propisima iz EU, no nažalost do njihove potpune primjene trebati će proći još jedno vrijeme.

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Essential oils: influence on weight gain, carcass composition and sensory meat properties

Hengl[1], B. M. Šperanda[2], T. Šperanda[3], G. Kralik[2], M. Đidara[2], S. Lilić[4]

scientific paper

Summary
The aim of this experiment was to determine the influence of different essential oil components capsaicin, carvacrol and cinnamaldehyde and combination of citrus and fennel essential oils on production performances of broilers, carcass weight and sensory quality of broilers meat. The experiment was performed on 3 groups of 48 Ross 308 broilers during 42 days. Acquired data were analysed by ANOVA using GLM model (General Linear Models) and Tukey's post hoc test. Analysed data showed positive influence of essential oil additives on live body weight, carcass weight, ratio of commercially valuable carcass parts and sensory characteristics.

Key words: *Essential oils, broilers, live weight, carcass weight, sensory properties*

Introduction

Essential oils and its components are diet phytogen additives which pose characteristics that can be exploited in broiler growth. Because of its antimicrobial (Carson et al., 2002; Burt, 2004; Ashok Kumar et al., 2011), and antioxidative (Cuppett and Hall, 1998; Craig, 1999; Zheng et al., 2001) properties, and influence on better feed digestibility (Lee, 2002, Hernandez et al., 2004. Jamroz et al., 2006), positive effects on health status and better feed weight gain (Florou-Paneri et al., 2006) can be expected, as well as better conversion and weight of high quality parts of carcass. According to present research its influence on sensoric quality of meat, especially juiciness, odor and taste, should not be unacceptable for customers (Lee, 2002). Essential oils composition, different amount of diet additives, zootechnical and microclimatic conditions, nutritional composition of diet and possible interaction with other diet components can all influence final growth performances of broilers in which feed essential oils and its components were added (Karimi at. al., 2010). Previous researches showed a great variety of ways of obtaining the essential oil, concentrations added in the feed and conditions of growing. In the present research commercial mixtures of essential oil and its components, adequate for intensive fattening were used.

Materials and Methods

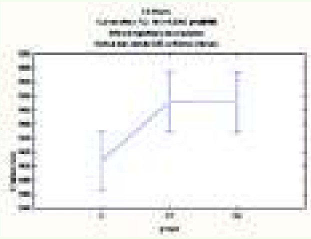
144 one-day old Ross 308 broilers were divided into three groups. Each group had the same basic diet according to growth category: starter, grower and finisher. No essential oils were added to the basic diet of the control group (C). The first experimental group (E1) was added 100 g/t Xtract® (Pancosma, Switzerland) to the basic diet and 400g/t Aroma Korm® (Ireks aroma, Croatia) was added to the basic diet of the second experimental group (E2). Xtract® is made of three different components of essential oil: capsaicin (*Capiscum* spp.), carvacrol (*Origanum vulgare*) and cinnamaldehyde (*Cinnamomum* spp.). Aroma Korm® is a mixture of citrus (*Citrus limon*) and fennel (*Foeniculum vulgare*) essential oil. The individual weight of broilers has been measured on 25th and 42nd fattening day. Carcasses were weighed after evisceration and cooling. Carcasses were trenched to drumsticks with tights, breasts, backs and wings, all of which were weighted individually. Sensory analysis of drumsticks with tights and breasts meat was performed by 6 trained panellists using descriptive qualitative scales with values from 1 to 8, 1 for the lowest and 8 for the highest evaluation (WPSA, 1987). Acquired data were analysed by ANOVA using GLM model (General Linear Models) and Tukey's *post hoc* test.

Results

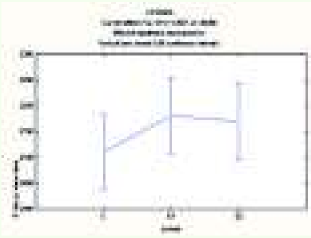
Body weight on 25th day were significantly ($p<0.05$) higher in both experimental groups in relation to the control group. (C:E1:E2 1410g:1490g:1490g; Graph 1.).

At the end of the experiment, both experimental groups had higher body weight in relation to the control group,

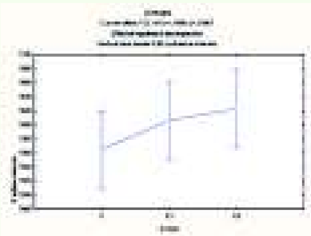
[1] **Brigita Hengl, DVM**, Croatian Food Agency, I. Gundulića 36b, 31000 Osijek
[2] **dr.sc. Marcela Šperanda**, Professor; **dr.sc.dr.h.c. Gordana Kralik**, Professor; **Mislav Đidara DVM**; J. J. Strossmayer University of Osijek, Faculty of Agriculture, Petra Svačića 1D, 31000 Osijek
[3] **mr. sc. Tomislav Šperanda**, Medical-Intertrade, Tuđmanova 3, 10431 Sveta Nedelja
[4] **dr. sc. Slobodan Lilić**, Institute for Hygiene and Technology of Meat, Kaćanskog 13, 11000 Belgrade, Serbia



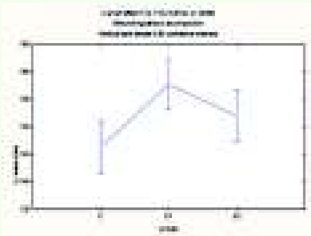
Graph 1 **Broilers' body weight 25^{th} day of fattening with different essential oils**



Graph 2 **Broilers' body weight 42^{nd} day of fattening with different essential oils**



Graph 3 **Carcass weight after evisceration and cooling of broilers fed with different essential oils**



Graph 4 **Backs weight of broilers fed with different essential oils**

although not statistically significant ($p>0.05$) (C:E1:E2 2110g:2180g:2160g; Graph 2.)

Average carcass weight after evisceration and cooling was 1565 g in the control group, 1605 g in E1 and 1620 g in E2 group, without statistical difference (Graph 3.).

Weight of valuable carcass parts (drumsticks with tights and wings) was higher in both experimental groups, while breast weight was equal. Average back weight was significantly higher ($p<0.05$) in E1 group compared to the control group (K: E1: 146,31g:157,75g, Graph 4.).

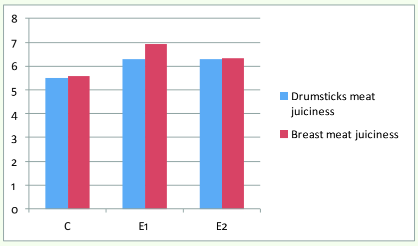
The mean score for drumstick juiciness was 5.5 in control group and 6.3 in both experimental groups. The mean score for breast juiciness was 5.6 in control group, 6.9 in E1 and 6.3 in E2 group. Significant difference ($p<0.05$) was between control and experimental groups (Graph 5).

The mean score for odor of drumsticks was a bit higher compared to the score for odor of breast. The mean score for odor of drumsticks in both experimental groups was higher compared to the control group (K: E1: E2 6.25:7.41:6.66). Higher scores for odor of breast were in experimental groups (E1 6.50; E2 6.58) compared to the control group (K 5.66) (Graph 6.)

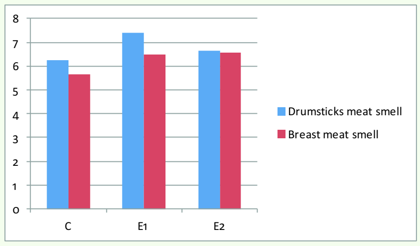
The mean score for taste of drumsticks and breast meat were almost the same in control group (C 6.41; 6.33) and E2 group (E2 6.5; 6.41), while E1 group had some higher grades (E1 7.25; 7.08; Graph 7.)

Discussion and conclusion

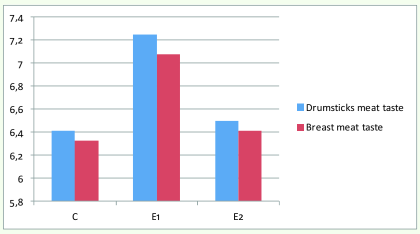
Results show that the combination of essential oil components capsaicin, carvacrol and cinnamaldehyde and combination of citrus and fennel essential oil has significantly ($p<0.05$) increased body weight by the 25^{th} day of fattening compared to the control group. At the end of the experiment body weight was also higher, but not significantly. These results are in accordance with Botsogloua et al. (2002) and Hernandez et al. (2004) who had found better digestibility in



Graph 5 **Comparison of the mean scores of drumstick and breast meat juiciness between groups**.



Graph 6 **Comparison of the mean scores for odor of drumsticks and breast meat**



Graph 7 **Comparison of the mean scores for the taste of drumsticks and breast meat**

broiler fed with essential oil components: capsaicin, carvacrol and cinnamaldehyde. Our results are not in cconsent with Lee et al. (2004) who found lower weight gain in groups fed with combination of carvacrol and *cinnamaldehyde*, while feeding with these components separately showed no negative effect. Results of Alçiçek et al. (2003) who fed broilers with feed added with a mixture of fennel (*Foeniculum vulgare*), oregano (*Origanum* sp.) and citrus (*Citrus* spp.) essential oil, showed higher body weight at 21^{st} and 42^{nd} day of growth. Weight of carcasses after evisceration and cooling were also higher in experimental groups. Botsoglou et al. (2002) recorded lower carcass weight although live body weight was higher in group fed with oregano essential oil. Weight of commercially valuable parts was higher in experimental groups in relation to control group.

Not many data can be found in literature regarding the influence of essential oils or their components on sensory properties of meat. In our experiment we recorded positive influence of EO on sensory characteristics of drumsticks and breast meat. Significant ($p<0.05$) increase of the mean score for drumsticks and breast juiciness was shown in both experimental groups comparing to the control group. Better mean scores for drumsticks and breast odor were also recorded in both experimental groups. Average drumsticks and breast meat taste score was similar in control and E2 group, while E1 group had higher mean scores (7.2; 7.1). Results for Xtract® (E1 group) are in correlation with results of Jamroz et al. (2003).

Essential oils had positive effect on all recorded parameters in this experiment. Slightly better influence had capsaicin, carvacrol and *cinnamaldehyde* combination compared to the citrus and fennel combination. Different ratio of essential oil components (Lawrence and Reynolds, 1984., Duke, 1986., Lee, 2002.) and other parameters like: physical form of fittogen additive, genetic variation of plant, age of plant, additive dose, extraction method and time of harvest, all can have influence on final results. All this can also explain differences in body weight and feed conversion in different experiments (Yang et al., 2009). Efficiency of additives also de-

Ätherische Öle: Einfluss auf die Mast von Broilern, Anteil der Grundteile im Rumpf und sensorische Fleischeigenschaften

Zusammenfassung

Das Ziel der Untersuchung war, den Einfluss der Komponentenkombination von ätherischen Ölen (Carvacrol, Capsaicin und Cinemaldehid) und den Einfluss der Kombination von ätherischen Ölen (Citrus und Fenchel) auf die Herstellungscharakteristiken der Masthähnchen, auf die Charakteristiken des Hähnchenrumpfes zu bestimmen. Es sollte festgestellt werden, ob diese Bestandteile einen Einfluss auf Saftigkeit, Geruch und Geschmack von Hähnhächenkeulen und Hähnchenbrust haben. Das Experiment fand in drei Gruppen je 48 Hähnchen Art Ross 308 in der Zeit von 42 Tagen statt. Die Resultate aus dem Experiment wurden durch die Analyse Variance (ANOVA) bearbeitet, wobei das GLM Modell und Tuckey post hoctest angewendet wurden. Die Analyse der Resultate bestätigte, dass die Zufügung von ätherischen Ölen einen positiven Einfluss auf die Körpermasse von Hähnchen im ersten Mastteil hat. Dasselbe gilt für Rumpfmasse, Anteil von wertvollen Teilen und alle zu beurteilenden sensorischen Charakteristiken

Schlüsselwörter: *Ätherische Öle, Hähnchen in Mast, Körpermasse, Rumpfmasse, sensorische Eigenschaften von Hähnchenfleisch*

Oli eterici: influenza sull'allevamento dei broiler, percentuale di pezzi fondamentali nell'addome e caratteristiche sensoriche della carne

Sommario

Lo scopo di quest'esame era determinare l'effetto del misto di componenti di oli eterici (carvacrolo, capsaicina e cinnamaldeide) e l'influenza del misto di oli eterici (agrume e finocchio) sulle caratteristiche produttive di pollame durante l'allevamento, sulle caratteristiche dell'addome di pollo e determinare se questi additivi influiscono sulla succosità, odore e sapore della carne di coscie e del petto di pollo. L'esame è stato fatto in tre gruppi a 48 polli del genere Ross 48 ciascuno, nell'ambito di 42 giorni. I risultati ottenuti durante l'esame sono stati analizzati mediante l'analisi della varianza (ANOVA), usando il modello GLM e l'analisi a posteriori o post-hoc di Tuckey. Durante l'analisi dei risultati è stata determinata un'influenza positiva di oli eterici sul peso corporeo, aggiunti al pollame nella prima fase d'allevamento, sul peso di addomi, sulla percentuale di pezzi di valore e su tutte le caratteristiche prese in considerazione durante l'esame.

Parole chiave: *oli eterici, pollame in allevamento, peso corporeo, caratteristiche sensoriche della carne di pollo*

pends on internal and external factors like: nutritive status of animals, exposure to infections, compatibility with other components of feed and environmental influences (Lee, 2002). Using the combination of essential oil components, most of these negative effects can be excluded. This might explain better live weight and carcass weight in groups feed with EO components: capsaicin, carvacrol and *cinnamaldehyde* and a bit lower for citrus and fennel.

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Control of malachite green in aquaculture products

Bilandžić N.[1], B. Solomun Kolanović[1], I. Varenina[1]

review

Summary

Malachite green (MG) is traditionally used as a triphenylmethane dye in the textile industry, as a pigment and a food additive. In fish breeding, it is used as a very effective fungicide, parasiticide, antiprotozoic and bacteriocide. In fish, MG is metabolised to leucomalachite green (LMG) which, due to its lipophilic properties, is retained in fat tissues over longer periods of time. Numerous in vitro and in vivo studies have indicated the cytotoxic, carcinogenic, mutagenic and teratogenic properties of both MG and LMG. For this reason, the use of MG is prohibited in animal species intended for human consumption in the US and EU Member States. Despite this ban, MG is still in use in intensive fish farming, and residues of MG and LMG are the most frequently prohibited substances found in aquaculture products. For that reason, the European Union has prescribed a minimum required performance limit (MRPL) of 2 μg/kg for the methods used for determination of MG and LMG. MG and LMG residues in fish tissue are quantified using liquid chromatography and liquid chromatography with tandem mass spectrometry. Despite the ban in EU Member States, increased concentrations of MG and LMG are systematically found in all species of fish and fish products. In the period from 2002 to 2011, the Rapid Alert System for Food and Feed (RASFF) confirmed increased MG and LMG concentrations in 123 samples of fish and fish products. The highest number, 50 samples, was reported in 2005. Of the total number of positive samples, 27 samples originated from Vietnam, 12 from Indonesia, 10 from China and 3 from Thailand, i.e. 58.5% of samples with residues originated in Asia. Therefore, controls of MG and LMG are important to protect consumer health.

Key words: *malachite green, leucomalahite green, fish, aquaculture*

Introduction

Malachite green (MG) is traditionally and extensively used as a triphenylmethane dye in the textile industry, a colouring agent and a food additive (Singh et al., 2011). Traditionally, it was used as a dye for materials such as silk, leather and paper. Millions of kilograms of MG and related triphenylmethane dyes are produced for this purpose annually. Malachite green has been determined in a large number of various food types in India, with a greater presence in rural areas than in urban food shops (Tripathi et al., 2007).

In intensive fish production, malachite green is used as a very efficacious fungicide, parasiticide, antiprotozic and bacteriocide (Cha et al.; Van de Riet et al., 2005; Yang et al., 2007). Due to its effectiveness and relatively low cost, it is an attractive agent for treating fish in closed farm systems such as fish ponds and lakes, and for fresh, brackish and salt water aquaria. It is lethal for all marine and freshwater invertebrates, algae and plants.

Due to its teratogenic and carcinogenic properties, MG was prohibited for use in animals intended for human consumption in the United States in 1991 (Marking et al., 1994) and in the European Union in 1997 (EC, 1990). Despite the ban, MG is still used in food production, and residues of MG and its metabolite, lecuomalachite green (LMG) are the most common prohibited compounds found in aquaculture products (VRC 2001-2010; Olesen, 2007).

The residues found in farmed fish products may also originate from environmental pollution due to dyestuff discharged into streams without pretreatment (Pourreza & Elhami, 2007). Therefore, surveillance of malachite green and leucomalachite green in aquaculture products is necessary for the purpose of human health protection.

Structure and mechanism of activity of malachite green

The MG molecule (Figure 1), 4-[(4-dimethylaminophenyl)phenyl-methyl]-*N*,*N*-dimethylaniline, is active in its oxidated form and inactive in the form of the non-chromophorous molecule LMG (Figuer 2).

In fish tissue, malachite green is rapidly metabolized to leucomalachite green and it is primarily in this form that it is retained in fish tissues (Henderson et al., 1997). Due to its lipophilic nature, LMG is retained in fatty tissues over long time periods (Stammati et al., 2005; Mitrowska et al., 2008).

In a study on catfish (*Ictalurus punctatus*), malachite green was added in a water tank in a concentration of 0.8 mg kg^{-1}. Fish were exposed for 1 hour and then rinsed and relocated to a tank with water flow. MG concentrations were determined in all tissues, and were found to be highest in fatty

[1] **Nina Bilandžić, PhD**, Scientific advisor, **Božica Solomun Kolanović, BSc**, **Ivana Varenina, BSc**; Laboratory for Residue Control, Department for Veterinary Public Health, Croatian Veterinary Institute, Zagreb