308 (n = 10)	Significance
Live weight (g)	49	824.12 [a]	2123.45[b]	* * *
	90	1919 .01[a]	5318.10[b]	* * *
Carcass weight (g)	49	502.11[a]	1583.21 [b]	** *
	90	1208.90[a]	3897.61[b]	** *
Carcass yield (%)	49	61.43[a]	68.90[b]	**
	90	63.67[a]	74.45[b]	***
Breast weight (g)	49	109.03[a]	423.42[b]	***
	90	281.71[a]	514.72[b]	***
Breast yield (%)	49	13.23[a]	19.94 [b]	* * *
	90	14.68[a]	24.24 [b]	***
Leg muscle + skin yield (%)	49	25.12	25 .44	NS
	90	26.4 3	26.65	NS
Abdominal fat (%)	49	0.11[a]	2.02 [b]	** *
	90	0.72[a]	2.78 [b]	***
Dry matter - breast (%)	49	25.12	25.40	N S
	90	27.61[a]	25.73[b]	***
Fat - breast (%)	49	0.48[a]	2.09 [b]	**
	90	0.67[a]	1.42 [b]	**
Drip loss - breast (%)	49	3.14	3.45	NS
	90	1.52[a]	0.71[b]	**
pH 30 min	49	6.11	6.14	NS
	90	6.15	6.27	NS
pH 24h	49	5.76[a]	5.57[b]	**
	90	5.72[a]	5.62[b]	**
Skin colour 24 h				
L *	49	71.42	71.52	NS
	90	68.14	71.05	NS
a *	49	6.53	6.16	NS
	90	7.17	8.68	NS
b*	49	27.42[a]	20.53[b]	*
	90	31.62[a]	26.66[b]	**
Breast colour 24 h				
L*	49	54.15[a]	58.12[b]	*
	90	50.34[a]	54.30[b]	***
a *	49	2.77[a]	1.26[b]	*
	90	0.04	0.16	NS
b*	49	17.73[a]	15.43[b]	**
	90	12.83[a]	9.79[b]	**

*Note: NS: not significant, *P > 0.05, **P > 0.01 and ***P > 0.001*

There was no significant difference between samples regarding drip losses at 49 days. But at 90 days the drip loss was significantly higher (P > 0.001) in SA as reported by Debut et al. (2003) and Fanatico et al. (2005a). Regardless of the age, the genotype had no significant effect on pH at 0.5 h but pH at 24 h was significantly higher (P > 0.01) in SA for both ages. Castellini et al. (2002a) and Alvarado et al. (2005) also reported higher pH in slow-growing chickens. However,

Debut et al. (2003) and Lonergan et al. (2003) did not find a significant effect of genotype on pH value of chicken meat. They did not observe a significant difference between slow and fast growing chickens in L*, a*, b*, either. As Fletcher (1999) showed, the correlations between the color and pH values were all highly significant. But in this experiment the meat color as an indicator of meat quality was also affected by genotype. The L* values of the breast were significantly higher at both ages in RS (49 days $P > 0.05$; 90 days $P > 0.001$). The same effect of genotype on L* was reported by Debut et al. (2003). (Grashorn and Clostermann, 2002) observed the significantly lowest L* in broilers with the significantly lowest live weight, but only at 84 days of age (not at 70 days). The SA had higher redness (a*) at 49 days ($P > 0.05$) but at 90 days the difference was not significant. Debut et al. (2003) did not observe a significant difference between slow and fast growing lines in a* values, either. Significantly higher ($P > 0.01$) b* values were found at both ages in SA, which confirmed the effect of genotype on this characteristic ((Debut et al., 2003; Lonergan et al., 2003; Fanatico et al., 2005a). The color difference was apparent not only by instrumental means but was also visible and confirmed by sensory evaluation. The b* values of skin were also significantly higher in SA (49 days $P > 0.05$; 90 days $P > 0.01$). The yellowness of the SA birds might be related to the increased foraging of plant material.

3.2. Meat sensory quality

At both ages of 49 days and 90 days, breast meat was significantly darker ($P > 0.001$) in SA. Improving the breast weight through selection can potentially result in the production of lighter-colored breast meat (Bihan-Duval et al., 1999). The breast meat of SA was tougher ($P > 0.01$) at 49 days, but at 90 days there was no significant difference in the texture of breast meat between RS and SA. Brown et al. (2008) reported significantly less tough ($P > 0.01$) breast meat from ISA 657 than Ross. The two genotypes showed no significant difference in flavor. The intensity of flavor increased with age in both genotypes, which was reviewed by Horsed et al. (2005). There were no significant differences between genotypes in juiciness at both ages. On the other hand, Lewis et al. (1997) found no difference in juiciness between birds at 7, 9, and 11 weeks of age, for either SA birds or a fast-growing strain. The overall acceptability was significantly higher ($P > 0.01$) in SA at 90 days of age, but at 49 days there was no difference between genotypes. Castellini et al. (2002a) also showed an overall preference for slow-growing birds in comparison with fast-growing ones.

Table 4. Sensory quality of breast meat

Breast meat quality	Day of age	SASSO	ROSS 308	Significance
Colour	49	35.54[a]	50.24[b]	***
	90	52.73[a]	63.43[b]	***
Flavour	49	49.22	54.37	NS
	90	33.53	38 .81	NS
Texture	49	56.82[a]	42.93[b]	**
	90	46.96	55. 37	NS
Juiciness	49	65.0 1	60.2 4	N S
	90	36.89	50.23	N S
Taste	49	52.0 5	50.82	N S
	90	37.43[a]	50.00[b]	**
Overall acceptability	49	56.31	53.33	N S
	90	46.98[a]	56.89[b]	**

*Note: NS: not significant, *P > 0.05, **P > 0.01 and ***P > 0.001*

Berri et al. (2005) and Fanatico et al. (2005b) had drawn a different conclusion concerning the effect of genotypes on meat quality, but they compared slow and fast-growing chicken at different ages at the same weight. Increasing the age of slaughter affects the meat quality (Horsed et al., 2005). Alvarado et al. (2005) also reported some similar results (pH, L*, b*), but they compared different genotypes bred in different conditions (diets, age at slaughter). In addition to genotypes, both the diet and the age also have an effect on sensory attributes, mainly on texture and appearance.

In organic, free-range or Label Rouge systems there is no advantage in improvement of growth rate, since birds cannot be slaughtered before a specified age and the body weight of fast-growing hybrids at these ages exceeded the requirements of the market. Males seem to offer utility for an alternative system of poultry meat production. Of course, the rate of growth is lower in comparison with slow-growing chickens and the meat yield would also be lower, but the meat quality of Sasso males is higher mainly due to the fat content. Color, taste and overall acceptability seem to be influenced by genotype to the greatest extent, while the Sasso males demonstrate superior attributes. Concerning the meat quality, this study shows that the fattening of males from egg-type hybrids could provide an alternative product for free-range systems. The quality of meat was comparable or even higher than that of fast-growing chickens.

4. CONCLUSION

The slow growing chicken (laying males) are compatible in free range system though their performance in terms of live weight and daily weight gain. Other traits such as breast meat yield, carcass yield, were lower than those from fast growing breed (meat type chicken). However, in acceptability for meat quality, slow growing chicken showed better sensory quality of the breast meat. Thus, for the demand of customers for the higher quality of chicken meat, it is recommendable to use slow growing laying males in alternation to fast growing broilers.

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