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INFLUENCE OF THE ADDITION OF POST-EXTRACTION RAPESEED MEAL ON THE SENSORIC QUALITY OF POULTRY MEAT

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ABSTRACT

Complete feed mixtures, very often enriched by the addition of various probiotic preparations, oils, extract, essential oils, mouldings, pollards etc., that are often added as a replacement for animal meals, antibiotic preparations, coccidiostats respectively, are used for feeding of chickens. In addition to the positive effects of these supplements, the final quality of meat may be adversely affected by the accumulation of certain components. The aim of the work was to monitor the influence of adding post -extraction rapeseed meal (PRM) to a broiler feed mixture on the sensory quality of breast and thigh muscle. The experience includes two hybrid combinations of broilers, ROSS 308 and COBB 500. Samples of breast and thigh muscle of broilers fed by a feed mixture with the addition of 10% post -extraction rapeseed meal were compared, using sensory analysis, with a control sample where the broilers were fed by a standard feed mixture without the addition of PRM. It has been found that the addition of post -extraction rapeseed meal to the broilers' feed mixture had a positive effect (p <0.05) on the sensory quality of hybrid ROSS 308, both on the breast and thigh muscle. For COBB 500 hybrid, the quality of both breath and thigh muscle has not been shown to be significantly affected. The addition of 10% PRM affected positively especially the texture properties of ROSS 308, hybrid breast muscle, whereas they were deteriorated in COBB 500. In sensory evaluation, by adding 10% of PRM to the feed mixture, thigh muscle was affected less than breath muscle. Adding 10% PRM to the feed has almost no effect on descriptors of the intensity and pleasantness of smell and the intensity and pleasantness of taste, both in the negative and positive sense, both in breath and thigh muscle. The evaluation of the overall quality of both breath and thigh muscle has turned out more positive for ROSS 308 hybrid, although only slightly. The addition of rapeseed extracted meal to feed hybrids ROSS COBB 308 and 500 had no significant effect on the sensory quality of breast and thigh muscle.

Keywords: sensory quality; poultry meat; feed; fat

INTRODUCTION

In the last 20 years, we have experienced a significant increase of chicken meat consumption worldwide and in Europe, primarily due to dietary properties, favourable price and relatively quick kitchen processing. The World Health Organization (WHO) recommends reducing the intact of fat to maximum 30% of the total daily intake, saturated fatty acids 10%, 10 – 15% MUFA, 6 – 10% PUFA, maximum 300 g of cholesterol per day and less than 1% trans fatty acids **(Jiménez-Colmenero, 2007)**. At the same time, the fattening period of broiler chickens has significantly decreased **(Mates, 2013)**. Chicken meat is distinguished by a high nutrition value. Due to the cholesterol content, relatively high protein content and the content of polyunsaturated fatty acids (PUFA), it can be used as a valuable component of the human diet, with potential health benefits **(Milićević et al., 2014)**.

The nutritional value of poultry, compared with other animal products, is characterised by a higher content and higher digestibility of proteins and lower content of energy. Compared with lard and beef tallow, poultry fat has a substantially lower content of adversely acting saturated fatty acids and contains two times higher amount of linoleic acid than beef tallow **(Adeymo et al., 2010; Guèye, 2009; Vandendriessche, 2008; Duclos et al., 2007)**. **Onyimonyi et al. (2009)** suggest a tendency that the poultry holding plays an important role when bridging the protein gap in developing countries where the average daily protein consumption is significantly lower than the recommended standards.

It is generally known that the highest costs in chickens fattening consist in the costs of feed, representing up to 80% of total costs and therefore it is not always possible to produce feed mixtures on the basis of the requirements of particular chicken hybrid combinations **(Olugbemi et al.,**

2010). **Adeymo et al. (2010)** state that delivering of high-quality feed which adequately meets broilers nutrition requirements is significant for their quick growth. A type of chicken hybrid combination is a basis for the creation and composition of feed mixtures **(Cerrate and Waldroup, 2009)**.

When feeding broiler chickens, there is an effort to achieve quickly the slaughter weight with low consumption of feed per kilogram of gain, while preserving the best slaughter quality of broilers **(Dozier et al., 2006)**. Most feed mixtures for fattening chicken are made in granular form, but also mixtures in bulk form are used **(Choi et al., 1986; Cutlip et al., 2006; Cutlip et al., 2008)**. Ross 308 is one of the most widely reared broilers worldwide. Its biggest advantage is a quick growth with a minimum feed consumption. It is preferred in higher integrated wholes that provide above-average useful properties and are combined with a balanced muscularity of the body as well as high muscle yields. It represents good satisfaction of the customer's requirements, the customer requires a balanced animal performance and universal use in the final processing of meat **(Xavergen, 2007)**. Cobb 500 is a robust broiler that achieves high daily gains when using basic types of feeds with lower nutrition content. High slaughter yield and great uniformity are appreciated the most in the manufacturing industry **(Xavergen, 2007)**. It has the lowest feed conversion, the best growth rate and low nutrition requirements.

In the past, as today, possible alternatives of price – intensive components or supplements and enzymatic preparations for complete feed mixtures as essential oils, plant essences and extracts, bee products, probiotic preparations etc. were tested **(Haščík et al., 2016; Mellen et al., 2014; Haščík et al., 2004, 2005; Skřivan and Túmová, 1992; Angelovičová 1997)**. One of the possibilities is the use of post-extraction rapeseed meal (PRM).

The rapeseed is a very important source of proteins and its use for feed mixtures for ruminants and non-ruminants has been increased in the last decade. In addition to the seed and rape oil **(Pelser et al., 2007)**, also PRM containing 32 – 38% of nitrogen substances is added to feed mixtures. Its quality depends on the variety of rape from which it stems.

Currently, double zero rapes having a low content of erucic acid which is less suitable for nutrition and glucosinolates (GSL) are grown. PRM 5 – 15% is added to feed mixtures for poultry. Besides the positive influence of PRM in animal fattening, also the sensory quality of meat can be affected **(Haak et al., 2008; Wood a kol., 2008; Jaworskaa et al, 2016)**.

The entire quality of food means a set of all properties of the particular product that are important for meeting the needs and requirements of the consumers. These properties are divided into two basic groups – basic characteristics and useful properties which include also food sensory analysis **(Ingr, 2010; Horčin, 2002)**. Sensory evaluation of food is one of the oldest methods of quality control which has been retained in the every day practices of the food-processing industry until today despite the high degree of development of objective methods, especially analytic ones **(Buňka et al., 2008; Jarošová, 2001)**. The sensory quality of a food product can be affected virtually by any intervention in the production, manufacturing, storing the product etc. compared to the standard production. Adding various accessory substances to the feed not only of poultry but also other animals can affect both positively and negatively the sensory properties of the meat.

MATERIAL AND METHODOLOGY

The samples which were used for sensory evaluation were supplied by a company which has been long-term engaged in chicken fattening and the slaughter processing.

30 chicken broilers of ROSS 308 and 30 chicken broilers of COBB 500 who were fed by a feed mixture with the addition of 10% post-extraction rapeseed meal (PRM) were used for the experiment with fattening. Length of fattening period was 38 days. 15 pieces of each broiler were randomly selected and slaughtered and these slaughter bodies were used for sensory evaluation. Control groups (C) in both hybrid combinations [ROSS 308 (K), n = 15; COBB 500 (K), n = 15] were fed by the same feed mixture but without adding PRM. The chickens (experimental and control group) were slaughtered and portioned on the same day. Both groups were sampled – samples of breast muscle [ROSS 308, n = 15; COBB 500, n = 15; ROSS 308 (C), 308 n = 10; COBB 500 (C), n = 10) and thigh muscle (ROSS 308, n = 15; COBB 500, n = 15;

Figure 1 Samples of chicken ready for heat treatment.

ROSS 308 (C), n = 10; COBB 500 (C), n = 10]. All samples were individually packed to an aluminium foil, described and maintained at the temperature 5 ±0.5 °C till the next day. Subsequently, the samples were thermally processed by stewing in their own juice at 250 °C for the duration of 1 hour (Figure 1). In total, n = 100 samples were thermally processed and presented for sensory testing.

Sensory analysis

Sensory evaluation was performed in sensory laboratory of the Department of Food Technology of Mendel University in Brno, equipped according to ISO 8589. Ten trained evaluators were presented with thermally processed samples of breast and thigh muscle of ROSS 308 and COBB 500 hybrids fed by a mixture without the addition (C) and with the addition of 10% PRM. The samples were presented always in the order control group (C), followed by the experimental group. At first, breast muscle was evaluated and subsequently thigh muscle. Sensory analysis was divided into the morning part (09:00 – 11:00 am) as ROSS 308 hybrid was evaluated and the afternoon part (02:00 – 04:00 pm) as COBB 500 hybrid was evaluated. The following descriptors were evaluated colour – pleasantness, colour – typicalness, colour – intensity, texture – by appearance and by palpation, smell – pleasantness, smell – intensity, chewiness, juiciness, taste – pleasantness, taste – intensity and the overall quality. The samples were presented anonymously. The results were recorded by the evaluators in forms with graphic unstructured scales (100 mm) with a verbal description of the end points where 0 was described as the worst value and 100 was described as the best value **(Ambrosiadis et al., 2004)**.

Statistical data processing

The obtained results were further processed in MS Excel 2010 programme and in STATISTICA CZ (version 12) programme. One factor ANOVA, Duncan's test (p <0.05) was used for statistical processing.

RESULTS AND DISCUSSION

Breast muscle

ROSS 308 control (C), ROSS 308 PRM

When comparing samples ROSS 308 hybrid control (C) and ROSS 308 with the addition of PRM in the feed we found that the addition of PRM did not affect significantly descriptors of smell and taste (Table 1). Mostly descriptors juiciness and chewiness were mostly affected by adding PRM, with statistic significance (p <0.05). In these two descriptors, the sample with PRM was evaluated better. Furthermore, the addition has also manifested positively in the monitored descriptor texture – by appearance, by palpation, but not statistically significant.

COBB 500 control (C), COBB 500

PRM In the samples COBB 500 control (C) and COBB 500 with the addition of PRM to the chicken feed it was found that the addition had again the greatest influence on descriptors juiciness and chewiness and also on descriptors colour – typicalness, colour – intensity with statistical significance (p <0.05) among the samples (Table 2). In this case, PRM in the feed affected negatively juiciness, chewiness and also colour intensity, whereas it affected positively the typicalness of colour. Descriptors of smell and taste were not affected at all.

ROSS 308 PRM, COBB 500 PRM

When comparing both hybrids ROSS 308 with the addition of PRM and COBB 500 with the addition of PRM to the feed, there were recorded the biggest differences and statistical significance of difference (p <0.05) was determined in descriptors colour – pleasantness, chewiness, juiciness, taste – pleasantness and overall quality (Table 3).

Thigh muscle

ROSS 308 control (C), ROSS 308 PRM

Statistically significant difference (p <0,05) when evaluating thigh muscle of ROSS hybrid and ROSS with the addition of 10% PMR was found in one descriptor – juiciness where the control sample (Table 4) was evaluated better. On the contrary, in chewiness the sample with the addition of PRM was evaluated better. Descriptors of colour, smell and taste were not affected almost at all.

COBB control (C), COBB PRM

By sensory evaluation of thigh muscle in samples COBB 500 control and COBB 500 with the addition of PRM, statistically significant difference (p <0,05) (Table 5) was not found in any of the monitored descriptors. In the sample with the addition of PRM to chicken feed, chewiness and texture by appearance and by palpation were affected only slightly positively.

ROSS 308 PRM, COBB 500 PRM

By sensory analysis of both hybrids with the addition of PRM, statistically significant difference (p <0.05) was found in two descriptors – chewiness and taste – intensity (Table 6). COBB was better evaluated in both descriptors. In thigh muscle, COBB was better evaluated in eight of the eleven monitored descriptors, but ROSS was better evaluated in overall quality.

The study carried out by **Miliećevic et al. (2014)** has shown that the content of cholesterol and unsaturated fatty acids in the chicken meat can be affected also by adjustment of feed mixture composition. Feed mixture composition had no impact on the sensory properties of meat but it has turned out that lower values of cholesterol and higher values of unsaturated fatty acids were measured in breath and thigh muscle.

There was conducted a study in Italy whose aim was to evaluate the effect of various genotypes and feeding for meat in terms of composition. Poultry was divided into 2 groups with a different food composition that differed in the protein source – soya bean and broad bean. In feeding rations with soya bean, lower contents of lipids, a higher proportion of PUFA and a lower proportion of monounsaturated fatty acids (MUFA) were found on breast and thigh muscle. The feed with broad bean has only slightly increased the levels of proteins in breast muscle and decreased the levels of lipids and ash in thigh muscle **(Meluzzi et al., 2009)**.

Table 1 Average values of individual descriptors monitored in sensory analysis of breast muscle of ROSS 308 control (C) and ROSS 308 with the addition of 10% post-extraction rapeseed meal (PRM).

Descriptors	ROSS 308 C	ROSS 308 PRM
Color – pleasantness	75.12 ±13.89	72.18 ±11.16
Color – typicalness	71.04 ±15.68	72.60 ±13.09
Color – intensity	49.10 ±10.80	51.50 ±10.69
Texture*	50.56 ±18.14	54.90 ±20.92
Smell – pleasantness	70.74 ±14.63	72.72 ±11.49
Smell – intensity	66.90 ±15.78	65.70 ±9.86
Chewiness	49.38 ±23.97[a]	60,20 ±20.20[b]
Juiciness	44.80 ±22.50[a]	56.77 ±20.58[b]
Taste – pleasantness	71.90 ±15.17	68.01 ±12.66
Taste – intensity	59,64 ±18.03	63.60 ±10.27
Overall quality	65.86 ±13.88	62.06 ±17.34

Note: *****by appearance, by palpation
[a, b] statistically significant difference (p <0.05) among groups.

Table 2 Average values of individual descriptors monitored in sensory analysis of breast muscle of COBB 500 hybrid control (C) and COBB 500 with the addition of 10% PRM.

Descriptors	COBB 500 C	COBB 500 PRM
Color – pleasantness	70.86 ±15.29	76.18 ±13.23
Color – typicalness	70.46 ±14.24[a]	76.39 ±14.13[b]
Color – intensity	56.66 ±13.15[b]	50.52 ±9.86[a]
Texture*	57.76 ±20.58	57.31 ±17.55
Smell – pleasantness	70.80 ±10.44	72.94 ±14.27
Smell – intensity	62.22 ±14.13	62.58 ±17.27
Chewiness	58.58 ±17.49[b]	48.90 ±19.21[a]
Juiciness	50.76 ±20.07[b]	43.17 ±19.28[a]
Taste – pleasantness	66.06 ±16.05	62.02 ±14.44
Taste – intensity	58.82 ±13.15	61.14 ±14.15
Overall quality	58.84 ±16.99	55.03 ±15.72

**Note: ***by appearance, by palpation
[a, b] statistically significant difference (p <0.05) among groups.

Table 3 Average values of individual descriptors monitored in sensory analysis of breast muscle of ROSS 308 hybrid with the addition of 10% PMR and COBB 500 hybrid with the addition of 10% PRM – post-extraction rapeseed meal (PRM).

Descriptors	ROSS 308 PRM	COBB 500 PRM
Color - pleasantness	72.18 ±11.16[a]	76.18 ±13.23[b]
Color - typicalness	72.60 ±13.09	76.39 ±14.13
Color - intensity	51.50 ±10.69	50.52 ±9.86
Texture*	54.90 ±20.92	57.31 ±17.55
Smell - pleasantness	72.72 ±11.49	72.94 ±14.27
Smell - intensity	65.7 ±9.86	62.58 ±17.27
Chewiness	60.20 ±20.20[b]	48.90 ±19.21[a]
Juiciness	56.77 ±20.58[b]	43.17 ±19.28[a]
Taste - pleasantness	68.01 ±12.66[b]	62.02 ±14.44[a]
Taste - intensity	63.60 ±10.27	61.14 ±14.15
Overall quality	62.06 ±17.34[b]	55.03 ±15.72

**Note: ***by appearance, by palpation
[a, b] statistically significant difference (p <0.05) among groups.

There are differences in the composition of various kinds of meat depending on their anatomical structure of animal **(Kameník, 2013)**. As stated by **Pipek and Pour (1998)**, meat with a higher content of fat, in which post-mortal ripening processes took place, has a fuller taste and smell. Our results showed that when controlling ROSS 308 and COBB 500 hybrids, higher values in the pleasantness of smell were found in thigh muscle but the intensity of smell was higher in breast muscle. In the descriptor pleasantness and the intensity of taste in COBB 500 hybrid, the values were higher in thigh muscle whereas in ROSS 308 hybrid, the pleasantness of taste was more intensive in breast muscle and the intensity of taste in thigh muscle. In samples with 10% PRM in COB 500, the higher values were always in thigh muscle whereas in ROSS 308, except for the pleasantness of taste, always in breast muscle. In the same way, the sensory quality can be significantly affected by the temperature of the presented sample as well as by the succession of evaluation of individual descriptors, i.e. the chosen methodology **(Kinclová et al.,**

Table 4 Average values of individual descriptors monitored in sensory analysis of thigh muscle of ROSS 308 hybrid control (C) and ROSS 308 with the addition of 10% post-extraction rapeseed meal (PRM).

Descriptors	ROSS 308 C	ROSS 308 PRM
Color – pleasantness	74.52 ±12.65	72.93 ±18.11
Color – typicalness	74.70 ±14.30	73.64 ±18.59
Color – intensity	51.26 ±11.30	55.53 ±14.78
Texture*	57.68 ±18.32	58.64 ±20.03
Smell – pleasantness	72.40 ±12.11	71.69 ±16.28
Smell – intensity	63.94 ±14.75	60.14 ±18.22
Chewiness	51.50 ±19.08	55.79 ±16.40
Juiciness	62.08 ±14.68[b]	55.60 ±16.40[a]
Taste – pleasantness	71.64 ±12.74	66.37 ±17.26
Taste – intensity	62.50 ±15.27	61.59 ±13.86
Overall quality	66.54 ±14.32	63.14 ±19.62

**Note: ***by appearance, by palpation
[a, b] statistically significant difference (p <0.05) among groups.

Table 5 Average values of individual descriptors monitored in sensory analysis of thigh muscle of COBB 500 hybrid control (C) and COBB with the addition of 10% post-extraction rapeseed meal (PRM).

Descriptors	COBB 500 C	COBB 500 PRM
Color – pleasantness	74.70 ±15.42	75.21 ±16.17
Color – typicalness	74.30 ±15.29	75.72 ±13.85
Color – intensity	58.24 ±13.38	54.52 ±16.17
Texture	61.02 ±20.78	63.70 ±21.75
Smell – pleasantness	71.88 ±15.18	73.25 ±15.04
Smell – intensity	61.28 ±13.94	62.73 ±15.54
Chewiness	59.62 ±16.02	64.08 ±19.57
Juiciness	57.52 ±19.32	57.28 ±22.95
Taste – pleasantness	68.64 ±12.99	64.58 ±16.44
Taste – intensity	65.06 ±11.82	65.78 ±13.06
Overall quality	65.54 ±16.96	62.95 ±18.90

**Note: ***by appearance, by palpation
[a, b] statistically significant difference (p <0.05) among groups.

Table 6 Average values of individual descriptors monitored in sensory analysis of thigh muscle of ROSS 308 hybrid with the addition of 10% post-extraction rapeseed meal (PRM) and COBB 500 hybrid with the addition of 10% post-extraction rapeseed meal (PRM).

Descriptors	ROSS 308 PRM	COBB 500 PRM
Color – pleasantness	72.93 ±18.11	75.21 ±16.17
Color – typicalness	73.64 ±18.59	75.72 ±13.85
Color – intensity	55.53 ±14.78	54,52 ±16.17
Texture*	58.64 ±20.03	63.70 ±21.75
Smell – pleasantness	71.69 ±16.28	73.25 ±15.04
Smell – intensity	60.14 ±18.22	62.73 ±15.54
Chewiness	55.79 ±16.40[a]	64.08 ±19.57[b]
Juiciness	55.60 ±16.40[a]	57.28 ±22.95
Taste – pleasantness	66.37 ±17.26	64.58 ±16.44
Taste – intensity	61.59 ±13.86[a]	65.78 ±13.06[b]
Overall quality	63.14 ±19.62	62.95 ±18.90

**Note: ***by appearance, by palpation
[a, b] statistically significant difference (p <0.05) among groups.

2004). **Kameník (2013)** and **Pipek and Kadlec (2009)** state that the texture properties can be affected not only by the degree of ripening, the content of connective tissue but also by the spectrum of fatty acids.

As stated by **Buňka et al. (2008)** and **Ingr et al. (2001)**, it is important to keep not only hygiene sampling but also the conditions of storing the samples before processing for consumption and the thermal processing since all these interventions may affect the nature of the product and its final sensory quality.

An important factor that affects the sensory quality of poultry meat is the length of fattening. It was found that broilers defeated in older age had a stronger flavor than younger chicks **(Nollet and Boylston, 2007)**.

CONCLUSION

From the results obtained, we can state that the sensory quality in thigh muscle of COBB 500 hybrid was not affected by the addition of PRM to the feed. The addition of 10% PRM affected positively especially the texture

properties of breast muscle in ROSS 308 hybrid, whereas it deteriorated them in COBB 500 hybrid. By adding 10% PRM to the feed, in sensory evaluation, thigh muscle is affected much less than breast muscle. By adding 10% PRM to the feed, there is no or only a small effect on descriptors of smell and taste, both in negative and positive sense, both in breast and thigh muscle. The overall quality evaluation in both breast and thigh muscle turned out more positively for ROSS 308 hybrid, although only slightly. It has been found that the addition of post-extraction rapeseed meal to the broiler feed mixture had a positive effect (p <0.05) on the sensory quality of ROSS 308 hybrid, both on breast and thigh muscle. In COBB 500 hybrid, a significant affection of the quality of breast or thigh muscle has not been shown. We can say that the addition of rapeseed extracted meal to feed hybrids ROSS COBB 308 and 500 had no significant effect on the sensory quality of breast and thigh muscle.

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