

# Effect of Phytogetic Additives on Oxidation Stability of Frozen Chicken Meat

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## Abstract

In this study, oxidative stability of frozen chicken breast and thigh muscle after application of feed mixtures enriched by phytogetic additives was investigated. The 150 pieces one-day-old chicks of Cobb 500 hybrid combination were divided into three groups: C - control group, G1 - experimental group with addition 1000 mg kg<sup>-1</sup> Biostrong 510 + FortiBac and G2 - experimental group with addition 1000 mg kg<sup>-1</sup> Agolin Acid. The broiler chickens were fed during 42 days by ad libitum. Samples of chicken breast and thigh muscle were analysed in the 1st day and after 1st, 2nd, 3rd, 4th, 5th and 6th month of frozen storage at -18 °C. During testing period we recorded positive influence of phytogetic additives on oxidative stability of chicken meat in experimental groups (G1, G2). After 6th month of frozen storage, we found higher malondialdehyde (MDA) values and lower oxidative stability of breast muscle in control group (0.167 mg.kg<sup>-1</sup>) compared to experimental groups G1 (0.149 mg.kg<sup>-1</sup>) and G2 (0.145 mg.kg<sup>-1</sup>). Similar tendency of oxidative changes as in the breast muscle was recorded in the thigh muscle. At the end of frozen storage MDA average values of thigh muscle were higher in control group (0.181 mg.kg<sup>-1</sup>) compared to experimental groups (G1 - 0.163 mg.kg<sup>-1</sup> and G2 - 0.160 mg.kg<sup>-1</sup>). Based on the obtained results we can stated, that phytogetic additives applied in chicken nutrition had positive influence of, namely on oxidation stability of fatty substances.

**Keywords:** chicken meat, oxidative stability, phytogetic additives.

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## 1. Introduction

Phytogetic feed additives (PFA) are commonly defined as plant-derived compounds incorporated into diets to improve the productivity of livestock through amelioration of feed properties, promotion of the animal's production performance, and improving quality of food derived from those animals. Although this definition is driven by purpose of use, other terms

are commonly used to classify the vast variety of phytogetic compounds, mainly with respect to origin and processing, such as herbs (flowering, non-woody, and non-persistent plants), spices (herbs with intensive smell or taste commonly added to human food), essential oils (volatile lipophilic compounds derived by cold expression or by steam or alcohol distillation), or oleoresins (extract derived by non-aqueous solvents). Within phytogetic feed additives, the content of active substance in products may vary widely, depending on the plant part used (e.g. seeds, leaf, root, or bark), harvesting season, and geographical origin.

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The technique for processing (e.g. cold expression, steam distillation, extraction with non-aqueous solvents, etc.) modifies the active substances and associated compounds within the final product [1,2].

Currently, there is an increasing interest in using herbs and spices in animal nutrition, in order to replace the use of antibiotics and ionophore anticoccidials, especially after the ban of antibiotics feed additives within the European Union countries in 2006 and discussions to restrict their use outside Europe [3,4].

The nutritional properties of poultry meat are highly valued; it is a meat with low fat content and less saturated fatty acid than the most ruminant tissues [5].

Lipid oxidation is a major cause of meat quality deterioration which lowers the functional, sensory and nutritive values of meat and neat products; and therefore, consumer's acceptability [6]. Oxidative stability of poultry meat is influenced not only by bird genotype but also feeding, rearing practices and the degree of muscle tissue damages during preslaughter, e.g. physical damage, early post-mortem conditions, pH and carcass temperature [7-9]. These factors could be manipulated by supplementing the animal diet with phytogetic compounds such as different essential oils and polyphenols to improve animal productivity and the quality of food derived from those animals [10].

Phytogetic feed additives are often applied into the feed mixtures, because they improve the taste and odour of feed and subsequently, body weight gain and feed intake are increased and feed conversion is improved, too [11].

Antioxidant effects of plant extracts may be used to slow or prevent the fat oxidation in food products [12].

Application of oils and plant extracts in poultry nutrition is important for health state of animals and animal performance as well as for oxidative stability of produced meat [13].

The aim of the experiment was to determine the oxidative stability in the most valuable parts of chicken carcasses (Cobb 500 hybrid combination) during the frozen storage (6 months) after application of phytogetic feed additives Biostrong 510 + FortiBac and Agolin Acid, in their diet.

## 2. Materials and methods

In the experiment the 150 pieces of one-day-old chickens of final hybrid Cobb 500 both sexes from the poultry station Zamostie Company were used. The chickens were divided into 3 groups (n=50): C - control group, G1 - experimental group with addition 1000 mg.kg<sup>-1</sup> Biostrong 510 + FortiBac and G2 - experimental group with addition 1000 mg.kg<sup>-1</sup> Agolin Acid. Experimental broiler chickens were fed during 42 days by *ad libitum* system with feed mixtures: BR1 starter feed mixture (until the 10<sup>th</sup> day of age), BR2 growth feed mixture (from 11<sup>th</sup> to 20<sup>th</sup> day of age), BR3 growth feed mixture (from 21<sup>st</sup> to 35<sup>th</sup> day of age) and BR4 final feed mixture (from 36<sup>th</sup> to 42<sup>nd</sup> day of age). Feed mixtures were produced without coccidiostats in powder form.

At the end of feeding (day 42<sup>th</sup>) from each group were selected 10 pieces of chicken for slaughter analysis. Chickens were slaughtered and cut in laboratory of the Department of animal products evaluation and processing. To determine changes in lipid degradation (determination of thiobarbiturates numbers, TBA) the samples of chickens were boned and thigh and breast muscle packed into polyethylene bags and stored for 6 months at -18 °C.

TBA value expressed in number of malondialdehyde (MDA) was measured in samples of chicken breast and thigh muscle in the 1st day and after 1st, 2nd, 3rd, 4th, 5th and 6th month of frozen storage. TBA number was determined according to [14]. Absorbance of samples was measured at a wavelength of 532 nm on UV-VIS spectrophotometer T80 (PG Limited Instruments, UK). Results were calculated as the amount of MDA in 1 kg of sample.

Results of the experiment were evaluated by statistical program SAS 9.3 with using application Enterprise Guide 4.2. The variation-statistical values (mean, standard deviation) were calculated and to determine the significant difference between groups was used variance analyse for nonparametric testing.

## 3. Results and discussion

The lipids in poultry exhibit a higher degree of unsaturation compared with red meat, because of a relatively high content of phospholipids. The degree of unsaturation of phospholipids in

subcellular membranes is an important factor in the determination of oxidative stability of meats. The oxidative potential increases as the degree of unsaturation of lipids in meat increases [15]. The oxidation of lipids is influenced by the addition of antioxidant substances. The practical application

of antioxidants can be difficult from the point of view of hygiene and technology. It is much better when natural antioxidants are incorporated in feed mixes [16].

**Table 1** Effect of frozen storage (-18 °C) on the concentration of MDA (mg.kg<sup>-1</sup>) in breast muscle (mean ±SD)

Time of storage	Control	1. EG	2. EG
Day - 1	0.108 ±0.009 <sup>a</sup>	0.099 ±0.007 <sup>a</sup>	0.100 ±0.015 <sup>a</sup>
Month - 1	0.119 ±0.009 <sup>a</sup>	0.117 ±0.008 <sup>a</sup>	0.117 ±0.012 <sup>a</sup>
Month - 2	0.127 ±0.009 <sup>a</sup>	0.124 ±0.013 <sup>a</sup>	0.123 ±0.011 <sup>a</sup>
Month - 3	0.137±0.015 <sup>a</sup>	0.131 ±0.014 <sup>a</sup>	0.129 ±0.018 <sup>a</sup>
Month - 4	0.143 ±0.006 <sup>a</sup>	0.136 ±0.012 <sup>a</sup>	0.134±0.010
Month - 5	0.155 ±0.006 <sup>a</sup>	0.138 ±0.006 <sup>b</sup>	0.135 ±0.008 <sup>b</sup>
Month - 6	0.167±0.010 <sup>a</sup>	0.149 ±0.010 <sup>b</sup>	0.145 ±0.007 <sup>b</sup>

**Table 2** Effect of frozen storage (-18 °C) on the concentration of MDA (mg.kg<sup>-1</sup>) in thigh muscle (mean ±SD)

Time of storage	Control	1.EG	2.EG
Day - 1	0.129 ±0.013 <sup>a</sup>	0.118±0.013 <sup>a</sup>	0.120 ±0.004 <sup>a</sup>
Month - 1	0.132 ±0.009 <sup>a</sup>	0.127 ±0.008 <sup>a</sup>	0.126 ±0.012 <sup>a</sup>
Month - 2	0.139 ±0.004 <sup>a</sup>	0.136 ±0.005 <sup>a</sup>	0.133 ±0.010 <sup>a</sup>
Month - 3	0.148 ±0.011 <sup>a</sup>	0.142 ±0.011 <sup>a</sup>	0.140 ±0.012 <sup>a</sup>
Month - 4	0.160 ±0.012 <sup>a</sup>	0.145 ±0.008 <sup>b</sup>	0.144±0.010 <sup>b</sup>
Month - 5	0.171 ±0.011 <sup>a</sup>	0.152 ±0.008 <sup>b</sup>	0.149 ±0.007 <sup>b</sup>
Month - 6	0.181 ±0.021 <sup>a</sup>	0.163 ±0.010 <sup>a</sup> <sup>b</sup>	0.160 ±0.009 <sup>b</sup>

The results of the oxidation stability determined in breast muscle of chickens COBB 500 during 6 months storage at -18 °C are shown in Table 1. Immediately after slaughtering and processing of poultry samples we recorded low values of MDA. Obtained results indicate that addition of antioxidants had effect on reducing of oxidation processes in meat. Process of production of meat products causes degradation of muscle membrane system and has a strong influence on oxidation of intracellular fat, primary phospholipids [17]. During freeze storage of the breast muscles (6 months) were detected increased content of MDA in comparison to the first day of storage. During whole period of freeze storage were higher values of MDA determined in control group compare to experimental groups. The higher average MDA value determined in breast muscles of broiler chicken hybrid combination COBB 500 was in samples of control group (0.167 mg.kg<sup>-1</sup>) compared to experimental groups E2 (0.145

mg.kg<sup>-1</sup>) and E1 (0.149 mg.kg<sup>-1</sup>) after 6-month of freezing storage. Significantly higher values of MDA were determined in control group compare to experimental groups from fifth month to the end of storage. Reached results oxidation stability breast muscle during freeze storage are in accordance with [18,19].

Trend of thigh muscle oxidation stability of chicken hybrid combination COBB 500 was during 6 months of freeze storage similar than in breast muscle. The results of the oxidation stability determined in thigh muscle of chickens COBB 500 during 6 months storage at -18 °C are shown in Table 3. The higher average MDA value determined in thigh muscles was in samples of control group (0.181 mg.kg<sup>-1</sup>) compared to experimental groups E2 (0.164 mg.kg<sup>-1</sup>) and E1 (0.163 mg.kg<sup>-1</sup>) after 6-month of frozen storage. Significantly higher values of MDA were determined in control group compare to experimental groups from fourth month to the end

of storage. Higher amount of MDA in thigh muscle compare to breast muscle is due to by higher amount of fat occurred in thigh muscle [20].

Reached results of oxidation stability determined in chicken meat of hybrid combination COBB 500 after phytogetic additives addition in their diet are in accordance with [21,22]. The possibilities of using alternative feed supplements containing various antioxidant active substances for poultry which increase the oxidation stability of the meat during its period of freeze storage are shown in works of [23].

[24,25] state that the degradation pathways of fatty substances play one of the main causes of foods deterioration and unpleasant odours. This factor is also responsible for the loss of flavour, texture, appearance, nutritional value of food, increases the drop losses, pigment, polyunsaturated fatty acids, fat-soluble vitamins, reduces the quality of meat intended for human consumption and ultimately reduces its stability, shelf life and safety.

#### 4. Conclusions

Results achieved in the experiment show that the addition of different phytogetic feed additives (Agolin Poultry and Agolin Tannin Plus) in feed mixture for broiler chickens had a significantly ( $P \leq 0.05$ ) positive impact on the reduction of oxidative processes in the breast and thigh muscles during 6 months freeze storage at  $-18^{\circ}\text{C}$ .

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