# Comparative analysis of meat chemical composition of different broiler provenances

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A b s t r a c t: *The objective of this study was to determine the effect of breed line and age on carcass chemical composition in broiler chickens. Chemical composition of broiler breast meat and drumstick with thigh were compared within 3 lines (Cobb, Ross, and Hubbard). Each line was divided into two groups, aged 42 and 50 days. Chemical composition of meat was determined 48 hours after slaughter and was very variable depending on the breed and age of the broilers. The most significant differences were observed in fat content. Breast meat and meat from drumstick with thigh of younger broilers (42 days old) had significantly lower fat content than older broilers (50 days old). Cobb broilers, 42 days old, had significantly lower percentages of fat (p<0.01) in breast meat and meat from drumsticks with thighs than other broiler lines of the same age, while 50 day old Hubbard broilers had lower fat levels in breast meat and meat from drumsticks with thighs than meat from the other two broiler provenances (Cobb or Ross) of the same age. Hubbard broilers (42 days old) had significantly lower (p<0.01) levels of water and protein in breast meat and meat from drumsticks with thighs compared to the other broiler lines. Interactions between breed line and age were found for fat percentage in breast meat and meat from drumsticks with thighs. Meat quality of broilers of different provenances can be estimated by determining the chemical composition of breast meat and meat from drumsticks with thighs.*

**Keywords:** *Cobb, Ross, Hubbard, chemical composition, breast meat, drumstick with thigh.*

## Introduction

Poultry meat production has doubled in the past 40 years in the world, has a trend of constant growth, and its production volume now exceeds beef, but is less than pork. The biggest producers of poultry meat are Asia, North and South America and Europe. The most significant category of poultry meat is that of young chicken (broilers) (*Glamočlija et al*, 2013a).

Broiler meat is a highly valuable food with evident nutritive and biological properties. It contains high biological value proteins with essential amino acids, fat/fatty acids, vitamins and minerals (*Glamoclija et al*, 2015). According to the United States Department of Agriculture (*USDA*, 2006), the average chemical composition of broiler meat is 74.6% water, 12.1% protein, 11.1% fat, 1.2% carbohydrate and 1% minerals.

The quality of broiler meat can be assessed to determine the suitability of meat for processing, storage and sale (*SRPS EN ISO*, 2012). Among others, some of the main attributes which define the quality of broiler meat, and other types of meats as well, are chemical characteristics such as content of water, protein, fat and ash. However, many factors can affect the chemical composition of broiler meat. Some of these factors are age and sex of broilers, diet and fattening, breed line – genetics, breeding processes and muscle type (red and white muscles) (*Ristic et al*., 2008, *Krischek et al*., 2011). Literature data indicate different broiler meats can contain relatively constant amounts of water, protein and ash, while fat content is very variable (*Ristic et al*., 2007).

Improvements in genetics and diet, plus many other factors, have enabled six week old broilers to now reach weights of nearly three kilograms, whereas 50 years ago, achievement of this weight took 16 weeks (*Glamočlija et al*, 2013b). Nowadays, the most common broiler breeding groups are Cobb-Vantress (with the Cobb500, Cobb700, CobbAvian48 and CobbSasso brands), Aviagen (with the Ross, Arbor Acres, Indian River, Rowan Range and Specialty Males brands), and Group Grimaud (with the Hubbard and Grimaud Frere brands) (*Elfick*, 2012). Cobb, Ross and Hubbard broiler provenances are the most common in Serbia (*Glamočlija et al*, 2013b). Other factors – age, sex, housing conditions, and

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post-mortem factors such as processing of carcasses and method of chilling –influence carcass yields (*Bilgili*, 2002, *Bihan-Duval et al*, 1999). Slaughter age and weight of, for example, Cobb500 broilers depend on the requirements of the consumer population, and can vary between countries. The average weight is from 1.70 kg (33 days old, Germany) to 2.92 kg (51 days old, Japan), where the meat yield is above 70 %. (*Anonym*, 2012a). At the most common age for slaughter – 42 days, Cobb 500 have an average weight before slaughter of 2.73 kg, Ross 308 – 2.65 kg and Hubbard Classic – 2.59 kg (*Anonym*, 2012a, b, c, ).

## Materials and Methods

The study was conducted on 36 commercial market broilers (100 Cobb 500, 100 Ross 308 and 100 Hubbard Classic) which were divided into six groups. Each line was divided into two groups of broilers, which were 42 and 50 days old, respectively. Broilers were between 2000 and 2600 g live weight. The broilers were fed according to a breeder feeding program based on recommended nutrient levels. Broilers were slaughtered in a registered slaughterhouse.

Determination of chemical composition (water, protein, fat and ash) was carried out on breast meat and meat from drumsticks with thighs from each group. The chemical composition was determined using standard methods (*SRPS ISO,* 1998; *SRPS ISO,* 1992; *SRPS ISO,* 1992; *SRPS ISO,* 1999).

Statistical analysis of the results was conducted using the software GraphPad Prism Version 5.00 for Windows (GraphPad Software, San Diego, California USA, www.graphpad.com). Mean values were calculated and the groups were compared with one-way ANOVA with Tukey's multiple comparison

statistical test. Two-way ANOVA with Bonferroni post hoc test was performed to test the effect of broilers line (Cobb, Ross and Hubbard) and age (42 and 50 days) as main effects, and their interaction on the chemical composition values. Values of $p<0.05$, $p<0.01$ and $p<0.001$ were considered significant. The results are expressed as mean ± SD.

## Results and Discussion

Results of the chemical composition of meat (breast and drumstick with thigh) of three different broiler lines are shown in Tables 1 and 2.

The chemical composition of broiler meat reported in the literature is very variable and depends on many factors. According to *Van Heerden et al.* (2002), breast meat contained on average 74.01% water, 23.29% protein, 2.91% fat, and 1.11% ash (Ross 308 and Cobb broilers), while meat from drumsticks with thighs contained 72.47% water, 19.16% protein, 8.91% fat, and 1.0% ash. *Wattanachant et al.* (2004) found that breast meat (CP707 broilers) contained an average of 74.87% water, 20.59% protein, 0.68% fat and 1.10% ash and meat from drumsticks with thighs was 77.22% water, 19.08% protein, 0.81% fat and 1.06% ash. According to *Lonergan et al.* (2003), breast meat (commercial broilers) contained on average 73.42% water, 24.02% protein and 1.08% fat. *Baltic et al*, 2015 found that commercial broiler breast meat contained 78.10±0.13% water, 16.33±0.51% protein, 1.92±0.20% fat and 3.65±0.07% ash. Djordjevic (2005) found that breast meat of broiler hybrid Hybro G contained on average 73.81% water, 24.17% protein, 0.94% fat and 1.22% ash, while meat from drumsticks with thighs contained 72.35% water, 17.50% protein, 9.24% fat and 1.05% ash. According to *Ristic* (2007), the average chemical composition of broiler breast meat

**Table 1.** The effect of breed line and age on chemical composition of breast meat (*Pectoralis major*) of broiler chickens (n=6)

| Parameter (%) | 42 days old | | | 50 days old | | | L | A | L × A |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | Cobb (n=6) | Ross (n=6) | Hubbard (n=6) | Cobb (n=6) | Ross (n=6) | Hubbard (n=6) | P value | | |
| Water | 72.99±0.34 | 73.23±0.14 | 73.12±0.16 | 73.50[a]±0.45 | 73.01[a]±0.17 | 73.32±0.34 | ns | ns | * |
| Protein | 25.44[a,b]±0.31 | 25.01[a] ±0.13 | 24.94[b]±0.18 | 24.57[a]±0.42 | 24.96[a]±0.13 | 24.87±0.40 | ns | ** | ** |
| Fat | 0.54[A,B]±0.07 | 0.76[A,a]±0.04 | 0.91[B,a]±0.10 | 0.90±0.07 | 1.01[C]±0.14 | 0.79[C]±0.13 | *** | *** | *** |
| Ash | 1.03±0.02 | 1.02±0.03 | 1.03±0.03 | 1.04±0.03 | 1.03±0.03 | 1.02±0.04 | ns | ns | ns |

**Legend:** Means within a row with a common superscript letter differ significantly: [a,b] – ($p<0.05$) and [A, B, C] – ($p<0.01$); ns – not significant ($p>0.05$); * – $p<0.05$; ** – $p<0.01$; *** – $p<0.001$; L – line factor; A – age factor; L × A – Interaction between line and age factor

**Table 2.** The effect of breed line and age on chemical composition of meat from drumsticks with thighs of broiler chickens (n=6)

| Parameter (%) | 42 days old | | | 50 days old | | | L | A | L × A |
|---|---|---|---|---|---|---|---|---|---|
| | Cobb (n=6) | Ross (n=6) | Hubbard (n=6) | Cobb (n=6) | Ross (n=6) | Hubbard (n=6) | P value | | |
| Water | 74.32A±0.69 | 74.44B ±0.21 | 73.28A,B±0.64 | 74.49±0.74 | 73.29±0.50 | 74.26±0.26 | * | * | ns |
| Protein | 19.85A±0.14 | 19.78B±0.27 | 19.09A,B±0.37 | 19.34±0.31 | 19.07C±0.28 | 19.72C±0.38 | ns | ns | *** |
| Fat | 4.46B±0.28 | 4.65C±0.22 | 6.77B,C±0.37 | 5.15A±0.63 | 6.62A,D±0.62 | 5.01D±0.22 | *** | * | *** |
| Ash | 1.04±0.04 | 1.03±0.03 | 1.03±0.05 | 1.03±0.03 | 1.03±0.03 | 1.02±0.02 | ns | ns | ns |

**Legend:** Means within a row with a common superscript letter differ significantly: A, B, C, D – (p<0.01); ns – not significant (p>0.05); * – p<0.05; ** – p<0.01; *** – p<0.001; L – line factor; A – age factor; L × A – Interaction between line and age factor

(Ross and Cobb hybrids) was 74.9±0.7% water, 23.6±0.7% protein, 0.6±0.38% fat and 1.2±0.1% ash, and of meat from drumsticks with thighs was 75.4±1.1% water, 19.6±0.9% protein, 3.88±1.33% of fat and 1.1±0.1% ash. *Castellini et al.* (2002) found the breast meat of 56 day old Ross broilers contained 75.54% water, 22.39% protein, 1.46% fat and 0.61% ash.

In all cases, breast meat was different to meat from drumstick with thigh, especially with respect to the fat content. Meat from drumstick with thigh has a higher fat content than breast meat. However, the protein content was consistently higher in breast meat compared to meat from drumstick with thigh. Additionally, variation was observed in chemical composition (water, protein and fat) in breast meat from different broiler provenances; this was also the case with meat from drumsticks with thighs.

Results of chemical analysis of breast and drumsticks with thigh meat from the examined groups of broilers in this study were in agreement with the results of other authors. Our results for breast meat and meat from drumsticks with thighs from three different broiler lines and two different ages, showed significant differences in the fat content. Finally, fat content certainly depends on both broiler line and age, but also depends on interactions of these factors. Cobb broilers at 42 days old contained a significantly lower percentage of fat (p<0.01) in both breast meat and in meat from drumsticks with thighs than Cobb broilers at 50 days old. Fat content was the highest in 42 day old Hubbard broilers. Meat from drumsticks with thighs derived from Hubbard broilers (42 days old) had significantly lower (p<0.01) amounts of water and protein compared to other broiler provenances. In contrast, older Hubbard broilers (50 days) had lower percentages of fat in breast meat and meat from drumsticks with thighs than the other two broiler provenances (Cobb and Ross) of the same age.

## Conclusion

Beside other factors, genetics, age, diet and breeding have a significant impact on broiler carcass quality parameters, such as chemical composition of breast meat and meat from drumsticks with thighs. Fat content was the most variable meat quality indicator measured, and depended on broiler line and age and both of these factors together. Cobb broilers, 42 days old, had the lowest percentage of fat in breast meat and meat from drumsticks with thighs, compared to meat from the other broiler lines of the same age. Hubbard broilers, 50 days old, had the lowest percentage of fat in breast meat and meat from drumsticks with thighs than the other two broiler provenances (Cobb and Ross) of the same age. Younger broilers (42 days old) always had lower fat levels in breast meat and meat from drumsticks with thighs than older broilers (50 days old).

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