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EFFECT OF ADDITION OF ALFALFA MEAL ON CHICKEN MEAT QUALITY

Jana Tkáčová[1], Mária Angelovičová[2], Juraj Čuboň[1], Adriana Pavelková[1], Marek Bobko[1], Peter Haščík[1]

Address(es): Ing. Jana Tkáčová, PhD.
[1]Slovak University of Agriculture, Faculty of Biotechnology and Food Sciences, Department of Evaluation and Processing of Animal Products, 949 76, Nitra, Tr. A. Hlinku 2, Slovakia, +421376414348
[2]Slovak University of Agriculture, Faculty of Biotechnology and Food Sciences, Department of Food Hygiene and Safety, 949 76, Nitra, Tr. A. Hlinku 2, Slovakia, +421376415805

*Corresponding author: xtkacova@uniag.sk

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ABSTRACT

The aim of the experiment was to analyse the effect of alfalfa meal addition into fed mixtures on chicken meat quality. The quality of chicken meat was influenced by the feed mixture according to age period. The feed mixture was prepared with addition of alfalfa meal. Alfalfa meal was produced by drying and milling the tops of alfalfa (*Medicago sativa*) at the stage of bugs and was added to feed mixture at relevant percentages: control group – feed mixture without of alfalfa meal addition, experimental group (E1) – feed mixture was supplemented with 2% of alfalfa meal, experimental group (E2) – feed mixture was supplemented with 4% of alfalfa meal, experimental group E3 – feed mixture was with 6% of alfalfa meal in proportion).The experimental period of chickens rear for meat production were divided into three phases according to the type of feed mixtures: a) the starter period, for chickens from hatching to 18 days of age; chickens was fed by starter feed mixture, b) growth period, for chickens from 19th to 31st day of age; chickens was fed by grower feed mixture, c) final period, for chickens from 32nd to 38th day of age; chickens was fed by finisher feed mixture. Chickens were fed *ad libitum*. For the experiment was used chicken hybrid combination ROSS 308. The chickens were killed after age 38 days. The right half of carcasses were deboned after 24 hours and the breast and thigh muscle with skin was separated and analysed (dry matter and fat). The left half of chicken carcasses was stored at -18 °C. Peroxide value was analysed after 12 and 18 months of storage. The additives of alfalfa meal had a little impact on meat quality parameters except the significant difference ($p \leq 0.05$) in fat between groups with 4% and 6% alfalfa meal proportion. Alfalfa meal can be recommended as a feed additive for chicken.

Keywords: alfalfa meal, chicken meat, dry matter, fat, peroxide value

INTRODUCTION

World meat production is projected to double by 2050, most of which is expected in developing countries. The growing meat market provides a significant opportunity for livestock farmers and meat processors in these countries. Nevertheless, increasing livestock production and the safe processing and marketing of hygienic meat and meat products represents a big challenge **(Bennett, 2016)**. Production and sale of poultry worldwide has increasing tendency (**Petersen *et al.*, 2004)**, as well as in Slovakia, the consumption of poultry meat is on second just behind pork meat **(Kerekréty, 1998; Holoubek, 2001; Benková *et al.*, 2005)**. Consumers are accustomed to paying low prices for poultry meat, they are increasingly interested in products that they perceive as naturally produced or environmentally friendly, provide a high level of nutrition with no contaminants, good flavour, and provide more information about the products they eat **(Chang and Zepeda, 2005; Fanatico *et al.*, 2007)**. Poultry meat is an essential part of a modern and well-balanced nutrition. In Slovakia people consume predominantly chicken, the meat of which is valuable dietary properties that consumers appreciate, also appreciates the speed of preparation and affordability (**Matošková *et al.*, 2014)**. Poultry meat is in terms of nutritional value very interesting due to the high content of protein, minerals and vitamins and the low proportion of fat (Although poultry experts are reducing the fat in poultry carcasses, it is an indispensable component of human nutrition. Human organism receives fats mainly in the form of triglycerides, phospholipids, glycolipids, which are the energy source and the vitamins, fat soluble and suppliers of essential fatty acids **(Benková, 2017).**

MATERIAL AND METHODS

The experiment was carried out in poultry farm. For the purpose of the experiment, chickens were used hybrid combination ROSS 308. Chickens were divided into 4 groups according to the amount of alfalfa meal addition in feed mixtures: control group – feed mixtures without alfalfa meal addition, experimental group (E1) – feed mixtures supplemented with 2% alfalfa meal, experimental group (E2) – feed mixtures supplemented with 4% alfalfa meal, experimental group E3 – feed mixtures supplemented with 6% alfalfa meal. All experimental groups were placed in separate box and reared according to **Council Directive 43/2007/EC**, which establishes a density of chickens intended for meat production. Chickens were housed on deep litter and monitored during feeding. The own feeding technology was used for the experiment. Chickens were fed *ad libitum.* Climatic conditions (temperature, light and air exchange system) were regulated in accordance with the recommendations for the type and age group of chickens reared for meat production. The standard soy-cereal feed mixtures were used as the basis of feed mixtures for chickens. The results were compared with the control group. The experimental period of chickens reared for meat production has been divided into three phases according to the type of feed mixtures:

a) the starter period, for chickens from hatching to 18 days of age; during this time chickens were fed with mixture starter mixture and in the experimental groups mixture was enriched with alfalfa meal (2%, 4%, ,6%),

b) growth period, for chickens from 19th to 31st day of age; during this time chickens were fed with starter mixture and in the experimental groups mixture was enriched with alfalfa meal (2%, 4%, ,6%),

c) final period, for chickens from 32nd to 38th day of age; during this time chickens were fed with starter mixture and in the experimental groups mixture was enriched with alfalfa meal (2%, 4%, ,6%).

Alfalfa meal was produced by drying and milling the tops of alfalfa *(Medicago sativa)* at the stage of bugs. Alfalfa meal was added to feed mixtures at different percentages according to experimental groups. Feed mixtures were produced by **Act. No. 440/2006**. The regulation of feed mixtures strictly not determinates the content of alfalfa meal, but it determines fibre max. 35 g.kg^{-1} in the starter feed mixture and max. 40 g.kg^{-1} grower and finisher feed mixture. The fibre content was maintained in all feed mixtures. The chickens were killed at age 38 days. . The right half of carcasses were deboned after 24 hours and the breast and thigh muscle with skin was separated and analysed (dry matter and fat). The left half of chicken carcasses was stored at -18 °C. Peroxide value was analysed after 12 and 18 months of storage. Chemical analyses of the meat samples were carried out at Department of food hygiene and safety, FBFS, SUA in Nitra. Analysis of meat dry matter content and fat were carried out immediately after slaughter of chickens. The dry matter content was determined by drying of the sample under the prescribed conditions at 102-103 °C to constant weight. The fat content was determined by extracting non-polar solvent (petroleum ether) of dried sample in a Soxhlet extractor. Lipid extraction was carried out using a device Det Gras N Selecta P (JP Selecta S.A., Barcelona, Spain). Results of amount fat were calculated in g.100 g^{-1}. The peroxide value was determined after 12 and 18 months of storage at -18 °C. The peroxide value is determined by measuring the amount of iodine, which is formed by the reaction of the hydroperoxides formed in fat with iodide ion under acidic conditions. The liberated iodine is titrated with sodium thiosulphate 0.01 mol.l^{-1}. Based on the usage of sodium thiosulfate in the analysed sample and in blank test it determined the amount of O_2 μmol.g^{-1}. Results of amount peroxide value were O_2 μmol.g^{-1}.

Statistical analysis

Obtained results were carried out according to basic statistical characteristic (arithmetic diameter, SD = standard deviation, c_V = coefficient of variation) and ANOVA by the system program SAS 9.3 Enterprise Guide version 4.2. We used the Student's t-test for comparison of two independent sets of data.

RESULTS AND DISCUSSION

Baraniak (1995) and Abbas (2013) reported preferable protein, energy and vitamins content of fresh green leafy plant for ruminants nutrition, and explained its restriction for monogastric animals because of its higher content of fibre. Alfalfa can be considered as the cheapest source of protein with respect high yields of green mass **(Radović *et al.*, 2009)** and it is a popular feed. Alfalfa contents biologically active substances, it is significant source of vitamins **(Jiang et al., 2012)**, β-carotene and the source of another 10 vitamins **(Lupašku, 1988; Kindschy, 1991; Sen *et al.*, 1998)** and various trace elements **(Markovic *et al.*, 2009)**.

The alfalfa is a natural source of xanthophylls **(Dansky, 1971; Ponte *et al.*, 2004)**.

However, despite these many positive properties, alfalfa also contains high levels of anti-nutritional factors, such as saponins **(Anderson, 1957; Whitehead *et al.*, 1981; Alector, 1993; Stochmal *et al.*, 2001; Francis *et al.*, 2002)**.

Saponins by **Rao and Gurfinkel (2000)**, however, have a positive hypocholesterolemic effect in the animal body; they form insoluble complexes with cholesterol in the matter digested in the gastrointestinal tract, thereby inhibiting its absorption. Consequently, it can lower the cholesterol in the meat **(Ostrowski-Meissner *et al.*, 1995)**. Due to the high fibre content, it is necessary to use a limited quantity of alfalfa **(Guenthner *et al.*, 1973; Dansky, 1971)** and **Kováč *et al.* (1989)** recommended the use of the 2 to 4% proportion.

(Haščík *et al.*, 2005) was determined the dry matter in chicken meat. Content of dry matter in breast muscle was 24.64 g.100 g^{-1} and in thigh muscle was 27.68 g.100 g^{-1}. Dry matter was determined separately for breast muscle and for the thigh muscles. The values in our experiment were in the range of 27.07 to 30.37 g.100 g $^{-1}$. In contrast with the authors **(Haščík *et al.*, 2005)**,. Statistically significant difference (P<0.05) was not found between groups in experiment. **Holcman et al., (2003)** found dry matter content 30.2% at chickens from free range and 28% at chickens from extensive indoor rearing. The average dry matter content of chicken meat was in range from 28.73 to 30.37 g.100 g^{-1}.

Table 1 Statistical evaluation of chicken meat dry matter in **g.100 g^{-1}**

Dry matter	Group			
	C	E1	E2	E3
mean ± SD	29.91±2.01^{a}	28.73±1.46^{a}	30.37±1.63^{a}	28.99±2.08^{a}
c_v (%)	6.72	5.09	5.35	7.18

Legend: Control group – without alfalfa meal, Experimental group E1– 2% alfalfa meal in feed mixture, Experimental group E2 – 4% alfalfa meal in feed mixture, Experimental group E3 – 6% alfalfa meal in feed mixture, SD – standard deviation, c_v – coefficient of variation a – means with different superscripts within row differ not significantly

The fat content in the experiment ranged from 2.14 to 3.35 g.100g^{-1}. Statistically significant difference (P <0.05) was found between a groups E2 (4% addition of alfalfa meal) and E3 (6% addition of alfalfa meal). The fat content in experiment is in accordance with literary knowledge **(Haščík *et al.*, 2005; Lo´pez-Ferrer *et al.*, 1999)**. Based on studies of many authors, it can be assumed that the composition of feed mixture, especially representation of different types of fatty acids have a significant effect on the chemical composition of broiler meat **(Gibs *et al.*, 2013)**. At present, the emphasis is on food quality and safety.

Table 2 Statistical evaluation of chicken meat fat in **g.100 g^{-1}**

Fat	Group			
	C	E1	E2	E3
mean ± SD	2.41±1.02^{ab}	2.85±0.66^{ab}	3.35±1.04^{a}	2.14±0.74^{b}
c_v (%)	42.43	23.14	30.92	34.76

Legend: Control group – without alfalfa meal, Experimental group E1– 2% alfalfa meal in feed mixture, Experimental group E2 – 4% alfalfa meal in feed mixture, Experimental group E3 – 6% alfalfa meal in feed mixture, SD – standard deviation, c_v – coefficient of variation a,b – means with different superscripts within row differ significantly

Oxidation may be initiated by the formation of lipid peroxides. Initial phases of lipid oxidation can be detected by measuring the peroxide value, which quantifies the levels of peroxides and hydroperoxides formed at that stage **(Bennett *et al.*, 2014)**.

A high oxidative stability of muscle-based foods is important to avoid or delay development of rancid products or warmed-over flavour. Increased antioxidative status in the living animal and a following increased oxidative stability of the raw product is considered beneficial for both the consumer and the processing industry. Feeding and conditions under which the animals are produced and slaughtered may influence the oxidative stability of the meat **(King *et al.*, 1995; Maraschiello *et al.*, 1999; Ruiz *et al.*, 1999; Young *et al.*, 2003)**.

Lipid oxidation is the major form of deterioration in stored muscle foods. Oxidative reactions in meat are the most important factor in quality losses, including flavour, texture, nutritive value and colour. Lipid oxidation is induced by oxygen and/or lipid free radical generation and results in the generation of toxic compounds such as the malondialdehyde and cholesterol oxidation products **(Morrissey *et al.*, 1998; Soyer *et al.*, 2010)**.

Dietary modulation of the composition of meat may enable us to improve its oxidative stability and thus increase the nutritional value and the shelf life of meat products. The oxidative status of meat can be assessed on the basis of primary oxidation or secondary oxidation or cholesterol oxidation products **(Grau *et al.*, 2001b; Grau *et al.*, 2001a)**.

Some of these secondary products can be toxic to humans and are responsible for the undesirable rancid odor typical of oxidized oils **(Decker *et el.*, 2010; Kołakowska *et al.*, 2014)**.

In meat, triacylglycerols, phospholipids, and cholesterol are the main substrates for lipid oxidation **(Márquez-Ruiz *et al.*, 2014)**. The oxidation can be influenced by the irradiation, packaging, oxygen and the like **(Ahn *et al.*, 1998)**.

Table 3 Statistical evaluation of peroxide value of stored chicken meat in O_2 µmol.g^{-1}

Storage month	Index	Group			
		C	E1	E2	E3
12 month	Mean	13.39	6.84	8.20	8.45
	Min	8.81	2.01	1.09	1.61
	Max	18.82	19.03	19.23	15.31
18 month	Mean	4.92	6.94	2.04	11.84
	Min	3.52	0.94	1.81	0.62
	Max	6.26	13.40	2.28	21.33

Legend: Control group – without alfalfa meal, Experimental group E1– 2% alfalfa meal in feed mixture, Experimental group E2 – 4% alfalfa meal in feed mixture, Experimental group E3 – 6% alfalfa meal in feed mixture

CONCLUSION

Alfalfa can be considered as one of alternative feed sources for the future. It is a rich source of biologically active substances and protein. Its disadvantage appears to be high content of fibre and saponins, which however have hypocholesterolemic effect. Despite these characteristics it has not a negative effect on meat quality. Alfalfa meal is recomended for suplemented of feed mixtures on the base of experiment in and can be added in proportion 2%, 4% alternatively 6%.

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