

The effects of a free-range system on the meat properties of organic chickens

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Abstract

The aim of the present review is to research the impact of free-range systems on the properties of organic chicken meat. The main factors of free-range systems are uncontrolled weather, pasture (fresh grass, insects and worms) and a large outside area (high physical activity for birds). The uncontrolled atmosphere in the outdoor area negatively influenced the growth performance of birds. Vegetation, insects and worms in the free-range area are sources of energy for chickens and can improve the flavour and chemical composition of the meat. Outdoor access provides a high level of physical activity for birds which is reflected in the tenderness and the fat and protein content of the meat. The high lipid oxidation of organic chicken meat is partially attributed to greater motor activity of the birds and affected the shelf life of the meat.

Broilers, growth performance, organic meat, outdoor access

Introduction

In the last few decades, consumer awareness of a healthy diet and its contribution in decreasing the risk of some diet-related diseases has increased, and consumers have become more interested in nutrition and the health-related characteristics of food products (Barreiro-Hurlè et al. 2010; Miller and Cassady 2012). At the same time, interest in the link between human health and environmental sustainability has also increased among consumers. The organic system has been created as a meeting point between health and environmental sustainability (Cavaliere et al. 2014). Consumers believed that organic foods have a higher nutritional value in comparison to conventional food and this could explain the increased production and consumption of food from organic production systems. For these reasons, organic systems have a doubly important role, on one hand providing organic products for a specific market responding to consumer demand, while on the other hand contributing to the field of environmental protection and animal welfare, as well as to rural development (Council regulation (EC) No. 834/2007). Outdoor access represents the principal characteristic of organic systems that provide poultry with a free-range area with fresh grass and the ingestion of insects and worms that could lead to improve product quality (Sossidou et al. 2015). The organic feed of poultry should be raised without synthetic fertilisers and pesticides, and pastures in the free-range area must also be organic (Regulation (EC) No. 889/2008). Uncontrolled environmental factors in the free-range area, such as temperature, photoperiod and weather fluctuations, play an important role in the growth performance and feed conversion ratio of organic chicken (Fanatico et al. 2005b). Providing birds with free-range areas means more physical activity and less resting time which is reflected in the production properties of broilers due to energy expenditure (Ricke et al. 2012). The aim of this work is to review the influence of free-range systems on the properties of organic chicken meat.

The impact of access to a free-range area

The principal characteristic of an organic system is outdoor access. It provides chickens with a free-range area with fresh grass and ingestion of insects and worms that could improve meat quality. Green matter, herbs, stems, roots and invertebrates which are obtained by poultry at pasture can be used as a source of enrichment to reduce dietary supplementation

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with vitamins and minerals on one hand and support gut fill on the other (Sossidou et al. 2015). Buildings for chickens should have exit/entry pop-holes of adequate size for the birds, with easy access to an open-air area for at least one third of their life. The maximum capacity of poultry houses should be 4 800 chickens. The available indoor area for fattening poultry (in fixed housing) is 10 birds per m² with a maximum of 21 kg live weight per m², while the outside area should be 4 broilers per m². Totally 16 m² of indoor area and 2.5 m² of outdoor area should be provided in the case of mobile housing. A period of light of a maximum of 16 hours per day should be provided for birds, including natural light and supplemented by artificial light, with at least an eight-hour rest period without artificial light at night (Regulation (EC) No. 889/2008). Pasture in free-range systems may contribute as a source of energy and protein for chicken, as well as providing a range of bioactive substances including antioxidants and anticarcinogenic and hypocholesterolemic compounds (Ponte et al. 2004). Some herbs and forages which are ingested by birds at pasture can contribute to giving the meat distinctive flavours (Gordon and Charles 2002). Many uncontrolled factors which are inherently variable play an important role in free-range systems with outdoor access, such as the temperature, photoperiod and light intensity (Fanatico et al. 2005b).

Growth performance and carcass characteristics

There are many uncontrolled factors that are inherently variable and play an important role in organic systems with outdoor access, such as the temperature, photoperiod and light intensity. Moreover, birds reared outdoors have access to pasture and the availability of various forages, insects and worms (Fanatico et al. 2005b). Several authors (Warad et al. 2001; Pavlovski et al. 2009; Bogosavljević-Bošković et al. 2006; Milošević et al. 2005 and Skomorucha et al. 2008) have indicated a reduction in the body weight of birds under free-range systems in comparison with indoors broilers. A negative role of outdoor access on the body weight gain and feed conversion ratio of organic chickens reared to the ages of 56 and 81 days was also reported by Castellini et al. (2002a) and Dou et al. (2009). Wang et al. (2009) compared slow-growing Gushi birds kept exclusively indoors with those kept free range, and found that indoor chicken had a significantly higher body weight and better feed conversion. Li et al. (2017) reared medium-growing birds in three different raising systems: free-range, indoor-floor and cage, and reported that the body weight gain and feed conversion ratios (feed/gain) of free-range broilers were lower than in those kept in cage and indoor-range systems. More locomotor activity and less rest are observed behaviours of birds under free-range systems and could be reasons for their poorer growth rate and feed efficiency (Andrews et al. 1997). Ricke et al. (2012) also indicated that great physical activity and the large energy expenditure associated with the thermoregulation of organic birds can influence their production properties. Moreover, the uncontrolled environmental conditions in the free-range area are also reflected in feed conversion resulting from higher energy requirements (Andrews et al. 1997). Many authors (Li et al. 2017; Fanatico et al. 2005b; Wang et al. 2009 and Chen et al. 2013) have indicated that free-range systems do not have a significant influence on the eviscerated carcass percentage of chickens in comparison with indoor rearing systems. In contrast, Castellini et al. (2002a) and Feddes et al. (2002) confirmed that birds with outdoor access had significantly higher eviscerated carcass yield due to increased motor activity. However, Wang et al. (2009) reported that despite the fact that a free-range raising system significantly reduced the growth performance of poultry, it did not have an effect on the eviscerated carcass, breast, thigh and wing yields. Skomorucha et al. (2008) indicated that the type of rearing system affected the production properties of chicken giblets. Adedeji et al. (2014) and Abdullah and Buchtová (2016) found that the livers, hearts and gizzards of organically raised chicken broilers were heavier than those of conventionally bred birds.

The availability of access to a grassy paddock and the opportunity of ingesting various forages, insects and sand particles which contain high crude fibre could stimulate the development of the stomachs of free-range birds (Dou et al. 2009).

The physical characteristics of meat

Skin colour is related to the ability of birds to produce melanin pigment in the dermis and epidermis, as well as to carotenoid absorption and deposition (Fletcher 1999). The skins of birds that had access to the outdoors became more yellow because the chickens had the chance of foraging plant material rich in carotenoid pigments (Fanatico et al. 2005a and 2007). According to Castellini et al. (2002a), the higher levels of welfare provided for birds in organic farming, reduced stress conditions and subsequently reduced pH (lower levels of glycogen catabolised to lactic acid) resulted in an increase to the lightness value (L^*) of meat products. Husák et al. (2008), Castellini et al. (2002a), Sirri et al. (2010), Castellini et al. (2012) and Abdullah and Buchtová (2017) indicated that the greater motor activity of organic poultry may have an effect on meat tenderness, increasing the shear value of the meat. Li et al. (2017) evaluated the effect of raising systems (cage, indoor-floor and free-range) on the meat tenderness of broilers of a medium-growing strain, and found that the shear force of bird muscle from the cage group was lower relative to its values in broilers from free-range or indoor-floor groups. In contrast, Wang et al. (2009) and Fanatico et al. (2005a) found that the free-raising system did not influence tenderness. However, variations in the degree of physical activity are perhaps reflected in the level of meat tenderness in poultry in free-range systems.

The chemical characteristics of meat

There are many factors affecting the chemical composition of meat, including genetics, feed rations and physical activity (Zerehdaran et al. 2004; Cangar et al. 2006; Rizzi et al. 2007). Several studies have shown that providing birds with additional space in free-range and organic systems led to increased leanness in the chickens due to their high level of activity (Castellini et al. 2002a; Fanatico et al. 2007; Fanatico et al. 2009; Lichovníková et al. 2009; Chen et al. 2013; Abdullah and Buchtová 2017). According to Castellini et al. (2002a) motor activity favours myogenesis over lipogenesis, for which reason organic poultry have lower fat. Chickens reared in an organic system have more chance of ingesting organic and inorganic substances rich in minerals from the soil and, therefore, increased ash retention in their meat. The total protein content in the wings, livers, hearts and necks of organic chickens was greater than its percentage in the same organs from conventional broilers (Abdullah and Buchtová 2016). Küçükyilm et al. (2012) and Castellini et al. (2002a) found that the meat of organic broilers contains more ash than the meat of birds from a conventional rearing system. The role of the farming system in lipid oxidation has been evaluated by Castellini et al. (2002b) who found that the organic production system provides more kinetic behaviour for animals which accelerates the muscle oxidative metabolism and consequently increases the amount of free radicals. According to Dal Bosco et al. (2016) and Castellini et al. (2002a), the higher TBARS value of organic chicken meat is probably due to the greater physical activity of the birds, the higher percentage of PUFAs in the muscles and the peroxidability index (higher content of total metallic ions and haem Fe). Grass consumption by organic chickens in a free range area improved the amount of alpha-tocopherol and carotenoids in their meat and therefore increased antioxidant capacity (Castellini and Mourvaki 2007). Dal Bosco et al. (2016) found that the meat of organic birds with outdoor access to pasture had higher levels of antioxidants (mainly tocopherols and tocotrienols) compared to indoor birds.

Conclusions

The goal of providing free-range areas for chickens in an organic system is to improve animal welfare and environmental sustainability. The terrain, climate, average rainfall and type and intensity of vegetation, insects and worms must be taken into account in view of their differences according to seasons and geographical regions. The presence of trees in a free-range area is a necessary requirement to protect birds from direct sunlight, particularly in warm regions and seasons. The combination of production of fruits trees and broilers in a free-range area could be of double utility organically. The high motor activity of birds in a free-range area increases the lipid oxidation of organic chicken meat. To prevent accelerated lipid oxidation, it is necessary to take in account carcass handling, such as avoiding excessive meat processing and packaging in an oxygen-free modified atmosphere (MAP).

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