

Impact of oregano essential oil on production data and lipid oxidation parameters in broiler chickens

R. Messikommer, S. Baltzer and C. Wenk*, Institute for Animal Sciences, Nutritionbiology, ETH Zürich, CH-8092 Zürich. E-mail: caspar.wenk@inw.agrl.ethz.ch

Abstract

In a study with male broiler chickens the impact of dietary oregano essential oil on performance data and on the susceptibility of abdominal fat, fresh and stored breast muscle tissue to lipid oxidation was examined. Four diets supplemented either with oregano essential oil in two levels (22.5 mg (OL) and 90 (OH) mg kg⁻¹ feed), 40 mg α -tocopheryl acetate (VE) or without these additives (NC) were examined. In abdominal fat the best oxidation stability (investigated by the Rancimat method) was found in VE, differing significantly from NC, OL and OH. Just as well in fresh breast muscle lowest susceptibility to lipid oxidation (in terms of thiobarbituric acid reactive substances) could be observed in VE. During refrigerated storage (3, 6 and 9 days at 4° C) VE and OL showed similar protective effects on lipid oxidation in breast muscle, whereas OH probably acted in a pro-oxidative manner. With regard to production data dietary oregano essential oil (OL) showed a slightly positive effect on feed intake and growth performance.

Introduction

Oregano (*origanum vulgare*) belongs to the *Lamiaceae* family and is a typical spice of the “Mediterranean cuisine”. Next to other ingredients it contains up to 4 % of essential oils, primarily the two isomeric phenols thymol and carvacrol to variable amounts. The latter depends on different factors such as climate, habitat, harvest conditions or part of the plant from which the oil is extracted. Due to their biological effects such as anti-microbial, antioxidative or probably appetite stimulating properties, essential oils have gained much attention in investigations with the objective to replace antimicrobial growth promoters and synthetic feed additives in general by natural products which might be more acceptable to consumers. Whereas a bigger part of these investigations are showing auspicious results in *in vitro* studies, there is a lack of adequate and consistent results from animal studies (Rodehutsord and Kluth, 2002). For this reason further clarifications are required. In the present investigation with broiler chickens the effect of dietary oregano essential oil compared to α -tocopheryl acetate on the susceptibility of abdominal fat and breast muscle meat to lipid oxidation was studied. Furthermore a possible impact of oregano on feed intake, growth and metabolism data was examined.

Materials and Methods

72 day-old chickens (Ross PM3) housed in metabolism cages in groups of 18 animals each were randomly assigned to 4 dietary treatments: basal diet NC (without α -tocopheryl acetate supplementation), basal diet supplemented with 40 mg α -tocopheryl acetate (VE), 22.5 (OL) and 90 (OH) mg oregano essential oil kg⁻¹ feed respectively. The basal diet mainly containing maize (30 %), wheat (30 %), soy bean meal (27.5 %) and rape oil (5 %) was formulated to contain all nutrients required by broilers. The oregano essential oil available was in a fine powder form, commercially known as ROPA[®] Green (ROPAFARM GmbH, Westerstede / Germany) and α -tocopheryl acetate as ROVIMIX E-50 adsorbate (DSM Vitamins Ltd, Basel / Switzerland). After one week the treatment groups were divided into three cages with 6 animals each. Feed and water were provided *ad libitum*. Group body weight, feed intake and water consumption were recorded weekly. Representative feed samples and excreta samples from each cage were taken on 3 consecutive days during the 3rd and 5th experimental week in order to estimate energy and nitrogen utilization according to the indicator method using acid

insoluble ash as an internal marker. At 36 days of age animals were slaughtered and the carcass and organ weights recorded. The abdominal fat as well as the right breast muscle and thigh of each carcass were removed for subsequent analyses. The susceptibility to lipid oxidation in abdominal fat was determined by the Rancimat method (Rancimat apparatus 679, Metrohm AG, Herisau, Switzerland) in terms of induction time (heating blocks at 110° C; air flow at 20 l/h) whereas in breast muscle tissue (pooled sample of 6 animals/cage) the thiobarbituric acid reactive substances (TBARS) as a parameter for lipid peroxidation were determined (Tarladgis *et al.* 1960, modified by Kunz and Prabucki, 1986). TBARS were determined in fresh meat and after a 3, 6 and 9 days storage time in the refrigerator at 4 °C.

Results and Discussion

Experimental diets: With regard to the nutrient composition feed analyses showed a good conformance between the experimental diets. Dietary vitamin E determined as total tocopherols amounted to 39.6 (NC), 38.4 (OL), 39.6 (OH) and 75.1 (VE) mg kg⁻¹ feed.

Production data: As given in Table 1 and in accordance to other studies (e.g. Wald *et al.*, 2002), dietary oregano essential oil did not show clear effects on growth data. However, the low dosed oregano treatment seemed to have a positive effect on feed intake and on daily weight gain. Utilization of energy and nitrogen ranged within normal limits and were not really affected by treatments as well as excreta dry matter content.

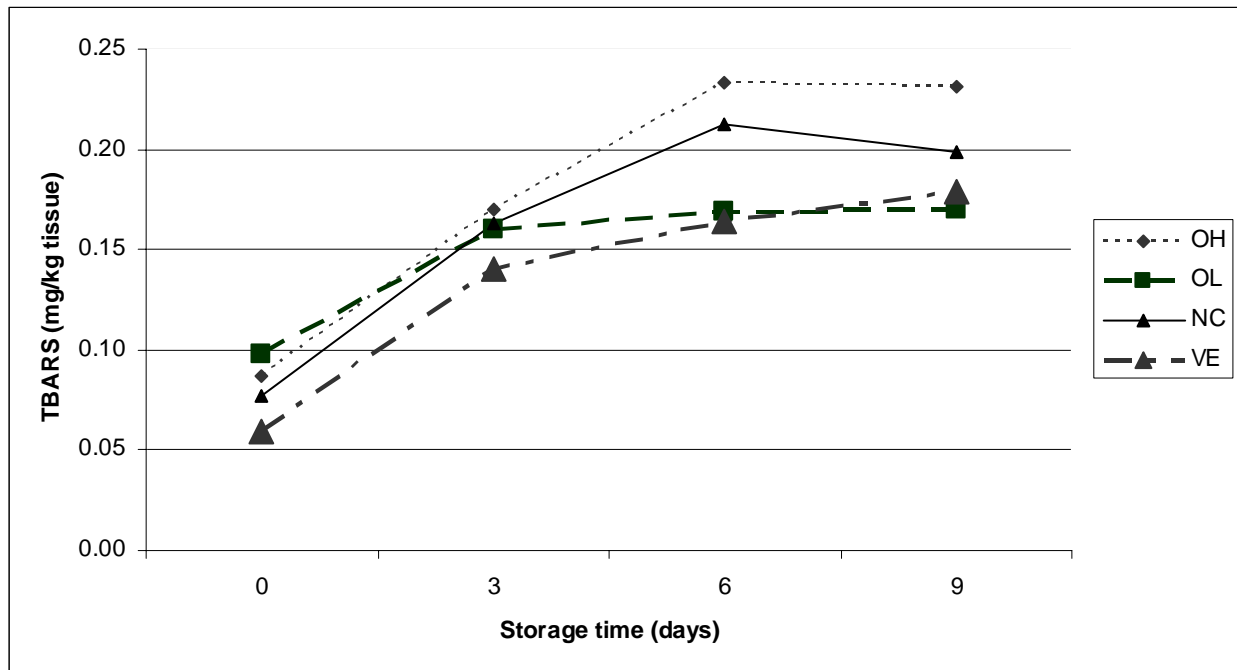
Table 1: Growth and metabolism data (mean values of 3 cages each)

<i>Growth data</i>	Treatment			
	NC	VE	OL	OH
Daily weight gain (g), day 1-36	51.7	52.4	54.5	51.4
Daily feed intake (g), day 1-36	85.0	84.7	91.5	86.1
FCE (kg/kg), day 1-36	1.645	1.616	1.677	1.673
Daily water intake (ml/bird), day 7-32	173	183	190	178
(ml/g feed), day 7-32	1.55	1.68	1.62	1.59
<i>Metabolism data</i>				
Energy metabolizability	0.749	0.739	0.757	0.759
Nitrogen utilization	0.582	0.578	0.580	0.599
Excreta dry matter [g kg ⁻¹]	284	290	284	289

Lipid oxidation in abdominal fat and breast muscle tissue:

In the Rancimat-test the abdominal fat samples (n=18/treatment) of the VE group resulted in the highest induction time (3.13 h^a) and therefore slightest susceptibility to lipid oxidation. It differed significantly (p<0.001; Bonferroni) from treatments NC (2.36 h^b), OH (2.22 h^b) and OL (2.11 h^b). TBARS in fresh breast muscle (n=3/treatment) showed with 0.058 (VE), 0.077 (NC), 0.087 (OH) and 0.098 (OL) mg malondialdehyde kg⁻¹ the same order in oxidation stability as in abdominal fat. As shown in Figure 1, TBARS in all treatments increased distinctly during storage until day 3. Afterwards, diets OL and VE worked in a similar way not further rising in TBARS concentration up to day 9, in contrast to diet NC. However, the high dosed oregano treatment caused highest TBARS values probably indicating a pro-oxidative effect. This is in contrast to Botsoglou *et al.* (2002), who found better antioxidative effects with 100 compared to 50 mg oregano essential oil kg⁻¹ feed.

Figure 1: Thiobarbituric acid reactive substances (TBARS) in fresh and stored breast muscle tissue (cage mean values)



Conclusion

Neither the omission of the customary α -tocopheryl acetate as feed additive nor its replacement by oregano essential oil had a negative impact on growth and metabolism parameters in broiler chickens. However, the slightly positive effect on feed intake and daily weight gain of the low dosed oregano diet has to be verified with a larger number of animals including further topics (e.g. choice-feeding). With regard to anti-oxidative properties, neither in abdominal fat nor in fresh breast muscle tissue positive effects could be established using dietary oregano essential oil. Alone, at refrigerated storage a slightly dose-dependent effect has been noticed.

References

- BOTSOGLU, N.A., CHRISTAKI, E., FLETOURIS, P., FLOUROU-PANERI, P. and SPAIS, A.B.** (2002) The effect of dietary oregano essential oil on lipid oxidation in raw and cooked chicken during refrigerated storage. *Meat Science*, **62**. 259-265
- KUNZ, R. and PRABUCKI, A.L.** (1986) Schnelltest zur Erfassung der Oxidationsstabilität von Fett in Fleischwaren und Fleisch. Tagungsbericht, 12.Juni 1986, Institut für Nutztierwissenschaften, ETH Zürich, 143-146.
- RODEHUTSCORD, M. and KLUTH, H.** (2002) Tierfütterung ohne antibiotisch wirkende Leistungsförderer. *Züchtungskunde*. **74**: 445-452.
- TARLADGIS, B.G., WATTS, B.M., YOUNATHAN, M.T. and DUGAN, L.** (1960) A distillation method for the quantitative determination of malondialdehyde in rancid foods. *J. Am. Oil Chem. Soc.*, **37**, 44-48.
- WALD, CH., KLUTH, H. and RODEHUTSCORD, M.** (2002) Wirkung verschiedener ätherischer Öle in der Broilermast. 7. Tagung Schweine- und Geflügelernährung der Martin-Luther-Universität Halle-Wittenberg, Lutherstadt Wittenberg 2002, 153-155.