

Effect of Dietary Clove Essential Oil on Poultry Meat Quality

P. Hernández, V. Juste, C. Zomeño, J. R. Moreno, P. Peñalver.

Abstract— the aim of this study was to evaluate the effect of clove essential oil dietary supplementation on the meat quality of broilers. A total of 120 animals were used in this experiment. During the final stage of fattening, half of the animals were fed with an experimental diet enriched with 100 ppm of the aromatic product containing clove essential oil and the other half with a control diet. Animals were slaughtered at the same age. Thighs and breasts were packed in trays with modified atmosphere and kept at 4°C for 8 and 10 days. There was no effect of the dietary supplementation with clove essential oil on the lipid content and the fatty acid profile of breast and thigh meat. There was only a small decrease in the percentage of linolenic acid in the thigh meat of the experimental group. Oxidation was not affected by clove essential oil dietary supplementation. Instrumental texture was evaluated in chicken breasts. No differences were observed between the control and experimental group in shear force and firmness, although the total area or work required to complete the shearing of the sample was smaller in the experimental group. Microbiological quality was not affected by experimental treatment. Our results suggest that dietary supplementation with clove essential oil as a growth promoter does not negatively affect chicken meat quality.

P. Hernández is with Institute for Animal Science and Technology. Universidad Politécnica de Valencia. Camino de Vera s/n. 46022 Valencia. Spain (phone: +34963879456; fax: +34963879439; email: phernan@dca.upv.es)

V. Juste is with Institute for Animal Science and Technology. Universidad Politécnica de Valencia. Camino de Vera s/n. 46022 Valencia. Spain (email: vejusag@dca.upv.es)

C. Zomeño is with Institute for Animal Science and Technology. Universidad Politécnica de Valencia. Camino de Vera s/n. 46022 Valencia. Spain (email: crizose@posgrado.upv.es)

J. R. Moreno is with Instituto Valenciano de Investigaciones Agrarias, Centro de Investigación y Tecnología Animal (CITA-IVIA), Segorbe. Spain (email: jomoch@dca.upv.es)

P. Peñalver is with Lidervet S.L. Plaza García Lorca, 17. Tarragona. Spain (email: ppenalver@lidervet.com)

Index Terms— eugenol, meat, poultry, quality.

I. INTRODUCTION

THE use of most antibiotic growth promoters as feed additives has been banned by the European Union [16] due to cross-resistance against pathogens and residues in tissues.

This has led to the search for alternative methods that do not

endanger human health and impair productive performance. Essential oils have been proposed for these purposes [6]. Several studies have demonstrated the antimicrobial ability of essential oils [4, 8, 13], their potential as growth promoters [5] and their antioxidant power. For instance, the dietary supplementation with oregano essential oil had an antioxidant effect by decreasing lipid oxidation in chicken meat [5], lamb [18] and pork [11].

Clove has been used as an antiseptic, antimicrobial, analgesic and local anesthetic [3]. The active ingredient of clove essential oil is eugenol [13]. Recently, the potential as a growth promoter of an essential oil mix derived from oregano, clove and anise has been pointed out in poultry [3]. However, there is a lack of information about the effect of dietary clove essential oil on meat quality.

The aim of this paper is to study the effect of dietary supplementation with clove essential oil on chicken meat quality.

II. MATERIALS AND METHODS

A. Animals and meat samples

One hundred and twenty broilers (Ross) were used in this experiment. Sixty animals were fed the experimental feed containing 100 ppm of the aromatic product with clove essential oil (the final content of eugenol in feed was 60 ppm) between days 39 and 46 of breeding. The other 60 animals were fed a control diet without clove essential oil.

The animals were slaughtered at the same age with an approximate weight of 3 kg. Once slaughtered and eviscerated, the carcasses were processed and thighs and breasts were packed in trays under modified atmosphere and stored at 4 °C for 8 and 10 days. Left thighs (without skin) were deboned and ground. Samples were vacuum packaged and stored at -80 °C until use for further analysis. Right skinless breasts were ground and also vacuum packaged and stored at -80°C, while the whole left skinless breasts were vacuum packaged and stored at -20° C until further use for microbiological and texture analysis.

B. Analytical procedures

Fat content was evaluated in the meat by ether extraction on Soxtec [1] and was expressed as g per 100 g of fresh tissue.

Lipids were extracted from meat with chloroform-methanol (2:1 v/v) [11] for later determination of fatty acid profile. Fatty acid methyl esters of total lipids were prepared as described by Berry *et al.* [2]. The analysis was carried out by gas chromatography of the corresponding methyl esters. The results were expressed as a percentage of the amount of present methyl esters.

The oxidation degree of meat samples was determined by the tiobarbituric acid test (TBARS) [15] and the peroxide value [17]. TBARS values were expressed as mg malonaldehyde/kg sample and peroxide values as milliequivalents peroxide/kg fat.

For the texture analysis, breasts were thawed at 4°C/24 h in their vacuum-packed plastic bag, cooked at 80°C for 1h by immersion in a water bath with automatic temperature control and then cooled at room temperature (20±2°C) before the analysis. The texture analysis was performed using a Warner-Bratzler test. The parameters measured were maximum shear force, shear firmness and the total work performed to cut the sample or the area under the curve obtained. Cooking losses (CL) were evaluated by cooking breast as described in the texture analysis, followed by weighing. CL is the ratio (x 100) of the difference in weight between the cooked and raw breast relative to the weight of raw breast.

Microbiological analysis was performed considering the presence of aerobic mesophiles [9] and lactose positive *Enterobacteriaceae* [10].

C. Statistical analysis

Data were analyzed using a model with muscle (breast, thigh), treatment (experimental and control diet) and storage time (8 and 10 days of refrigerated storage) effects. A least squares analysis was performed using the GLM procedure of SAS.

III. RESULTS AND DISCUSSION

Supplemented diet with clove essential oil improved the productive indexes of the rabbits. Thus, average daily gain of the experimental group was higher than in the control group (data not showed). Ertas *et al.* [5] pointed out that supplementation with 200 ppm essential oil mix (include oregano, clove and anise oils) in broiler diets improved the daily live weight gain and feed conversion.

Lipid amount was lower in breast than in thigh (1.3% and 4.9, respectively). No differences were found in meat lipid content as a consequence of dietary clove essential oil supplementation. Table 1 shows the relative percentage of fatty acids in chicken breasts and thighs at 8 and 10 postmortem days. The breasts had higher percentage of saturated fatty acids (SFA) and lower percentage of monounsaturated fatty acids (MUFA) than the thighs. The fatty acid profile was hardly modified between the two times studied; only small differences were observed in breast between 8 and 10 postmortem days. The total percentage of

SFA was higher at 8 days of refrigerated storage while the percentage of polyunsaturated fatty acids (PUFA) was higher after 10 days. The PUFA:SFA ratio was not different between breasts and thighs, but the n-6:n-3 PUFA ratio was lower in breasts than in thighs.

The fatty acid profile of both breasts and thighs was not affected by the dietary supplementation of clove essential oil. Only a slight decrease in the linolenic acid (C18:3) percentage was observed in the thigh of the animals fed with the experimental diet (1.0 and 1.1% for the treatment and control, respectively). Janz *et al.* [11] did not observe significant differences in fatty acid profile of pork meat when supplemented animal diets with essential oils of rosemary, garlic, oregano and ginger.

Several studies have shown the antioxidant effect of dietary oregano essential oil on chicken [3], lamb [18] and pork meat [11]. Regarding to the clove essential oil, different studies have shown its antioxidant capacity in vitro [12, 14]. However, in our experiment dietary supplementation with clove essential oil did not affected oxidation parameters measured in breast and thigh meat. Nevertheless, the level of oxidation was low in control and experimental groups. The thigh meat presented a higher peroxide value (PV) and TBARS than the breast meat (table 2). No significant differences were found in oxidation parameters between the two post-mortem times measured (8 and 10 days).

Table 3 shows the effect of dietary clove essential oil on chicken breast texture parameters. Breast from the animals fed with the diet supplemented with clove essential oil had lower value of total work performed to cut the sample than control group. No differences between experimental and control group were found for breast shear force and firmness. Simitzis *et al.* [18] found that oregano oil supplementation did not influence meat shear force values in lamb. In agreement, Janz *et al.* [11] did not observe an effect of the dietary supplementation with different essential oil (rosemary, ginger, oregano and garlic) on pork meat shear values. We did not find studies related to the effect of the dietary supplementation of clove essential oil on meat tenderness. Cooking losses were not different between treatments with an average value of 21.8%.

In vitro studies have demonstrated antibacterial activity of essential oils [4]. Dietary clove essential oil prevented cross contamination in eggs in an experimental infection of commercial layers [13]. Information concerning the effect of the addition of essential oils to feed on meat microbial quality is scarce. Soutos *et al.* [19] studied the effect of dietary oregano essential oil in rabbits showing lower average microbial counts on the carcasses, compared to the control, throughout refrigerated storage. In the present study, no differences were found between control and experimental group in microbiological meat quality. The aerobic mesophiles count was 9.07×10^3 (cfu/g meat) and lactose positive *Enterobacteriaceae* counts ranged between 0 and 110 (cfu/g meat).

IV. CONCLUSION

Essential oils appear to be an alternative to synthetic additives in animal nutrition. In the present study, dietary clove essential oil supplementation did not negatively affect chicken meat quality.

ACKNOWLEDGEMENT

This work was founded by Lidervet S. L.

REFERENCES

- [1] Association of official Analytical Chemist (AOAC) (1990). Official methods of analysis (Vol. 2, 5th ed.). Arlington, Virginia
- [2] Berry, J. F., Cervillos, W. H., & Wade, R. R. (1965). Lipid class and fatty acid composition of intact peripheral nerve and during wallerian degeneration. *Journal of the American Oil Chemists' Society*, 42, 492-495.
- [3] Boutsoglou, N.A., Christaki, E., Fletouris, D.J., Florou-Paneri, P., & Spais, A.B. (2002). The effect of dietary oregano essential oil on lipid oxidation in raw cooked chicken during refrigerated storage. *Meat Science*, 62, 259-265.
- [4] Burt, S. (2004). Essential oils: their antibacterial properties and potential applications in foods-a review. *International Journal of Food Microbiology*, 94, 223-253
- [5] Ertas, O. N., Güler, T., Çiftçi, M., Dalkılıç, B., & Simsek, G. (2005). The effect of an essential oil mix derived from oregano, clove and anise on broiler performance *International Journal of Poultry Science*, 4(11), 879-884.
- [6] Fernández Martínez, C. (2005). Aditivos zootécnicos. Alternativas a los antibióticos promotores del crecimiento. Madrid: Agrícola española, S.A.
- [7] Folch, J., Lees, M., & Stanley, G.H.S. (1957). A simple method for the isolation and purification of lipids from animal tissues. *Journal of Biological Chemistry*, 226, 497-509.
- [8] Huerta, B., Ponsa, F., Ordóñez, G., Fernández, N., & Peñalver, P. (2005). Estudio de eficacia de aceites esenciales ante una infección experimental de *Salmonella enteritidis* en gallinas ponedoras en producción. In Proceedings XLII simposium científico de avicultura. AECA. Cáceres, Spain.
- [9] ISO (2003). ISO 4833:2003(E). Microbiology of food and animal feeding stuffs – Horizontal method for the enumeration of microorganisms – Colony-count technique at 30 °C, International Organisation for Standardisation, Switzerland (2003).
- [10] ISO (2004). ISO 21528-2:2004(E). Microbiology of food and animal feeding stuffs – Horizontal methods for the detection and enumeration of Enterobacteriaceae – Part 2: Colony-count method, International Organisation for Standardisation, Switzerland (2004).
- [11] Janz, J.A.M., Morel, P.C.H., Wilkinson, B.H.P., & Purchas, R.W. (2007). Preliminary investigation of the effects of low-level dietary inclusion of fragrant essential oils and oleoresins on pig performance and pork quality. *Meat Science*, 75, 350-355.
- [12] Lee, K. G., & Shibamoto, T. (2002). Determination of antioxidant potential of volatile extract isolated from various herbs and spices. *Journal of Agricultural and Food Chemistry*, 50, 4947-4952.
- [13] Ordóñez, G., Llopis, N., & Peñalver, P. 2008. Efficacy of eugenol against a *Salmonella enterica* serovar enteritidis experimental infection in commercial layers in production. *The Journal of Applied Poultry Research*, 17, 376-382.
- [14] Pérez-Rosés, R., Risco, E., Vila, R., Peñalver, P., & Cañigüeral, S. (2007). Antioxidant and complement modulating activities of five essential oil. In Proceedings 55th International Congress and Annual Meeting of the Society for Medical Plant Research, Granz, Austria 2007.
- [15] Raharjo, S., Sofos, J. N., & Schmidt, G. R. (1992). Improved speed, specificity and limit of determination of an aqueous acid extraction thiobarbituric acid-C18 method for measuring lipid oxidation. *Journal of Agricultural and Food Chemistry*, 40, 2182-2185.
- [16] Regulation (EC) No 1831/2003 of the European Parliament and of the Council of 22 September 2003 on additives for use in animal nutrition
- [17] Shanta, N. C., & Decker, E. A. (1994). Rapid, sensitive, iron-based spectrophotometric methods for determination of peroxide value of food lipids. *Journal of Association of Official Analytical Chemists*, 77, 421-424.
- [18] Simitzis, P.E., Deligeorgis, S.G., Bizelis, J.A., Dardamani, A., Theodosiou, I., & Fegeros, K. (2008). Effect of dietary oregan oil supplementation on lamb meat characteristics. *Meat Science*, 79, 217-223.
- [19] Soutos, N., Tzikas, Z., Christaki, E., Papageorgiou, K., & Steris, V. (2009). The effect of dietary oregano essential oil on microbial growth of rabbit carcasses during refrigerated storage. *Meat Science*, 81 (3), 474-478 .