

Influence of Probiotics and Thyme Essential Oil on the Sensory Properties and Cooking Loss of Broiler Chicken Meat

Ebrahim Alfaig^{1*}, Maria Angelovičova¹, Martin Kral¹, Ondrej Bučko¹, Maria Walczycka²

¹Slovak University of Agriculture in Nitra, Department of Food Hygiene and Safety, Slovakia

²Agricultural University of Cracow, Department of Animal Products Processing, Poland

Abstract

A study was conducted to determine the effect of probiotics and thyme essential oil (TEO) as feed additives on the sensory attributes, cooking loss and the texture of broiler chicken meat. Day-old broilers Ross 308 (n=400 chicks) were randomly divided into four groups based on the feed supplement as follows: C-control, E1-probiotics 0.05%, E2-TEO 0.05% and E4-combined, probiotics 5% with TEO 5%, respectively. The fattening period was 42 days. Warner Bratzler shear force, cooking loss and the following sensory attributes (colour, odour, taste, texture, meat decomposing and overall acceptability) were tested. The obtained results of the Warner Bratzler shear force show that there was significant different (p<0.05) between control and TEO group and for the cooking loss there was no significant difference between groups. The descriptive sensory analysis results show that the probiotics group results were somewhat similar to that obtained by control while the TEO group and the combined group results were similar. Regarding the sensory analysis we can state that the combination of the probiotics with TEO have a positive effect on the chicken breast meat sensory characteristics.

Keywords: cooking loss, probiotics, Ross 308, sensory attributes, texture, thyme essential oil.

1. Introduction

Sensory evaluation is analysis of product attributes perceived by the human senses of smell, taste, touch, sight, and hearing. People (consumers or users of the product) are used to assess the sensory characteristics and providing a response. However, instruments are sought that provide a corollary measurement that can predict or relate to the anticipated sensory experience. Both human and instrumental methods are critical when assessing sensory quality [1].

Nowadays, the consumer demand for specialty, high quality poultry meat products is growing.

One of these products is the capon. Caponization increases the abdominal, subcutaneous and intramuscular fat deposition; hence, it enhances flavour, texture and meat juiciness and makes the meat more tender and appreciated by consumers than that of roosters of the same age [2].

Texture is probably the single most critical quality factor associated with the consumers' ultimate satisfaction with a poultry meat product. The two major contributors to poultry meat tenderness are the maturity of the connective tissues and contractile state of the myofibrillar proteins [3]. Attractive appearance to consumer of indigenous chicken meat is performed by its carcass conformation, skin or meat color which might be related to chicken genotypes, feeds, rearing system or even processing condition [4]. Feed supplementation with thyme essential oil could be considered as useful natural supplements to be applied in the poultry industry to improve meat

* Corresponding author: Ebrahim Alfaig

Tel: +421944979410

Email: ibreifalg@gmail.com

quality [5, 6]. The use of probiotics for meat and carcass quality improvement has been questioned and many unclear results have been shown [6, 7]. The final product of broiler fattening is highly dependent to the feed type and nutrients available therefore the feed should be selected carefully to fulfill the consumer demands beside the high productivity, safe with high performance meat [8]. The aim of the research was the evaluation of the effect of probiotics and thyme essential oil (TEO) as feed additives on the sensory attributes, cooking loss and the texture of broiler chicken meat.

2. Materials and methods

The experiment was carried out at the Poultry Farm Ltd., Zámotie, Slovakia, the chicks were reared in a pen equipped with a hay deep litter,

housing conditions were under the breed standard and EU welfare. The slaughtering and the analysis were done in the laboratories of the Slovak University of Agriculture in Nitra, Slovakia.

Animals and diets

Day-old broilers Ross 308 (n=400 chicks) were randomly divided into four groups. The first C-control group which fed the basal diet, the second group E1-fed the basal diet with 0.05% probiotics (*Bacillus subtilis* PB6, CloSTAT) with the activity minimally 2×10^7 CFU \cdot g $^{-1}$, the third E2-fed the basal diet with 0.05% thyme essential oil (*Thymus vulgaris* L.), and the fourth E3-combined group which fed the basal diet with 0.05% thyme essential oil with 0.05% probiotics. Three nutritional phases (starter, grower, and finisher) were implemented (Table 1).

Table 1. The composition of the feed mixtures (%) (Basal diet)

Component	Starter	Grower	Finisher
Wheat	35.00	36.00	30.00
Maize	35.20	40.00	45.70
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% ¹	0.02	-	-
SACOX 12% ²	-	0.05	-
EUROMIX BR 0.5% ³	0.50	0.50	0.50

*¹ Clinacox 0.5% Active Ingredient: Each 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.

*² 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.

*³ 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 3 000 mg; riboflavin 1 800 mg; pyridoxine 1 200 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 2 400 mg; Co 80 mg; I 200 mg; Se 50 mg.

The fattening period was 42 days divided into three stages from 1-18 days as a starter, 19-31 days grower and 32-42 days as a finisher. Six birds of both sexes from each group were randomly selected as samples, slaughtered then

the carcasses were mechanically defeathered, manually eviscerated, washed with cold water cooled (4°C) for 4 hours then chilled at -18°C till analysis.

Sample cooking and preparation

Sample cooking and preparation was carried out according to Lawlor [9] and Ruiz [10]. After three days storage, chicken breast samples were defrosted from -18°C for overnight at 4°C then at room temperature (21°C) for 1 hour just before the cooking process. The breast and thigh samples were wrapped individually in aluminum foil and baked in an electric oven, preheated to 180°C till 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 [11] was used for determination, in this procedure shear force was measured across the muscle fibres with Volodkevich cell on TA.XT Plus -Texture Analyser 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.

Sensory analysis

The sensory analysis was carried out for the cooked meat of the breast and thigh separately. The quantification of the final sensory profile was carried out according to the Degree of difference testing (DOD). Seven certified panelists were trained on the methodology in order to familiarize them with the different sensory properties of chicken meat that will evaluate and to assimilate the scoring scale to be used. The panelists were asked to evaluate the colour, odour, taste, texture, meat decomposing (cohere of the muscles), overall acceptance and finally ranking of the samples from one to four. The panelists were asked to rinse their palate with water between samples. The different attributes were quantified on a rating scale from 1 to 9, where the control sample considered as a reference sample with the

value 5 for the all attributes. The panelists were asked to give the values (1 to 9) for the tested attributes by comparing the sample with the control (always 5) if the sample looks better than control so it will get more than 5 and if worst it will get less than 5.

Statistical analysis

Data were analyzed 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.

3. 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 in the control group. The statistical analysis showed that there was slightly significant different ($p < 0.05$) between control and thyme essential oil group.

The results reported by Rababah [12] stated 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. This result was slightly higher than the result obtained by Malovrh [11] 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 [13] recorded 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 tested groups considered as very tender as Lyon [1] reported that if the Warner Bratzler shear force in kg less than 3.61 the chicken breast meat considered as very tender and if it is between 3.62-6.61 considered as a moderate slightly tender. Pelicano [14] who 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 a probiotics based on *Lactobacillus* and probiotics based on *Bacillus subtilis* samples without significant from the control. However, Pelicano [7] 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 for probiotics on chicken breast texture. Area of the shear curve (Work of shearing) indicates the work or the distribution of force across time. Higher values mean more work is needed to shear the sample and relates to an overall measurement of sensory “toughness.” The work of Warner Bratzler work of shearing results shown in Table 2 and the statistical analysis showed that there is no significant differences between the tested groups. A similar results obtained by Rababah [12] 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.

Cooking loss

The cooking loss of the breast and thigh of the chicken meat was mentioned in Table 2. The

numerically higher cooking loss percent 25.29 was recorded breast sample of the combination group while the lowest 20.24 was recorded by the thigh sample of thyme group. The statistical analysis showed that there was no significant difference ($p < 0.05$) between the groups regarding the cooking loss. These results were close to that reported by Zhuang [13] who compared three ways of cooking and reported a cooking loss percent of 18.9, 20.5 and 25.8 for Combi oven, hot water cooking and commercial oven, respectively. These results were less than that reported by Saláková [15] who studied the characteristics of cooked breast of three groups and reported cooking loss percent of 31.4–26.45 and 30.32–25.08 for the male and female samples, respectively.

Table 2. Cooking loss and Warner Bratzler shear force and work of shearing area of the cooked meat (Mean±S.D.)

	Control	Probiotics	Thyme	Probiotics with thyme
WB shear force (kg)	2.40±0.18 ^b	2.63±0.28 ^{a,b}	2.94±0.64 ^a	2.84±0.53 ^{a,b}
WB Area (kg.s)*	4.13±0.37	4.60±0.66	4.80±1.17	4.92±1.15
Cooking loss% (breast)	21.199±3.73	22.23±1.07	22.68±1.79	25.29±2.10
Cooking loss% (thigh)	20.941±1.85	22.58±1.11	20.24±2.74	24.22±1.71

* WB Area=Warner Bratzler work of shearing area

^{a,b}Mean values with different superscript in the same row are significantly different from each other ($p < 0.05$)

S.D.=standard deviation

Warner Bratzler shear force and work of shearing area was carried out only for the breast meat

Sensory analysis

The sensory analysis results were calculated as average from the results of the seven trained panelist committee. Sensory analysis results for the color illustrated in figure 1. The panelist stated that the breast samples of the combination group showed better color compared with the other groups. Figure 2 and figure 5 showed the results of the texture and taste, respectively. In both the texture and taste results the probiotics group scored the best results for the thigh samples while the combination group reported the best results for the breast samples compared with the other groups. Figure 3 and figure 4 illustrated the odour and the meat decomposing results, respectively in which the experimental groups scored almost similar results. Figure 6 stated the overall

acceptability and it is obviously shown that for the breast samples the panelists prefer the thyme and the combination group samples while regarding the thigh samples the panelists prefer the probiotics sample. The panelist results regarding the ranking of the samples (average) show that for the breast samples the combination group was in the first position and the control and thyme group together in the second position while the probiotics group was the last. However for the thigh samples the combination group also came first followed by the probiotics group, then the control and finally the TEO group. However, 4 of 7 panelists considered the combination group meat is the best and 2 of 7 considered it in the second position compared with the other groups.

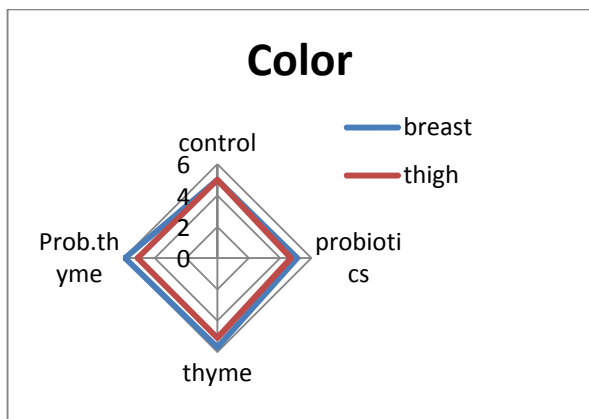


Figure 1. The color of breast and thigh meat

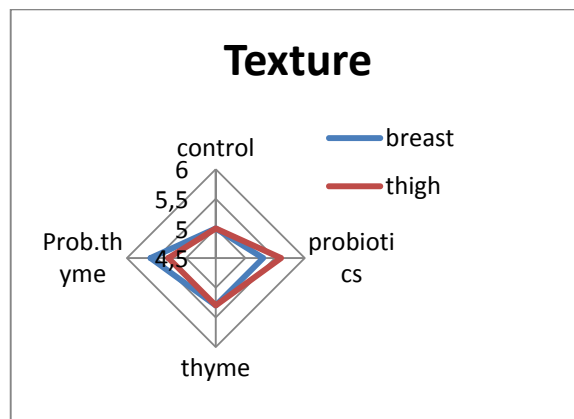


Figure 2. The texture of breast and thigh meat

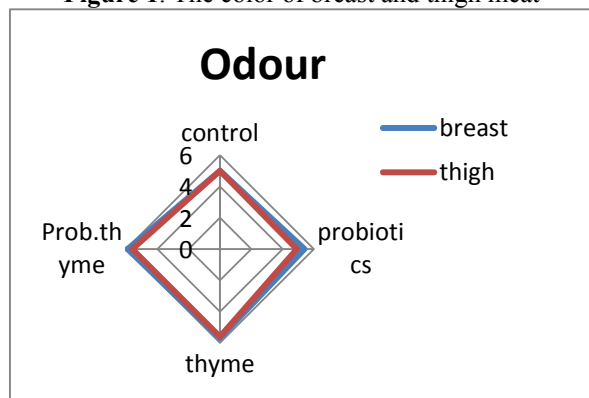


Figure 3. The odour of breast and thigh meat

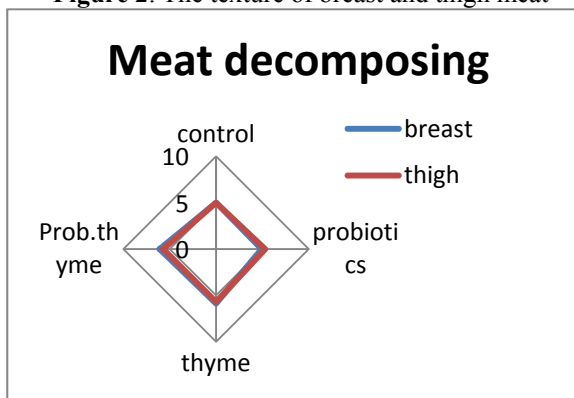


Figure 4. Decomposing of breast and thigh meat

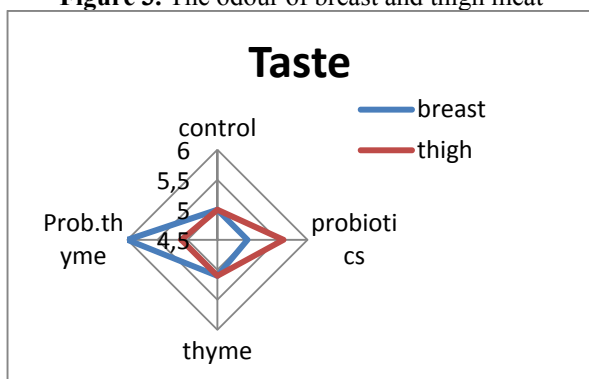


Figure 5. Taste of breast and thigh meat

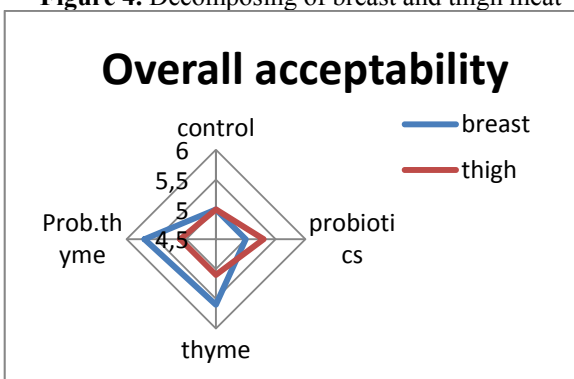


Figure 6. Overall acceptability of breast and thigh meat

4. Conclusions

According to the obtained results it can be concluded that the additives were not affecting the cooking loss while the thyme essential oil slightly affect the texture but still the meat was tender. Regarding the sensory analysis we can state that the combination of the probiotics with the thyme essential oil have a positive effect on the chicken breast meat acceptability and sensory characteristics.

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