# Comparison of organic and conventional chicken meat from the consumer's perspective: production properties and sensory attributes

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**Abstract**

The aim of this study was evaluation of the properties of chicken meat from organic and conventional rearing systems which are observable by the consumer. The production properties (weight and yield) of different cuts/portions and sensory attributes of fresh eviscerated carcasses were investigated. The breasts of conventional chicken showed a significantly higher weight and yield ($p < 0.01$), whereas most of the other evaluated portions (thighs, muscles of thighs, bones of thighs, wings, skin of wings, bones of wing and skeleton) of conventional broilers showed lower weight and yield. The breast and skeleton were the heaviest part of the carcass with the highest yield in conventional and organic chicken, respectively. The tibia of organic birds was significantly ($p < 0.01$) longer. Panelists evaluated lower meatiness on the carcasses of organic chicken. The average difference of price between organic and conventional chicken meat was 180%. The price for which the panelists would buy the organic chicken meat was lower by 42.5% than the price in retail market of organic food products. This work aims to clarify for consumers the quantitative characteristics of the carcass portions that they will get when buying organic chicken at relatively higher prices from the retail market.

*ecological system, broiler meat, yield, prices, panellists*

## Introduction

The goal of establishing organic agriculture was to improve management of ecological production that promotes environmental sustainability, biodiversity, animal welfare, food safety and quality (Hovi et al. 2003). The Czech organic food market is described as "developed" in comparison with other Central European and Eastern European countries. In 2017, production of poultry meat from organic systems in the Czech Republic totaled 112 tons (Hrabalova 2018), while the total poultry meat production reached more than 251 thousand tons (Durilova 2018). The rules of organic production system for poultry include living conditions, genotypes, feeding, welfare, health and veterinary care and are detailed in Commission Regulation (EC) No. 889/2008, amended in April 2016 by Commission Implementing Regulation (EU) 2016/673. In order to prevent intensive rearing methods of poultry, the organic system prefers slow-growing hybrids, or poultry reared till the minimum age which is 81 days. Slow-growing genotypes of broilers which are usually used in the European Union organic program need 12 weeks to reach the market body weight. Although slow-growing breeds of chicken are less efficient for meat production, they are more adaptable to organic system conditions due to better viability, more activity and can have different meat quality (Fanatico et al. 2009). Fast-growing genotypes of birds are widely used in conventional system due to economic benefits. Such hybrids are designed genetically for commercial reasons in order to be slaughtered at younger age (40-55 days) and to obtain high breast yield. Fast-growing birds are reared organically in some countries to minimum slaughter age (81 days) also for commercial purpose, but there are not suitable for organic system due to poor welfare (Francham et al. 2004). The access of poultry to free rage areas is one of the most important characteristic of an organic system. Outdoor access provides chicken with the possibility of ingestion of green matter, herbs, stems, roots, insects and worms as well as with high activity (Sossidou et al. 2015). Our previous publications deal with the physical, chemical (Abdullah and Buchtova 2017;

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Abdullah and Buchtova 2016) and microbial properties of organic chicken meat (Hulankova et al. 2018). The aim of this study is to evaluate the observable properties of organic chicken meat that can be monitored by the consumer (production properties and sensorial attributes) and compare them with conventional chicken meat.

## Material and methods

### Samples for analysis

A total of 16 organic broiler chicken and 16 conventional broiler chicken carcasses were obtained from retail markets (the research was conducted in two cycles for each experimental group). The organic samples were from a farm which uses organic production system (Biopark s.r.o., Lipova, Czech Republic) according to the Commission Regulation (EC) No. 889/2008. The conventional samples were from a conventional production system (Vodnanska drubez, a.s., Vodnany, Czech Republic). Both the production companies are dominant suppliers of organic/conventional poultry meat to the Czech retail market. Breeding conditions of organic broiler chicken were as follows: slow growing hybrid (Colour yield hybrid), age at slaughter 81 days, stocking density in indoor area 10 birds per $m^2$, free range area available during the summer period. The breeding conditions of conventional production system were: fast growing hybrid (Ross 308), age at slaughter 38 days, stocking density in indoor area 18 birds per $m^2$, no possibility of access to a free range area. Detailed information on rearing conditions, feeding of birds and slaughter are described in our previous publications (Hulankova et al. 2018 for organic broiler chicken and Abdullah and Buchtova 2017 for the conventional broiler chicken). The organic samples were in a high-oxygen modified atmosphere packaging (80% $O_2$: 20% $CO_2$) while the conventional samples were packaged using polyolefin film stretched over the tray.

### Production properties

Dissection of the chicken broiler carcasses was performed according to the Commission Regulation (EC) No. 543/2008. Each eviscerated carcass (without neck, feet and offal) was weighed and then dissected to the following cuts/portions: breast (with skin), muscles of breast, skin of breast, thighs (with bones and skin), muscles of thighs, bones of thighs, skin of thighs, wings (with bones and skin), muscles of wings, bones of wings, skin of wings and skeleton. The aforementioned cuts/portions were weighed and the length of tibia bones was measured. The wings were dissected from the carcasses at the shoulder joint, and then weighed as pairs. The wings (drumette and wing flat) were deboned after dissection of the wing tip. The remaining meat (triceps, biceps and forearm muscles) of the wing and skin were weighed separately. The wing bones (humerus, radius, and ulna) and tip were weighed as well. Both thighs were weighed after dissection from the carcass at hip joint and then deboned (after skinning). The deboned muscles, bones (femur and tibia) and skin of thighs were weighed, then the length of each tibia was measured in centimetres with a ruler.

Yield measurement: yields of cuts/portions were calculated using the following formula:

$$\text{yield} = (\text{weight of the carcass cut} / \text{carcass weight}) \times 100$$

### Sensory attributes and price evaluation

Sensory evaluation was conducted in accordance with the requirements of the legal standard CSN ISO 8589:2008. For evaluations, a protocol with unstructured 100-mm graphic scales was used. A total of 96 consumer panelists (students from the University of Veterinary and Pharmaceutical Sciences Brno) were recruited for sensory assessment of raw chicken carcasses from organic and conventional rearing systems. The panelists were trained in the basic rules of sensory analysis but there was no special training in poultry meat evaluation. The evaluators were asked to evaluate the sensory attributes of the raw chicken carcasses including their overall acceptability, colour, odour, the quality of technological processing of carcass, meatiness, attractiveness of product for the consumer and the price for which the consumer would buy the product. The consumer panelists were informed beforehand about the purchase price of both products. Price of chicken meat in retail market was 9.28 Euro/kg and 3.31 Euro/kg for chicken meat from organic and conventional system, respectively. The price for evaluation was originally expressed in Czech crowns (CZK) and later converted to Euro only for the purpose of this article.

### Statistical analysis

Data was analysed statistically using Microsoft Office Excel 2003. Determination of the differences between organic and conventional samples was conducted by Student's t-test. The used levels of significance were 0.05 and 0.01.

## Results

### Production properties

Production properties (weight and yield) of chicken cuts/portions from organic and conventional production system are shown in Tab. 1, 2. The organic and conventional chicken had approximately the same average carcass weight ($p > 0.05$). There is a consensus

between the results of yield and weight of evaluated cuts/portions from analysed samples. With exception of breast, all evaluated cuts/portion of organic chicken carcass showed a higher weight and yield than those of conventional chicken. On the other hand, the breast of each conventional chicken was significantly ($p < 0.01$) heavier (more than 100 g) than the breast of each chicken from organic system. Approximately one third of each conventional chicken carcass (32.8%) was represented by the breast, which showed the highest yield of all the carcass cuts/portions.

Table 1. Weight [g] of cuts/portions of organic and conventional chicken meat.

| cuts/portions of carcass | organic | conventional | stat. sign. |
|---|---|---|---|
| carcass | 1488.50±77.11 | 1496.51±75.36 | NS |
| breast | 367.97±57.94[a] | 488.80±44.96[b] | ** |
| muscle of breast | 322.78±54.87[a] | 436.13±46.34[b] | ** |
| skin of breast | 43.64±10.21 | 47.76±8.94 | NS |
| thighs | 489.46±40.53[a] | 431.07±33.78[b] | ** |
| muscles of thighs | 340.08±44.17[a] | 293.13±39.63[b] | ** |
| skin of thighs | 48.30±5.77 | 50.63±10.95 | NS |
| bones of thighs | 111.43±23.14[a] | 92.49±9.96[b] | ** |
| wings | 187.73±12.21[a] | 148.83±11.76[b] | ** |
| muscles of wings | 78.29±27.64 | 64.03±18.52 | NS |
| skin of wings | 34.61±7.12[a] | 26.04±5.37[b] | ** |
| bones of wings | 77.78±8.29[a] | 59.83±4.72[b] | ** |
| skeleton | 436.41±36.41[a] | 405.51±41.45[b] | * |
| length of tibia (in cm) | 12.24±0.99[a] | 10.27±1.03[b] | ** |

Stat. sign.: Statistical significance, values on the same row with different letters [a], [b] are significantly different *$p < 0.05$, **$p < 0.01$, NS: No significance.

Generally, the shape of the breast from each organic broiler in the comparison with conventional chicken breast was narrower, thinner and longer (Plate VIII, Fig. 1). The weight of thighs (muscles and bones of thighs) from an organic chicken was significantly ($p < 0.01$) higher than that of a conventional chicken (Tab. 1). In the organic chicken carcass, the yield of thighs (32.86%) was the highest from all the cuts/portions (Tab. 2).

Table 2. Yield [%] of cuts/portions of organic and conventional chicken meat.

| cuts/portions of carcass | organic | conventional | stat. sign. |
|---|---|---|---|
| breast | 24.67±3.35[a] | 32.75±3.36[b] | ** |
| muscle of breast | 21.63±3.15[a] | 29.21±3.28[b] | ** |
| skin of breast | 2.94±0.69 | 3.20±0.63 | NS |
| thighs | 32.86±1.80[a] | 28.81±1.91[b] | ** |
| muscles of thighs | 22.84±2.75[a] | 19.62±2.76[b] | ** |
| skin of thighs | 3.25±0.39 | 3.38±0.69 | NS |
| bones of thigh | 7.51±1.70[a] | 6.20±0.78[b] | ** |
| wings | 12.61±0.35[a] | 9.96±0.84[b] | ** |
| muscles of wings | 5.28±1.94 | 4.31±1.34 | NS |
| skin of wings | 2.32±0.45[a] | 1.74±0.35[b] | ** |
| bones of wings | 5.22±0.45[a] | 4.00±0.33[b] | ** |
| skeleton | 29.41±3.08[a] | 27.15±3.09[b] | * |

Stat. sign.: Statistical significance, values on the same row with different letters [a], [b] are significantly different *$p < 0.05$, **$p < 0.01$, NS: No significance.

Organic birds had longer thighs (legs) due to significantly ($p < 0.01$) longer tibia bones (12.24 cm) compared with the length of the tibia of conventional birds (10.27 cm) (Plate VIII, Fig. 2, Plate IX, Fig. 3). Wings of the organic chickens weighed significantly higher ($p < 0.01$) than the wings of broilers from the conventional system (Tab. I). The larger size of organic chicken wings' meat was clearly observed by the naked eye (Plate IX, Fig. 4).

### Sensory attributes and price evaluation

The results of sensorial attributes are presented in Table 3. Significantly ($p < 0.01$) lower carcass meatiness of organic chicken was evaluated by the panelists (Tab. 3, Plate X, Fig. 5), which is compatible with production properties (weight and yield) of chicken breast. The panelists gave higher evaluation to sensory attributes of organic chicken including: overall acceptability, colour, odour, attractiveness of product for the consumer, and the price for which the consumer would buy the product.

Table 3. Sensorial attributes of organic and conventional chicken meat.

| parameters | organic | conventional | Stat. sign. |
|---|---|---|---|
| overall acceptability | 77.05±16.55[a] | 64.26±18.63[b] | ** |
| colour | 81.22±14.77[a] | 68.17±15.80[b] | ** |
| odour | 82.63±14.19[a] | 70.49±19.47b | ** |
| technological processing of carcass | 74.68±19.44 | 79.19±14.72 | NS |
| meatiness | 68.42±16.56[a] | 76.81±17.49[b] | ** |
| attractiveness of the product for the consumer | 78.96±14.09[a] | 70.74±15.05[b] | ** |
| the price for which you would buy the product (Euro/kg) | 5.37±1.78[a] | 3.20±1.01[b] | ** |

Stat. sign.: Statistical significance, values on the same row with different letters [a], [b] are significantly different **$p < 0.01$, NS: No significance.

The price for which the panelists would buy the organic chicken meat (5.73 Euro/kg) was lower (42.5%) than it prices in retail market of organic food products (9.28 Euro/kg). The average price which the panelists were ready to pay for conventional chicken meat (3.20 Euro/kg) was only few cents lower than the price in retail (3.31 Euro/kg).

## Discussion

### Production properties

Broilers from fast-growing breeds which are typically used in conventional rearing systems are efficient in growth in order to reach the market body weight in 7 weeks (Fanatico et al. 2009). Such hybrids are bred to provide the highest breast meat yield in order to fulfil consumer requests (breast is of the highest interest and the preferred carcass portion) and to provide the maximum profitability for producer (MacRae et al. 2007; Gordon and Charles 2002). The impact of hybrids on carcass characteristics was studied by Fanatico et al. (2005b). Their research compared slow-, medium- and fast-growing breeds of chicken broilers and found that the yield of breast meat was highest in fast-growing birds whereas it was lowest in slow-growing broilers. In addition, Dal Bosco et al. (2014) indicated that the breast of fast-growing chickens grows more than the whole body. Although these physical parameters were not measured and observed only by the naked eye, they are compatible with results published by Dal Bosco et al. (2014).

Castellini et al. (2002) indicated that the yield of drumsticks increased when the birds had a lower stocking density and access to the free range area as in organic production system due to increased locomotive activity. Shorter tibia length and drumstick yield of fast-growing chicken in comparison with the slow-growing breed were observed previously by Dal Bosco et al. (2014). A high percentage of leg lameness (acute inflammation of joints), foot pad dermatitis lesions and breast blisters were observed in fast-growing birds when reared organically (to 70 and 81 days of age) which restricted their natural movement. These afflictions and leg lesions were indicators of unsuitability of such hybrids for organic production system (Dal Bosco et al. 2014). The study of Fanatico et al. (2005b) indicated that the increase in breast yield of fast-growing chickens leads to decreased yield of other cuts/portions of eviscerated carcasses such as wings, confirming that wings of slow- and medium- growing chickens showed a higher yield in comparison with fast-growing broilers. Greater use of wings by chickens (as in organic and free range system) promotes the development and growth of bone and muscle masses (Gordon and Charles 2002; Fanatico et al. 2005b).

### Sensory attributes and price evaluation

Free-range rearing systems significantly reduce growth performance of poultry (Wang et al. 2009). Such reduction of growth performance could be attributed to the greater physical activity and the larger energy expenditures related to thermoregulation of chickens in organic systems (Ricke et al. 2012). Behaviours of organic broilers such as high locomotive activity and less time spent resting, as well as the uncontrolled environmental conditions in the free range area could be the reasons for their poorer growth rate and feed efficiency (Andrews et al. 1997). According to Napolitano et al. (2013), the consumer preferences of organic chicken meat over conventional are mostly based on promoting positive information about the organic rearing system, confirming that untrained consumers do not have the ability to distinguish between sensory properties of organic and conventional chicken meat. The yellower skin of organic chicken in comparison to conventional chicken skin was observed also previously by Fanatico et al. (2005a, 2007). The reasons for more yellow colour of skin of birds from organic system are attributed to slow-growing genotype, access to outdoors with possibility of forage for the plant material rich with carotenoid pigments or it could be due to use of organic corn as feed which is not common in conventional production system (Grashorn and Serini 2006). The average difference of price between organic and conventional food in most of the EU countries is about 20–30%, while in the Czech Republic this difference is up to 120% (Zivelova and Crhova 2013). The price difference between chicken meat from organic and conventional systems in our study reached up to 180%. According to Zivelova and Crhova (2013) the most important factor which plays a role in the marketing choices for Czech consumers is the price of organic food.

## Conclusions

In this study we compared organic and conventional chickens from retail with approximately the same average carcass weight. Properties of chicken meat are affected by the rules and conditions of organic system. The most important conditions of the organic production system which are clearly reflected on the production properties (weight and yield) and sensory attributes of evaluated chicken meat are:

- Genotypes: rearing slow-growing genotypes of birds with slaughtering age of 81 days
- Welfare: providing birds with higher welfare through access to free-range area (greater kinetic activity, available pasture, low stress factors but uncontrolled environmental conditions).

Organic systems negatively affected quantitative characteristics of the breast. Breast muscles of the conventional birds were heavier than breasts of organic broilers and also showed a higher yield. Slow-growing birds with high kinetic activity under organic systems resulted in a higher weight and yield of thighs and wings in comparison to conventional broilers. Breast is the preferred cut/portion of the chicken carcass. Producers try to fulfil the consumer demand by selecting hybrids of birds with the highest breast yield, and the rearing of fast-growing breeds is more profitable. Although the organic system has advantages regarding environmental sustainability, biodiversity, animal welfare and some aspects food quality, it seems that the consumers are unwilling to buy more than doubly expensive chicken with lower meatiness.

**Acknowledgements**

Financial support for this study was provided by the University of Veterinary and Pharmaceutical Sciences Brno, Internal Creative Agency FVHE/Tremlová/ITA2019, Czech Republic.

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Fig.1. Breast of conventional (c) and organic (o) chicken


Fig. 2. Thigh of conventional (c) and organic (o) chicken


Fig. 3. Tibia of conventional (c) and organic (o) chicken

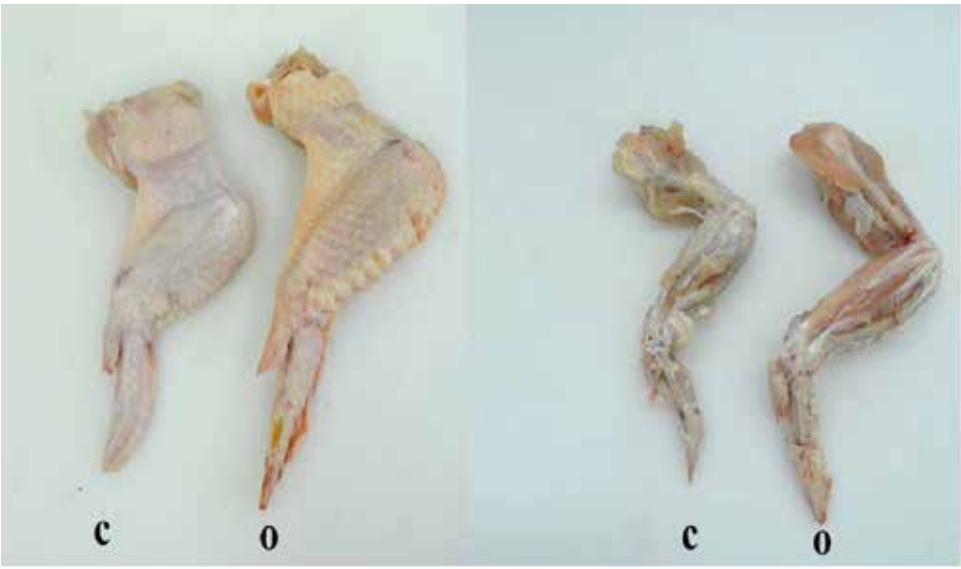


Fig. 4. Wigs of conventional (c) and organic (o) chicken

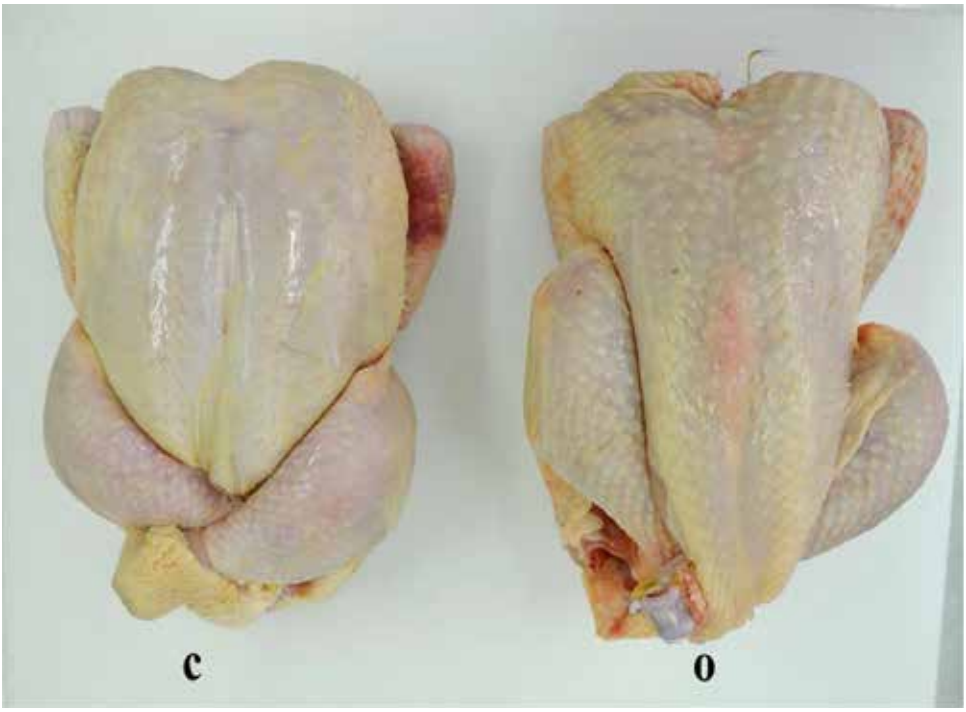


Fig. 5. Carcasses of conventional (c) and organic (o) chicken