THE EFFECT OF *ORIGAMI AETHEROOLEUM* ON THE STORAGE LENGTH OF BROILERS MEAT: A REVIEW

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ABSTRACT

Poultry meat has some advantages from nutritive aspect e.g., high contents of proteins, essential polyunsaturated fatty acids, minerals and low lipid content. Oxidative degradation of lipids is one of the main factors limiting the shelf-life of food products. Quality losses in oxidized meat products are generally characterized by flavour deterioration, discoluorization, depletion of nutrients, and possible formation of toxic compounds. Lipid oxidation in meat is one of the reasons for quality degradation during storage. Antioxidants are widely used to stabilize fats and control oxidative deterioration of foods. Spices and their alcoholic extracts belong to the more studied vegetal species because of their antioxidant activity. Oregano is a plant of the Labiatae family that has been studied for its antioxidant activity, concretely the *Origami aetheroleum*. The use of natural antioxidants could be effective in protecting food nutrients against oxidation. Animal health depends on many factors and recently it has been appreciated that diet plays a key role in maintaining health status and preventing various diseases.

Key words: Origami aetheroleum, antioxidant, poultry meat, storage conditions, fat oxidation,

INTRODUCTION

Meat Quality and Safety:

Poultry meat is a very popular food commodity around the world and its consumption has increased over the last decades in many countries. Some of the reasons for the popularity are the relatively low cost of production, low fat content and the high nutritional value of poultry meat. Considering the fact that poultry belongs to perishable foods, the main concern of industries is the shelf-life extension of the poultry products. Modern trends to achieve this goal include the application of the hurdle technology concept **(Leistner, 1995)** and the use of natural food preservatives in order to maintain minimal processing and also to ensure protection from both spoilage and pathogenic microorganisms **(Chouliara and Kontominas, 2006)**.

Growing awareness and concern about the quality and safety of meat have led to numerous developments in meat preservation. Current meat preservation methods include heat processing, irradiation, low-temperature storage, vacuum packaging and addition of preservatives. Although none of these techniques can completely protect meat, they all play important roles. Traditionally, people around the world have used curing for meat or fish preservation by the addition of salt, sugar, nitrite and/or nitrate. However, a salt-rich diet is related to the risk of hypertension and heart disease. Nitrosoamines are considered carcinogenic in animals. For this reason, nitrate is prohibited and the nitrite concentration is limited in cured meats. Therefore the use of natural preservatives to replace these synthetic preservatives is preferable and may be of great interest to the meat industry **(Bin Shan et al., 2008)**.

Microbial growth, colors change and oxidative rancidity are the major problems causing shortening of shelf life in meat and meat products. Lipid oxidation is a major cause of muscle food deterioration **(Ladikos and Lougovois, 1990)**.

Lipid oxidation and antioxidants:

The process of lipid oxidation, in which lipids react with atmospheric oxygen, is a major component of food spoilage. In the case of meat this involves a loss of quality both in terms of

appearance and flavour. Lipid oxidation leads to darkening of meat (formation of brown metmyoglobin) which reduces the period over which it can be displayed, because consumers prefer to see meat red (the red form of oxymyoglobin) **(Foyer and Dewhurst, 1998)**
It has also been found that lipid oxidation can cause pathological changes in the mucous membrane of the alimentary tract, inhibit the activity of enzymes and increase the content of cholesterol and peroxides in blood serum, thus potentially leading to atherosclerosis. Moreover, lipid oxidation can also lead to the production of malondialdehyde, a potent mutagen and/or carcinogen **(Ames, 1983; Frankel, 1991)**.
A high oxidative stability of meat is important when attempting to avoid or delay development of rancid products or warmed-over flavour. In relation to character of process of lipid oxidation, effect of antioxidants is the more significant, the sooner they are applied. Ideal situation is the fats are protected immediately after slaughtering of animals **(Govaris et al., 2004; Marcinčák et al., 2004)**. This protection can be achieved due to feeding of antioxidants in live animals **(Lopez-Bote et al., 1998)**. Increased antioxidative status in the living animal and the following increased oxidative stability of the raw product is considered beneficial the consumer and processing industry.
Most of the antioxidant compounds in a typical diet are derived from plant sources and belong to various classes of compounds with a wide variety of physical and chemical properties. Some compounds, such as gallates, have strong antioxidant activity, while others, such as the mono-phenols are weak antioxidants. The main characteristic of an antioxidant is its ability to trap free radicals. Highly reactive free radicals and oxygen species are present in biological systems from a wide variety of sources. These free radicals may oxidize nucleic acids, proteins, lipids or DNA and can initiate degenerative disease. Antioxidant compounds like phenolic acids, polyphenols and flavonoids scavenge free radicals such as peroxide, hydroperoxide or lipid peroxyl and thus inhibit the oxidative mechanisms that lead to degenerative diseases. There is a number of clinical studies suggesting that the antioxidants in fruits, vegetables, tea and red wine are the main factors for the observed efficacy of these foods in reducing the incidence of chronic diseases including heart disease and some cancers. The free radical scavenging activity of antioxidants in foods has been substantially investigated and reported in the literature by **Miller and Rigelhof et al. (2000)**.
Antioxidant activities of plant extracts could be used to retard or prevent lipid oxidation in a variety of food products **(Rababah et al., 2004)**.
Kahkonen et al (1999) have also reported that phenolic compounds found in spice herb plants are mainly responsible for the biological effects such as antioxidant potential. Phenolic compounds exhibit antioxidant properties through various possible mechanisms such as free-radical scavenging activity, transitionmetal- chelating activity, and/or singlet-oxygen quenching capacity **(Shan et al., 2005)**.
Natural product of plant origin **(Origami aetheroleum):**
An essential oil is a mixture of fragrant, volatile compounds, named after the aromatic characteristics of plant materials from which they can be isolated. The term „essential“ was adapted from the theory of „quinta essentia“ proposed by Paracelsus who believed that this quintessence was the effective element in a medical preparation **(Oyen and Dung, 1999; Lee et al., 2004)**.
Several recent reports have shown that extracts of rosemary and sage **(Lopez-Bote et al., 1998)**, tea catechins **(Tang et al., 2000, 2001)**, Origami aetheroleum **(Botsoglou et al., 2002a; b; 2003a)**, and a blend of several essential oils **(Botsoglou et al., 2004)** improved the oxidative stability of stored chicken meat when added in diets. However, in turkeys, only the Origami aetheroleum has been yet investigated as an antioxidant feed supplement **(Botsoglou et al., 2003b, c)**.

Oregano is a characteristic spice of the Mediterranean cuisine, obtained by drying leaves and flowers of *Origanum vulgare* subsp. *hirtum* plants, well known for its antioxidative and antimicrobial activity **(Botsoglou et al., 2003c; Burt, 2004)**.
Oregano is an aromatic plant that contains mainly thymol and carvacrol in its essential oil; these phenols are responsible for the antibacterial properties of oregano **(Kintzios, 2002; Ultee et al. 2002; Burt 2004)**. Thymol is structurally very similar to carvacrol, the difference being the location of the hydroxyl group on the phenolic ring. Both components appear to make the cell membrane permeable **(Lambert et al., 2001)**.
An antioxidant effect of essential oils in broiler chickens has been reported as well **(Lopez-Bote et al., 1998; Botsoglou et al., 2002)**. **Botsoglou et al., 2002** reported that Origami aetheroleum exerted antioxidant property in meat and abdominal fat, pointing at the incorporation of the protective antioxidant components of the essential oil into the membrane. The authors further found that the antioxidant effect was dose dependent. It is thus concluded that thymol and carvacol can act as antioxidant in egg and meat of broilers when introduced into the diets.
Lee at al. (2004) reported that accumulation of essential oils in the body is unlikely due to their fast metabolic conversion and excretion. However, when continuously feeding diets containing essential oils to broilers without withdrawal periods, essential oil constituents can be deposited in various tissues. **Botsoglou et al. (2002a)** showed that essential oils can be deposited in a dose-dependent fashion. On the other hand, their impact on sensory quality of poultry meat is regarded as minor **(Vogt and Rauch, 1991)**.
Snitsar et al. (1986) measured chemical changes in meat and bone meal stored at 15–20 °C in jute bags for up to 6 months and showed peroxide values to increase during the first 2.5 months whereafter peroxide values decreased. **Racanicci et al. (2000)** investigated the effect of storage (10 weeks) and the effect of the addition of butylatedhydroxytoluene (BHT), an antioxidant, to meat and bone meal on the performance of broilers. The authors found no effect of feeding oxidised meat and bone meal or meat and bone meal preserved with BHT (500 $mg.kg^{-1}$) on bird performance when included at 40 g/kg diet. Storage resulted in increases in peroxide values which were reduced as a result of BHT additions.
Hendriks et al. (2005) investigated the effect of storage on the nutritional quality of meat and bone meal. Three meat and bone meal samples were stored for 1, 2, 3, 6 and 9 months, with or without the addition of the antioxidants. The addition of antioxidants to the meat and bone meal significantly decreased the thiobarbituric acid reactive substances (TBARS) compared to the unsupplemented samples. TBARS are products formed as a result of free radical induced lipid peroxidation in the body.

CONCLUSION

The effect of Origami aetheroleum on the oxidative stability of broiler meat and on the storage stability could be effective in protecting food nutrients against oxidation. Several authors reported that Origami aetheroleum have antioxidant property in meats and effect of storage and nutritional quality of meat. Antioxidant compounds scavenge free radicals and thus inhibit the oxidative mechanisms that lead to degenerative diseases. Antioxidant activities of plant extracts retard or prevent lipid oxidation.

REFERENCES

AMES, B. M. 1983. Dietary carcinogens and anticarcinogens: oxygen radical and degenerative diseases. In *Science* vol. 221, 1983, p. 1256–1263.
SHAN, B. CAI, Y-Z. BROOKS, J. D., CORKE, H. 2009. Antibacterial and antioxidant effects of five spice and herb extracts as natural preservatives of raw pork.
Available on the Internet [2009-09-19] www.interscience.wiley.com

BOTSOGLOU, N.A., FLOROU-PANERI, P., CHRISTAKI, E., FLETOURIS, D. J., SPAIS, A. B. 2002a. Effect of dietary oregano essential oil on performance of chickens and on iron-induced lipid oxidation of breast, thigh and abdominal fat tissues. In *Poult. Sci*., vol. 43, 2002, no. 2, p. 223–230.

BOTSOGLOU, N. A., CHRISTAKI, E., FLETOURIS, D. J., FLOROU-PANERI, P., SPAIS, A. B. 2002b. The effect of dietary oregano essential oil on lipid oxidation in raw and and cooked chicken during refrigerated storage. In *Meat Sci*., vol. 62, 2002, no. 2, p. 259–265.

BOTSOGLOU, N. A., FLETOURIS, D. J., FLOROU-PANERI, P., CHRISTAKI, E., SPAIS, A. B. 2003a. Inhibition of lipid oxidation in long-term frozen stored chicken meat by dietary oregano essential oil and " α -tocopheryl acetate supplementation. In *Food Res. Int*., vol. 36, 2003, no. 3, p. 207–213.

BOTSOGLOU, N. A., GOVARIS, A., BOTSOGLOU, E. N., GRIGOROPOULOU, S.H., PAPAGEORGIOU, G. 2003b. Antioxidant activity of dietary oregano essential oil and "-tocopheryl acetate supplementation in longterm frozen stored turkey meat. In *J. Agri. Food Chem.*, vol. 51, 2003, p. 2930–2936.

BOTSOGLOU, N. A., GRIGOROPOULOU, S. H., BOTSOGLOU, E. N., GOVARIS, A., PAPAGEORGIOU, G. 2003c. The effects of dietary oregano essential oil and "α-tocopheryl acetate on lipid oxidation in raw and cooked turkey during refrigerated storage. In *Meat Sci*., vol. 65, 2003, p. 1193–1200.

BOTSOGLOU, N. A., CHRISTAKI, E., FLOROU-PANERI, P., GIANNENAS, I., PAPAGEORGIOU, G., SPAIS, A. 2004. The effect of a mixture of herbal essential oils or "-tocopheryl acetate on performance parameters and oxidation of body lipids in broilers. In *S. Afr. J. Anim. Sci.*, vol. 34, 2004, p. 52–61.

BURT, S. 2004. Essential oils: Their antibacterial properties and potential applications in foods. In *Int. J. Food Microbiol*. vol. *94*, 2004, p. 223–253.

FOYER, CH., DEWHURST R. 1998. Are Antioxidants The Key to Ensuring Crop and Meat Quality? In *Iger Innovations*,1998, p. 18–21.

FRANKEL E. N. 1991. Recent advances in lipid oxidation. In *J Sci Food Agric*, vol. 54, 1991, no. 4, p. 495–511.

GOVARIS, A., BOTSOGLOU, N., PAPAGEORGIOU, G., BOTSOGLOU, E., AMBROSIADIS I. 2004. Dietary versus post-mortem use of oregano oil and/or α-tocopherol in turkeys to inhibit development of lipid oxidation in meat during refrigerated storage. In *Int J. Food Sci. Nutr.*, vol. 55, 2004, no. 2, p. 115–123.

CHOULIARA, I., KONTOMINAS, M. G. 2006. Combined effect of thyme essential oil and modified atmosphere packaging to extend shelf life of fresh chicken meat. In *Natural Product*, Studium Press, LLC, USA, 2006, p. 423–442.

KAHKONEN, M. P., HOPIA, A. I., VUORELA, H. J., RAUHA, J. P., PIHLAJA, K., KUJALA, T. S., HEINONEN M. 1999. Antioxidant activity of plant extracts containing phenolic compounds. In *J. Agric. Food Chem.* vol. 47, 1999, no. 10, p. 3954–3962.

KINTZIOS, S. 2002. *Oregano, The Genera Origanum and Lippia*. London, Taylor and Francis, p. 269. ISBN 0-415-36943-6.

LADIKOS, D., LOUGOVOIS, V. 1990. Lipid oxidation inmuscle foods – a review. In *Food Chem.* vol. 35, 1990, no. 4, p. 295–314.

LAMBERT, R., SKANDAMIS, P., COOTE, P., NYCHAS, G. 2001. A study of the minimum inhibitory concentration and mode of action of oregano essential oil, thymol and carvacrol. In *J. Appl. Microbiol*., vol. 91, 2001, no. 3, p. 453–462.

LEE, K. W., EVERTS, H., BEYNEN, A. C. 2004. Essential Oils in Broiler Nutrition. In *International Journal of Poultry Sci.*, vol. 3, 2004, no. 12, p. 738–759.

LEISTNER, L. 1995. Principles and applications of hurdle technology. In Gould, G. W.: *New methods of food preservation*. London : Blackie Academic and Professional. 1995, p. 1–21.

LOPEZ-BOTE, C. J., GRAY, J. I., GOMAA, E. A., FLEGAL, C. J. 1998. Effect of dietary administration of oil extract from rosemary and sage on lipid oxidation in broiler meat. In *Br. Poultry Sci.*, vol. 39, 1998, no. 2, p. 235–240.
MARCINČAK, S., POPELKA, P., NAGY, J., HUSSEIN, K., HORŇANOVA Ľ. 2004. The impact of vitamin E and rosemary on the oxidative stability of poultry meat and ground meat products. In *Folia Vet.*, vol. 48, 2004, no. 3, p. 165–8.
MILLER, H. E., RIGELHOF, F., MARQUART, L., PRAKASH, A., KANTER, M. 2000. In *Cereal Foods World*, vol. 45, 2000, no. 2, p. 59–63.
OYEN, L. P. A., DUNG, N. X. 1999. Essential-oil plants. In Oyen, L. P. A., Dung, N. X.: *Resources of South-East Asia.* Leiden : Backhuys Publishers. 1999, p. 131–135.,
RABABAH, T. M., HETTIARACHCHY, N. S., HORAX, R. 2004. Total phenolics and antioxidant activities of fenugreek, green tea, black tea, grape seed, ginger, rosemary, gotu kola, and ginkgo extracts, vitamin E, and tert-butylhydroquinone. In *J. Agric. Food Chem.* vol. 52, 2004, no. 16, p. 5183–5186.
RACANICCI, A. M. C., MENTEN, J. F. M., IAFIGLIOLA, M. C., GAIOTTO, J. B., PEDROSO, A. A. 2000. Effects of the addition of BHT and storage on the quality of meat and bone meal for broiler chickens. In *Revista Brasileira de Ciencia Avicola*, vol. 2, 2000, no. 2, p. 155–161.
SHAN, B., CAI, Y. Z., SUN, M., CORKE, H. 2005. Antioxidant capacity of 26 spice extracts and characterization of their phenolic constituents. In *J Agric. Food Chem.*, vol. 53, 2005, no. 20, 7749–7759.
SNITSAR', A. I., STEKOL'NIKOV, L. I., SKLYAROVA, N. Y. U. 1986. Variations in some characteristics of meat-and-bone meal during storage. In *Myasnaya Industriya SSSR*, vol. 6, 1986, p. 11–12.
TANG, S. Z., KERRY, J., SHEEHAM, D., BUCKLEY, D., MORRISSEY, P. 2000. Dietary tea catechins and iron- induced lipid oxidation in chicken meat, liver and heart. In *Meat Sci*., vol. 56, 2000, no. 3, p. 285–290.
TANG, S. Z., KERRY, J. SHEEHAM, D., BUCKLEY, D. MORRISSEY, P. 2001. Antioxidative effect of dietary tea catechins on lipid oxidation of long-term frozen stored chicken meat. In *Meat Sci*., vol. 57, 2001, no. 3, p. 331–336.
ULTEE, A., BENNIK, M., MOEZELAAR, R. 2002. The phenolic hydroxyl group of carvacrol is essential for action against the food-borne pathogen Bacillus cereus. In *Appl. Environ. Microbiol*., vol. 68, 2002, no. 4, p. 1561–1568.
VOGT, H., RAUCH, H. W. 1991. Der einsatz einzelner ätherischer öle im geflügelmastfutter. In *Lanbauforschung Völkenrode*, vol. 41, 1991, p. 94–97.

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