Consumer perceptions of meat quality and shelf-life in commercially raised broilers compared to organic free range broilers

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Summary

Consumers in the United States are increasingly interested in both free-range and organic chicken. Therefore, the objectives of this research were to compare eating quality and shelf-life of meat from organic free range broilers to meat from commercially raised broilers. No significant differences in breast fillet tenderness or proximate composition were noted between the two treatments. Free-range chicken breasts were significantly larger (153 g) than commercial chicken breasts (121 g). Breast fillets from the free range birds had higher pH values (5.96 vs. 5.72 respectively) and were darker (49.14 vs. 53.46, respectively) than fillets from the commercially raised birds. Initial TBARS (day 0) were significantly higher for the commercially raised broiler breast fillets (4.96 vs. 3.07 mg malonaldehyde/kg), but by day 3 of refrigerated storage the level of oxidation was similar. Free range fillets had significantly higher APC and coliform counts and exhibited signs of spoilage earlier than commercial fillets. Consumers evaluated breast fillets, using a ranking test (1-least intense to 5-most intense) and the resultant data was analyzed using Kruskal-Wallis. Consumers found no difference in fillet juiciness, tenderness or flavour ($P>0.05$). Commercial breast fillets, however, were preferred over the free-range fillets ($P<0.05$). Trained panellists evaluated drums finding no difference in tenderness or flavour, but meat from free range birds was juicier and had stronger attachment of the meat to the bone. Commercial and free-range chicken had many similarities in meat quality and sensory attributes, but meat from free-range poultry had a shorter shelf life than meat from commercially raised chickens.

Introduction

All poultry was raised outdoors until around the 1950s, when poultry producers began to raise birds inside for protection from predators, disease control, and to integrate their control measures to produce a more uniform product. Today, we call this indoor production "commercial" poultry production. Alternative poultry production systems such as organic and free range organic are mostly outside production system and have created a niche market in the poultry industry.

Currently, there is quite a lot of confusion with consumers between the terms organic and free range. Often, consumers use these terms interchangeably. In the USA, Certified Organic poultry meat must go though a rigorous certification process as described by USDA guidelines (USDA Organic Standards). The certification process can take months and is often subject to multiple on-site inspections to continue certified organic standards. The cost associated with organic poultry meat is often very high due to the cost and availability of organic grain and other ingredients used in feed. Currently there are very few major poultry processors (~2 specifically) in the USA that produce organic poultry meat in mass production. Most are small scale organic and free range processors which process the birds mostly by hand with small pilot scale equipment, have an exemption status (limited USDA inspection) and can only sell the organic poultry meat with-in state lines. On the other hand, the USDA definition for free range is just simply allowing the birds access to the outdoors. There are currently no other standards for free range chickens. Most all small processors that sell free range chickens are also certified organic for marketing purposes.

The sale of organic food is growing at a rate of at least 20% which makes it the fastest growing agricultural market (Organic Consumer Trends, 2001). Most poultry processors that raise broilers for the organic market also use the label "free range" for increased marketing. These alternative poultry

production systems offer opportunities for small scale producers to infiltrate a niche market and to provide a specialty product for consumers.

Most articles dealing with organic and free range poultry are from Europe and deal strictly with the production of these pastured poultry systems (how to, disease control, feeding and meat quality of organic and free range organic production of chickens utilizing meat from actual organic and free range production systems). The European production system is much more advanced for free range production when compared to the USA. There are very few research studies in the USA regarding these methods.

It is important for processors and consumers that unbiased research detailing consumer perceptions are determined and actual meat quality comparisons are conducted to determine differences between meat purchased form a commercial processor and meat purchased from an organic and free range producer. Therefore, the objective of this study was to determine objective meat quality, composition, and sensory differences among commercial and free-range organic broiler breast fillets.

Materials and methods

The commercial birds were 42 days of age before slaughter and the organic free range birds were 10 weeks prior to slaughter. A total of 200 broiler breast fillets in 2 trials were be obtained from a commercial processor and an organic free range processor. The breast fillets arrived at the Texas Tech University Meat Laboratory within 24 hours of slaughter. At 24 hours post-mortem, the fillets were weighed, and colour (Minolta colorimeter) and pH (IQF Scientific probe and meter) data were collected on all the samples. Half of the breast fillets from each treatment (commercial and free range organic) will be cooked in a convection oven according to the procedures of Sams (1990) for cook loss determination. Following cook loss determination, a caudal portion of the cooked sample was analyzed for cooked total moisture according to standard oven dry methodology (AOAC, 1993). The remaining cranial portion of the breast fillet was analyzed for tenderness with a non-destructive razor blade method (Cavitt *et al.*, 2004). Since this method is non-destructive, the remaining cranial portion of the fillet was used for the sensory testing.

Oxidation (TBARS) was determined in the samples from each of the treatments on Day 0 (24 hr post slaughter) and 4 (5 days post slaughter) according to Spanier and Traylor (1991). Since differences in production method, especially feed, can result in different nutritional components in the meat, proximate analysis of the broiler breast meat from the 3 treatments was also determined in this study using AOAC methods (1993) to determine differences in protein (FP200 Leco Nitrogen analyzer), fat (Bligh and Dyer, 1982), ash (AOAC 1995), and moisture. On the remaining broiler breast fillets not used for the above analyses, microbiological (APC and coliforms) shelf-life data was conducted using Petri-film plates.

For the consumer sensory testing on the broiler breast fillets, an 8 point hedonic scale was used to determine preference testing on tenderness, juiciness, flavour, and overall preference on the commercial and organic free range chicken breast fillets. A minimum of 60 consumer panellists were used in this study. The legs were evaluated by a trained panel of 6 members. The members were trained on flavour, tenderness, juiciness, and attachment of the meat to the bone.

The data will be subjected to the GLM procedure of SAS and means will be separated using Duncan's Multiple Range Test. The sensory data will be subjected to a non-parametric test (Kruskal-Walis). A significance level of $P< 0.05$ will be used to determine significant differences.

Results

Table 1 Quality parameters of commercial and free range chicken breast fillets [1].

Treatment	Pre-cook Weight (g)	Cook Loss (%)	pH	Tenderness (N)
Commercial	121.40[b]	23.10[a]	5.72[b]	4.42[a]
Free Range	153.10[a]	24.26[a]	5.96[a]	4.98[a]

[1]Means within a column with different superscripts are different ($P<0.05$)

Table 2 Hunter colour values of commercial and free range chicken breast fillets [1].

	Colour		
Treatment	L*	a*	b*
Commercial	53.46[a]	3.72[b]	2.03[b]
Free Range	49.14[b]	5.47[a]	3.00[a]

[1]Means within a column with different superscripts are different (P<0.05)

Table 3 Proximate analysis of commercial and free range chicken broiler breast fillets [1].

Treatment	Protein (%)	Fat (%)	Ash (%)
Commercial	19.54[a]	1.80[a]	1.65[a]
Free Range	20.84[a]	2.14[a]	1.83[a]

[1]Means within a column with different superscripts are different (P<0.05)

Table 4 Oxidation measurements of the commercial and free range chicken broiler breast fillets[1].

	TBARS (mg malonaldehyde/kg fat)	
Treatment	Day 0	Day 3
Commercial	4.9[a]	10.7[a]
Free Range	3.0[b]	11.0[a]

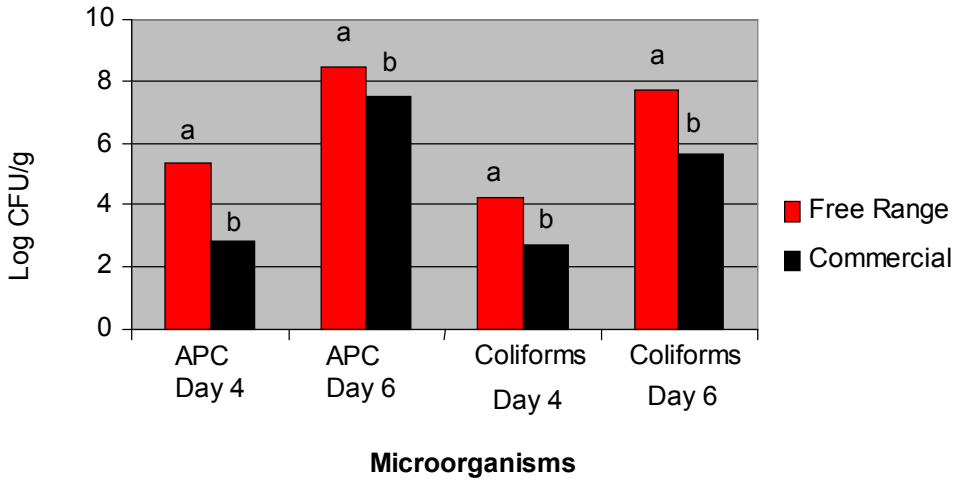


Figure 1 Shelf-life of commercial and free range chicken breast fillets at Days 4 and 6 post slaughter.

Discussion

QUALITY PARAMETERS AND COLOUR VALUES

Quality parameters including cook loss (%), pH, colour and tenderness were evaluated in this study to compare commercial chicken to organic free range chicken breast fillets (Table 1). Pre-cook weights were significantly higher in the free range birds. In the USA, free range birds are slaughtered around 10 – 12 weeks of age where commercial birds are slaughtered 5-6 weeks of age. Even though the free range birds are a slower growing bird due to decreased feed efficiency, they are raised for a longer period and therefore have a larger breast fillet compared to the commercial birds. Cook loss (%) and tenderness of the breast fillets were similar indicating that neither the commercial or organic free range birds lost a significant amount of moisture during cooking. However, the free range chicken breast fillets had a significantly higher pH and lower L* value (Table 2) indicating a darker colour than the commercial breast fillets. This dark fillet colour is expected with a high pH. The free range breast fillets also had a significantly more intense red colour (a*) and a more intense yellow colour (b*) than the commercial chicken breast fillets. The differences in colour of the breast fillets from the organic free range birds may be due to feed differences. The commercial birds were fed a diet based on the NRC guidelines (NRC, 1994) while the free range birds were fed diets with similar NRC guidelines except the birds were fed certified organic feed. Free range birds were also raised outdoors and allowed access to grass and other outdoor feed which could have affected breast colour.

PROXIMATE ANALYSIS AND OXIDATION

Protein (%), % fat and % ash were similar for the free range and commercial chicken breast fillets. Previous preliminary data has indicated that there are no nutritional differences between free range and commercial chicken breast meat. However, even thought the percentages of the proximate analyses (specifically fat) are not significantly different there may be differences in the fatty acid profiles. Currently fatty acid profiles are being analyzed for both commercial and free range chickens used in this study to determine if any differences exist.

There were significant differences in oxidation (TBARS) levels on Day 0 (24 hr post slaughter) with the commercial breasts having a higher oxidation level than the free range breasts. This same pattern was noted in the trained sensory evaluation with higher oxidation or an increased “warmer over flavour” in the commercial breast fillets. Also, by Day 4 there were no noticeable differences in oxidation. The differences at Day 4 could be due to a different fatty acid profile or higher vitamins and minerals that are antioxidant present in the feed or grasses available to the free range birds. However, by Day 4 (5 days post slaughter) the oxidation levels were not significantly different between the 2 treatments. This lack of difference is a natural occurrence following cooking of the broiler breast fillets and extended storage times.

SENSORY ANALYSES

Sensory analysis was conducted on the commercial and free range chicken breast fillets. However, no differences were found for the attributes: juiciness, tenderness, and flavour. Differences were observed in the overall preference of the chicken; the commercial chicken breast fillets were preferred over the free range chicken breast fillets because the free range chicken breast fillets had a more grain-like flavour. Sensory analysis was also conducted on the drums. Tenderness and flavour were similar. However, the free range drums were juicier and had a stronger attachment to the bone than did the commercial chicken drums.

SHELF-LIFE

The microbiological data indicated that the free range chicken breast fillets had significantly higher APC counts on both Day 0 (24 post slaughter) and Day 4 (Day 5 post slaughter) than the commercial chicken indicating earlier spoilage. The free range chicken breast fillets also had significantly higher coliform values on both Day 0 and Day 4 than did the commercial chicken breast fillets. These high APC and coliform counts maybe indicative of small processors not having as adequate microbiological control methods compared to large commercial processors.

Conclusions

Commercial and free-range chicken had many similarities in meat quality and sensory attributes, but meat from free-range poultry had a shorter shelf life than meat from commercially raised chickens.

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