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EFFECT OF PROBIOTICS AND THYME ESSENTIAL OIL ON THE TEXTURE OF COOKED CHICKEN BREAST MEAT*

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ABSTRACT

Background. Texture is probably the single most critical quality factor associated with the consumers' ultimate satisfaction with a poultry meat product and can be affected by several factors including the type of feed used for chickens fattening. The use of probiotics for meat and carcass quality improvement has been questioned, while the possibility of deposition of essential oils in various muscle tissues can alter the sensory attributes of the chicken's meat.
Material and methods. Probiotics and thyme essential oil in the percentage of 0.05% were used as feed supplements for Ross 308 broiler chickens, as the broilers were reared in four separated groups based on the feed supplement as follows: control, probiotics, thyme essential oil and combination of probiotics and thyme essential oil group, while the fattening period was 42 days. TA.XT Plus-Texture analyser apparatus was used for determination of the texture profile and Warner Bratzler shear force for the cooked breast meat.
Results. Warner Bratzler shear test results showed that the tested feed additives were not affecting the texture of the chicken breast meat, while probiotic appears to have moderately effect on the hardness, cohesiveness, springiness and chewiness attributes of the cooked breast meat compared with the other groups, this effect of probiotics considered as negligible, as the results showed that all the tested groups meat were very tender according to the tenderness scale.
Conclusions. According to the obtained results it can be concluded the combination of probiotics and thyme group resulted in the lowest score for the hardness, cohesiveness, springiness and chewiness attributes, while probiotics group scored the highest compared with the control.

Key words: texture, probiotics, thyme essential oil, Warner Bratzler, breast muscle, broiler chicken

INTRODUCTION

Poultry meat quality attributes may be affected by several factors such as genotype, rearing conditions and feeding that impact on muscle metabolism as well as on chemical composition [Meluzzi et al. 2009]. Texture is probably the single most critical quality factor associated with the consumers' ultimate satisfaction with a poultry meat product [Fletcher 2002]. Feed supplementation with thyme essential oil has effectiveness to retard lipid oxidation and could be considered useful natural supplements to be applied in the poultry

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industry to improve meat quality [Luna et al. 2010]. Lee et al. [2004] reported that when continuously feeding diets containing essential oils to chickens without withdrawal periods, essential oil constituents can be deposited in various tissues. It is well known that increasing the content of polyunsaturated fatty acids in muscle tissues alters the sensory attributes of the meat [Grashorn 2007]. Probiotics are classified as safe and called generally regarded as safe substances by the Food and Drug Administration and the concept behind their use is that the addition of beneficial microorganisms improves the balance of the intestinal microflora [Pelicano et al. 2005]. The use of probiotics for meat and carcass quality improvement has been questioned and many unclear results have been shown [Pelicano et al. 2003]. Kabir [2009] metioned that probiotics have a beneficial effect on improving sensory characteristics of dressed broiler meat. Savkovic et al. [2005] reported an improvenemt in the juiciness and the tenderness of the broiler cooked meat supplemented with probiotics.

Texture profile analysis (TPA) is an instrumental method that imitates the conditions to which food is subjected in the mouth. TPA has been used by a few people to evaluate poultry meat texture [Owens and Meullenet 2010], while majority of the instrumental data used to determine tenderness in cooked poultry meat specially the breast, have been generated on the Warner-Bratzler (W-B) or the Kramer Shear Press (KSP). These procedures are designed to shear or cut through fibers of muscle [Lyon and Lyon 2001].

The goal of the paper was to examine the effect of probiotics and thyme essential oil supplemented in the feed mixtures on the texture of the cooked breast meat of the broiler chickens.

MATERIAL AND METHODS

Ross 308 broilers chicks of one day old divided into four groups of 100 birds. The chicks were obtained from the local hatcheries, the birds were raised on the Poultry Farm Ltd., Zámostie, Slovakia. The different groups fed different feed mixtures. The first group was control group which fed the basal diet, the second group was fed the basal diet with 0.05% thyme essenial oil (*Thymus vulgaris* L.), the third group was fed the basal diet with 0.05% probiotics (*Bacillus subtilis* PB6, CloSTAT), and the fourth group fed the basal diet with 0.05% thyme essential oil and 0.05% probiotics.

The rearing period was 42 days divided to three stages from 1-18 days as starter, 19-31 days grower and 32-42 days as finisher phase with different feed mixtures for each stage which were intended for chickens producing meat. Randomly 6 broilers

Table 1. Composition of the feed mixtures, % (Basal diet)

Component	Starter	Grower	Finisher
Wheat	35.00	36.00	30.00
Maize	35.00	40.00	45.00
Soybean meal	21.00	17.00	17.00
Fish meal 71%	4.00	3.00	2.50
Dry blood meal	1.25	1.25	1.25
Lime stone	1.05	1.00	1.13
Monocalcium phosphate P 22.7%	0.90	0.60	0.90
Salts	0.10	0.15	0.20
Sodium biocarbonate	0.15	0.15	0.22
Lysine HCL	0.10	0.08	0.30
Methionine	0.15	0.22	0.30
Bergafat	0.58	–	–
Clinacox 0.5%*	0.02	–	–
SACOX 12%**	–	0.05	–
EUROMIX BR 0.5%***	0.50	0.50	0.50

*Clinacox 0.5%. Active ingredient: each 1 kg contains 5 grams of diclazuril. As an aid in the prevention of coccidiosis caused by *Eimeria acervulina*, *E. brunetti*, *E. maxima*, *E. mitis*, *E. necatrix* and *E. tenella* in broiler chickens.

**SACOX is 12% micro granulated salinomycin sodium besides strong control of coccidiosis The approved dose range is 50 to 70 mg/kg complete feed in the EU.

***EUROMIX BR 0.5% the active substances per kilogram of premix: vitamin A 2 500 000 IU, vitamin E 20 000 mg, vitamin D3 800 000 IU, niacin 12 000 mg, d-pantothenic acid 3000 mg, riboflavin 1800 mg, pyridoxine 1200 mg, thiamine 600 mg, menadione 800 mg, ascorbic acid 20 000 mg, folic acid 400 mg, biotin 40 mg, kobalamin 8.0 mg, choline 100 000 mg, betaine 50 000 mg, Mn 20 000 mg, Zn 16 000 mg, Fe 14 000 mg, Cu 2400 mg, Co 80 mg, I 200 mg, Se 50 mg.

selected from each group as samples for the analysis. The slaughtering and the analysis were done in the laboratories of the Slovak University of Agriculture in Nitra, Slovakia.

Sample cooking and preparation

Sample cooking and preparation was carried out according to Lawlor et al. [2003] and Ruiz et al. [2001]. After three days storage at –18°C, chicken breast samples were defrosted from –18°C for overnight at 4°C, then at room temperature (21°C) for about one hour just before the cooking process. The half breast considered as representative for the breast muscle then each individual half breast muscle was wrapped in aluminum foil and baked in an electric oven, preheated to 180°C. Temperature probes were used during cooking to ensure that the internal temperature of the meat reached 85°C. The internal temperatures were checked in the thickest part of each fillet with a hand-held digital thermometer fitted with a hypodermic needle probe digital thermometer.

Warner-Bratzler shear force

The procedure described by Malovrh et al. [2009] was used for determination, in this procedure shear force was measured across the muscle fibers with Volodkevich cell on TA.XT Plus – Texture analyzer apparatus (Stable Micro Systems, Surrey, U.K.) fitted with a 25 kg load cell and Texture Exponent stable micro system TE32 version; 5.0, 9.0 software. A TA-7 Warner Bratzler shear type blade was used. Cooled breast meat was cut into 1.9 cm thick and 1.9 cm wide slices. The speed of the blade was 2 mm/s and the passage of blade through sample slice was 25 mm. Measurements (in kg) were performed in 10 repetitions per sample slices.

Instrumental texture profile of cooked chicken breast

Procedures described by Lyon and Lyon [1990] and Rababah et al. [2005] were used for measurement of the texture profile analysis (TPA) of the cooked chicken samples with slight modification in tested sample dimensions.

The texture profile analysis was performed on cooked chicken breast, with TA-XT Plus Texture Analyzer (Stable Micro System, Surrey, UK). The tested sample dimensions were 10×10×10 mm. The samples were examined using a Stable Micro Systems Type (version 5.0, 9.0). A three-inch diameter compression plate was installed to the 25 kg load cell of the analyzer. A 5-kg weight was used to calibrate the 25 kg load cell prior to analysis and the setting was adjusted at a pretest speed of 5 mm/s, a test speed of 10 mm/s and a posttest speed of 5 mm/s. All samples were compressed twice to 50% of their original height using a cylindrical-shaped piston, 38 mm in diameter. The texture probe was oriented perpendicular to the muscle fibers, and measurements were made at ambient temperature. The obtained texture profiles were used to measure the instrumental hardness, springiness, cohesiveness, and chewiness of the chicken breast samples and the calculation process from the obtained curve illustrated in Figure 1. Hardness is the force needed for the 1st compression H1. Springiness (D2/D1) is the ratio between the distance or time of contact for the 2nd compression (D2) to the distance or time of contact for the 1st compression (D1).

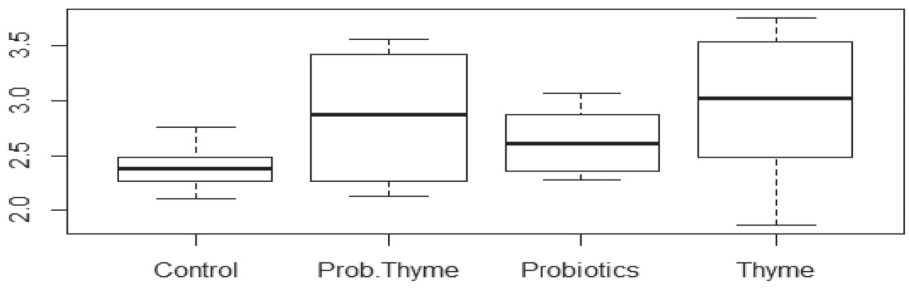

Fig. 1. Statistical plot for the Warner Bratzler shear force

Cohesiveness is the ratio between the total areas under the 2nd compression curve (A2) to that under the 1st compression curve (A1). Chewiness is the product of hardness, springiness, and cohesiveness. Seven determinations were made for each group of the chicken samples to determine significant differences between treatments.

Statistical analysis

Data were analysed using R i386 2.15.2 for Windows statistical program for the ANOVA test, while Tukey's HSD (honestly significant difference) multiple comparison test conducted to find means that are significantly different from each other.

RESULTS AND DISCUSSION

The Warner Bratzler shear force of the tested breast sample illustrated in Table 2, and had averages ranged between 2.94 kg as highest for thyme group and the lowest was 2.40 kg for the control group. The statistical analysis showed that there is slightly significant different between control and thyme essential oil group as shown as plot in Figure 1.

Rababah et al. [2005] reported a Warner Bratzler shear force ranged between 1.64-2.28 kg (16.08--22.36 N) for cooked chicken breast and irradiation cooked breast samples, respectively. These results were slightly higher than the result obtained by Malovrh et al. [2009] who studied the Warner Bratzler shear force for three chicken genotypes and reported an average shear force of 2.16 kg (21.22 N). Zhuang and Savage [2008] reported an average Warner Bratzler shear force ranged between 4.3 to 4.7 kg for chicken breast cooked with three different commercial ovens. According to the above mentioned results for the tested groups, the cooked breast meat of the tested groups considered as very tender as Lyon and Lyon [2001] reported that if the Warner Bratzler shear force in kg is less than 3.61 the chicken breast meat is considered as very tender and if it is between 3.62-6.61 it is considered as moderately slightly tender. Pelicano et al. [2005] studied the effect of probiotic on chicken meat quality and he obtained a Warner Bratzler shear force of 3.88 and 4.08 for chicken fed probiotics based on *Lactobacillus* and probiotics based on *Bacillus subtilis* samples without significant difference from control. Pelicano et al. [2003] studied the effect of different probiotics applied in feed and drinking water on chicken breast texture and he concluded that there was no significant effect of probiotics on chicken breast texture.

Area of the shear curve (Work of shearing) indicates work or the distribution of force across time. Higher values mean more work is needed to shear the sample and it relates to an overall measurement of sensory "toughness." The work of Warner Bratzler work of shearing results are shown in Table 2 and the statistical analysis showed that there is no significant difference between the tested groups. A similar results was obtained by Rababah et al. [2005] who reported a shearing area of 3.43 and 4.15 kg (33.60 and 40.86 N) for cooked chicken breast and irradiation cooked breast samples, respectively.

Table 2. Warner Bratzler shear force and area of the cooked chicken breast meat (mean ±S.D.)

	Control	Probiotics	Thyme	Probiotics + thyme
WB shear force, kg	2.40 ±0.18[a]	2.63 ±0.28	2.94 ±0.64[a]	2.84 ±0.53
WB area, kg·s	4.13 ±0.37	4.60 ±0.66	4.80 ±1.17	4.92 ±1.15

WB area – Warner Bratzler work of shearing area.
[a]Mean values with common superscript in the same row are significantly different from each other ($P < 0.05$).
S.D. – standard deviation.

Instrumental texture profile of chicken breast

The instrumental measurements of the sensory attributes of chicken breast results were shown in Table 3. The hardness of the tested breast samples had averages ranging between 2.69 kg as the highest for probiotics group and the lowest was 1.46 kg for probiotics + thyme group. The statistical analysis for hardness showed that the probiotics group was significantly different from all other groups and also there was a significant differece between control group and probiotics + thyme group. Can [2012] reported a hardness ranged between 3.52-3.96 kg for cooked chicken balls with the purpose of studying the effect of thyme oil on the shelf life of chicken balls during storage period and he concluded that the thyme oil did not affect the texture profile. The obtained results did not agree with the results of Rababah et al. [2005] who studied the effect of irradiation and some plant extracts on chicken breast texture and found a hardness ranging between 7.2-9.23 kg (70.65-90.54 N). The differences between our results and Rababah et al. [2005] maybe due to the differences in the dimensions of the tested samples as he mentioned a core of 0.5 inches in diameter was cut from the middle or anterior end of the cooked chicken breast used for analysis, while our tested sample dimensions were 10×10×10 mm.

Table 3. Instrumental texture profile of chicken breast (mean ±S.D.)

Group	Hardness	Cohesiveness	Springiness	Chewiness
Control	2.11 ±0.47^{a,b}	1.30 ±0.28	0.68 ±0.13^{a}	2.07 ±1.26^{a}
Probiotics	2.69 ±0.40^{a,c,d}	1.54 ±0.13^{a,b}	1.04 ±0.18^{a,b,c}	4.44 ±1.41^{a,b,c}
Thyme	1.62 ±0.16^{c}	1.24 ±0.13^{a}	0.52 ±0.08^{b}	1.04 ±0.28^{b}
Probiotics + thyme	1.46 ±0.32^{b,d}	1.02 ±0.23^{b}	0.61 ±0.14^{c}	0.98 ±0.52^{c}

Mean values with common superscript in the same column are significantly different from each other ($P < 0.05$).
S.D. – standard deviation.

The cohesiveness ranged between 1.02-1.54 with significant differences between probiotics group from thyme and proboitic+thyme group. Can [2012] reported a cohesiveness for chicken balls ranged between 0.65-0.69, while Rababah et al. [2005] mentioned a cohesiveness of 0.32 for non irradiated control cooked chicken breast sample. The springiness result for probiotics group was slightly higher with a significant differences ($P < 0.05$) from the other tested groups and the minimum springiness obtained by thyme group of 0.52, while Rababah et al. [2005] found a springiness of 0.37 for nonirradiated control cooked chicken breast sample. The highest chewiness was obtained by the probiotics of group 4.44, with high standard deviation 1.41.

CONCLUSION

Based on the studied instrumental sensory attributes for the chicken breast, the obtained results and statistical analysis, it can be concluded that for Warner Bratzler shear test, the tested feed additives did not affect the chicken breast meat, while probiotics treatment moderately affected the hardness, cohesiveness, springiness and chewiness attributes of the cooked breast meat compared with the control and thyme groups, at the same time it is interesting that the combination of the probiotics and thyme essential oil obtained the lowest results for the texture profile attributes. The probiotics effect on the texture profile attributes obtained in this study cannot by considered as a negative effect, because the final result of the tested breast sample for all the treatments considered as very tender according to the tenderness well known scale for chicken breast mentioned by Lyon and Lyon [2001], thats mean the samples were different in their degree of tenderness. More research is recommended to confirm the obtained results.

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