Influence of farm application of oregano on performances of sows

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Abstract — This study was performed in a large commercial herd in eastern Europe to test the effect of oregano feed supplementation. Sows were studied in a unit where alternate farrowing groups were given diets containing 1000 ppm oregano in the prefarrowing and lactation diet. Oregano-treated groups showed a lower ($P = 0.003$) annual sow mortality rate, a lower ($P = 0.03$) sow culling rate during lactation, an increased ($P = 0.01$) subsequent farrowing rate, and more ($P = 0.05$) live-born piglets per litter compared with the nontreated sows. The conclusion was that dietary oregano supplementation improved the reproductive performance of sows in this herd.

Résumé — Influence de l'utilisation agricole de l'origan sur led perfomances des truies. Cette étude a été réalisée sur un grand troupeau commercial d'Europe de l'Est afin de vérifier l'effet d'un supplément ailmentaire d'origan. L'étude a été réalisée dans une enclos ou des groupes de truies ont reçu successivement une ailmentation contenant 1000 ppm d'origan mélangé à une moulée de pré mise bas et de lactation. Les groupes de truies traitées à l'origan avaient un taux annuel de mortalité inférieur (P = 0,003), un taux d'élimination en cours de lactation plus bas (P = 0,03), une augmentation du taux subséquent de mise bas (P = 0,01) et une plus grosse portée de cochonnets nés vivants (P = 0,05), lorsque comparé aux groupes non traités. Il a été conclu qu'un supplément alimentaire d'origan améliorait la performance reproductrice des truies de ce troupeau.

(Traduit par Docteur André Blouin)

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Introduction

Sow mortality markedly influences the economics of pig breeding units (1). According to Bilkei et al (1) and Maxwell et al (2), antimicrobial feed additives reduce sow mortality caused by infections. The European restrictions on antimicrobial feed additives were followed by increased sow mortality due to urogenital infectious diseases (1); periparturient infectious bacterial diseases increase sow mortality significantly (3).

Antimicrobial feed additives benefit production by increasing profitability (4,5), reducing animal wastes into the environment (6), and diminishing pathogen carriage (7). Natural and cheap feed additives could be important for improving meat production. Phytogenic feed additives, especially oregano, are experiencing a revival in eastern Europe (8). Oregano feed additives have been shown to be a successful alternative to the prophylactic use of antibiotics against swine dysentery (9). Oregano feed supplementation positively influenced daily feed intake, daily weight gains, and feed utilization in growing pigs (10–12). Feeding oregano supplements to the sow has been shown to improve the farrowing rate (8). Khajarern and Khajarern (13) have stated that, in sows, *Origanum* essential oils act not only as an alternative to antibacterial performance promoters, digestion aids, and appetite enhancers, but also as a natural feed additive enhancing growth and reproductive performance.

The present study was designed to examine the effect of the strategic addition of oregano to the prefarrowing and lactation diets of sows under field conditions. The hypothesis was that the antibacterial, antiinflammatory, antioxidant, and appetite enhancing ability of oregano essential oils would increase the sows' feed intake, reduce mortality and culling, and improve subsequent production parameters.

Material and methods

The trial was performed in Alföld, Hungary, from 1999 to 2001. A large indoor herd of 1800 sows of similar genetics and typical for this geographic area (F1 and F2 of large white X Landrace mated to Duroc boars) was selected for the study. Replacement gilts were introduced from the nucleus herd at between 140 and 150 d of age. The annual replacement rate varied from 39% to 48% between 1989 and 1998. The animals were bred at their first observed standing estrus.

Standard farm management included weaning at 3 wk of lactation, group rotation of 30 females, double artificial insemination (A1), and culling after parity 9.

Sows were kept in high investment facilities according to the requirements of the intensive breeding enterprises of the early 1990s (farrowing crates, individual gestation crates, eros center). The sows were artificially inseminated at their 1st postweaning estrus. After a positive pregnancy diagnosis, they were moved into gestation barns. On the 110th d of pregnancy, the sows were relocated into farrowing barns, where they remained until week 3 of lactation. Sow mortality rates of 6.7% to 8.1% per annum had been recorded in this herd during the previous years (1989 to 1998). The unit had a pretrial (1998) annual

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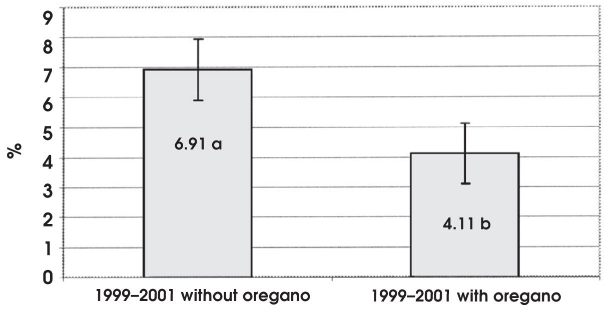
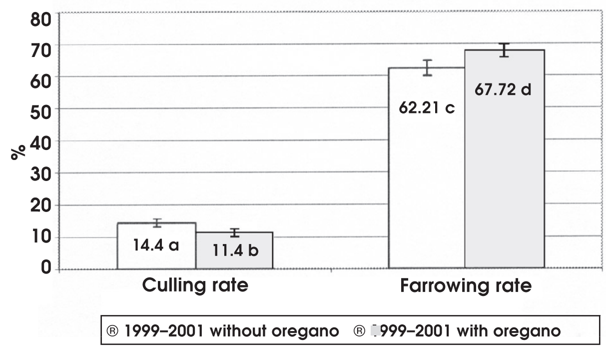


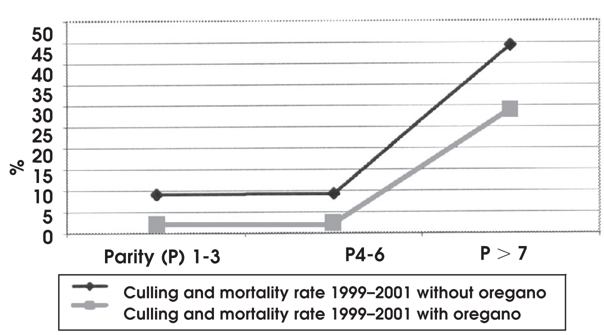
a,b $P = 0.003$

Figure 1. Annual sow mortality with or without oregano feed supplementation during lactation.



a,b $P = 0.03$
c,d $P = 0.01$

Figure 2. Sow lactational culling and subsequent farrowing rate, 1999–2001, with or without oregano feed supplementation during lactation.



Parity > 7 sows had a lower ($P = 0.04$) mortality rate in the oregano treated groups compared with the non treated ones

Figure 3. Annualized average sow culling and mortality rate by parity, 1999–2001.

culling rate of 44.3% (14.7% for reproductive reasons, 9.1% for locomotor problems, 5.5% for torsion of abdominal organs, 4.9% for heart failure, 6.9% due to old age, and 3.2% for miscellaneous causes). Pretrial investigations revealed a high occurrence (> 15% of the sow inventory) of urogenital bacterial disease accompanied by vulval discharges. Bacteriological examination of vulval discharges revealed the presence of either *Clostridium* spp., *Actinobaculum suis*, *Klebsiella* spp., or *Proteus* spp., and streptococci, staphylococci, *Erysipelothrix rhusiopathiae*, or *Escherichia coli*.

The sows were fed as follows:

- From AI to gestational day 89, 2 kg/sow/d, and from gestational days 90 to 110, 3 kg/sow/d, of a commercial gestation ration containing 12.2 megajoul digestible energy (MJ DE)/kg, 125 g/kg crude protein, 6.5 g/kg lysine, 8 g/kg calcium, and 6 g/kg phosphorus.
- From 110 d of pregnancy to parturition, 3 kg/sow/d of lactation diet. On the day of parturition, 1 kg of feed was given. Beginning with the 2nd d after parturition, sows were fed ad libitum with the same lactation diet, containing 13.0 MJ DE/kg, 180 g/kg crude protein, 10 g/kg lysine, 8 g/kg calcium, and 6 g/kg phosphorus.
- From weaning to mating, the sows received ad libitum the same lactation diet, supplemented with 300 IU vitamin E per kg and 500 g potato starch/sow/d ("flushing") (8).

In this study, alternate farrowing groups were given lactation diets containing 1000 ppm oregano feed supplementation (500 g oregano oils, containing 60 g carvacrol and 55 g thymol/kg, mixed with dried leaf and flower of *Origanum vulgare* up to 1 kg [Oregpig, Pecs, Hungary]) from day 110 of pregnancy until A1 as follows:

- 30 experimental (oregano-treated) farrowing subgroups of 30 sows each ($n = 900$ sows, average parity of 2.98, $s = 0.41$, average body condition 3.4, $s = 0.22$.
- 30 control (oregano untreated) (30 subgroups of 29 to 30 sows each, $n = 899$ sows, average parity 3.04, $s = 0.39$, average body condition 3.5, $s = 0.18$).

Body condition was scored according to Bilkei and Biro (14) on day 110 of pregnancy. All farrowing barns had identical management and nutrition. Piglets were cross-fostered within 24 h of birth to equalize the litter size to 9 to 11 piglets. The sows were kept during lactation in individual crates. In each farrowing crate, there was a deep trough (depth of 30 cm), into which a self-feeder (a plastic container with a capacity for 50 kg feed) emptied. Feed was weighed when it was placed in the feeder; the feed remaining in the feeder was reweighed weekly in order to determine accurately the weekly feed consumption.

Sow weight loss and "back fat loss" during lactation were not recorded. The litters were weaned at 22.1, $s = 2.1$ d, and 22.3, $s = 1.7$ d of lactation in the experimental and control groups, respectively. On the day of weaning, no feed was given to the sow. Estrus detection began on day 3 postweaning.

Possible outcomes after farrowing were that a sow died, was culled, was bred but returned to estrus, or farrowed again. If she farrowed another litter, the subsequent litter size was recorded.

Statistical analysis was performed by a procedure (General Linear Model Procedure [GLM]; SAS Institute, Cary, North Carolina, USA) to derive least squares means and standard errors. Week to week variation was accounted for in the analysis and the variations were not statistically significant ($P > 0.05$). Differences between calculated parameters of the groups were compared by using the χ^2 test. When a marked deviation from normality was present (verified by Levene's test significance), data were transformed to homogenize such variations

Table 1. The effect of oregano on stillbirth and liveborn litter size in a large pig breeding unit

	Oregano treated sows (n = 900)	Non treated sows (n = 899)	P-value
Stillbirth (number of piglets, s)	0.808, s = 0.01	0.907, s = 0.01	0.05
Liveborn litter size (number of piglets, s)	10.09, s = 1.01	9.84, s = 0.02	0.05

s — standard deviation

(variation was transformed to take into account the size of the mean through the calculation coefficients of variation [100 × s/average]). Class included in the model was parity, and the dependent variables were weaning to estrus interval (WEI) and subsequent litter size. The month of weaning, body condition at birth, and lactation feed intake were found to be significant and were included as a covariate. Full lactation length, full litter size suckled, numbers of piglets removed, and number of piglets remaining with the sow had no significant effects on subsequent litter size; therefore, they were not included as covariates. The statistical model used in the analysis included covariates for the linear and quadratic effects of litter weight, and the fixed effects of herd, group, herd by group interaction, and parity. A herd-by-group interaction was fit to remove variation due to the interaction with season or weather. Sow mortality and culling rate were examined by using χ^2 test.

Results

Average voluntary daily feed intake was similar for treatment and control primiparous sows (5.6, s = 0.82 kg in experimental group, and 5.6, s = 0.87 kg in the control animals, $P > 0.05$). Average voluntary daily feed intake in multiparous sows was 7.3, s = 0.09 kg (experimental group 7.5, s = 0.12 kg; control 7.0, s = 0.31 kg; P = 0.05). No feed wastage occurred. When the confounding factors sow line, parity, and farrowing barn were controlled, oregano supplementation to the lactation diet influenced the following parameters:

- annual sow mortality decreased from 6.91% in control to 4.11% (P = 0.003) in experimental animals;
- sow culling rate during lactation decreased from 14.42, s = 1.23% in control animals to 11.42, s = 1.11% in experimental sows (P = 0.03);
- culling and mortality was higher (P = 0.04) in older sows;
- farrowing rate was higher in the experimental groups (67.72, s = 2.42%) compared with the control groups (62.21, s = 2.01%) (P = 0.01); and
- experimental groups had significantly (P = 0.05) more (10.09, s = 1.01) liveborn piglets per litter than the control (9.84, s = 1.02 piglets) (Table 1).

Discussion

Average voluntary daily feed disappearance was interpreted as average daily feed intake. Feed intake is difficult to measure during a trial on a commercial farm; it is different from feed disappearance (which includes wastage). Nevertheless the deep trough under the self-feeder made feed wastage unlikely in the present trial.

The positive effect of dietary oregano on sow production parameters may be the cumulative result of effects of oregano etheric oils. According to published data, oregano etheric oils exert antioxidant (15), antibacterial (16), and antiphlogistic (17) effects. The decreased stillbirth rate is difficult to explain, it may have been the cumulative result of the antiphlogistic and antioxidant effects of oregano etheric oils. Additionally, the appetite enhancing effect of oregano resulted in higher voluntary feed intake in the oregano-treated multiparous animals.

The principal reasons for the culling and mortality of the sows were anestrus (experimental group 16% versus control 15%) and locomotor problems (experimental group 23% versus control 21%). Swine urogenital disease (experimental group 14% versus control 21% of culling/mortality), periparturient diseases (mastitis-metritis-agalactia [MMA] experimental group 16% versus control 25% culling/mortality), heart failure (experimental group 21% versus control 10% of culling/mortality), and miscellaneous reasons (experimental group 8%, control 10% of culling/mortality) were registered. Most of the culling due to anestrus took place in September and during the winter months, indicating that adverse environmental conditions (summer heat and cold-wet winter) suppress reproductive activity. The marked reduction in MMA must have been the effect of the antioxidant (15), antibacterial (16), and antiinflammatory (17) properties of oregano essential oils.

Swine urogenital disease and MMA often occur in intensive management systems (18). In a study in a large eastern European breeding company, swine urogenital disease accounted for 32.4% of sow deaths and MMA following 40% of births (19). In the present study, oregano application diminished sow death caused by urogenital disease by 66.6% and by MMA by 64%. There exists no scientific data on possible effect of oregano on swine urogenital diseases and MMA. The lower death rate caused by periparturient diseases in the present study suggests that oregano etheric oils may have a positive effect on the health status of the periparturient sow. The subsequent farrowing rates (62% control and 67% experimental) in the present trial were well below industry expectations. The low farrowing rates may have been caused by the high endemic occurrence of urogenital disease caused by the various bacteria that were recorded in vulval discharges both in the pretrial evaluation and during the trial. Nevertheless, despite low farrowing rates, the differences between the oregano treated and nontreated sows were significant.

The use of phytogenic feed additives is controversial (7,13,14,21–24). It has been stated that oregano stimulates organic and microbiotical digestion (21). Khajarern and Khajarern (13) stated that carvacrol and thymol had an effect on the upper layer of mature enterocytes and accelerated the renewal rate of mature enterocytes at the surface of the villi of the intestine. This would reduce the pathogenic contamination of enterocytes and improve their capacity for nutrient absorption. Oregano supports digestion and the regulation of gastrointestinal metabolism (10), and exerts antibacterial properties by hindering dysbiotic processes in the digestive tract of pigs (17,22–24). It has been reported that giving feed supplemented with 60 g carvacrol and 55 g thymol per ton (1000 ppm Oregpig) during the postweaning period significantly improves the weight gain and health of pigs (12), and Khajarern and Khajarern (13) have stated that in sows the essential oils of *Origanum* act not only as alternative antibacterial performance promoters, digestion aids, and appetite enhancers, increasing daily feed intake ($P < 0.05$), but, when used as natural feed additives, act also as enhancers of growth, reproductive performance, and milk production. Consistent with the findings of Khajarern and Khajarern (13), in the present study, the multiparous sows in the experimental group showed higher lactational feed intake than multiparous sows in the control group (7.5, $s = 0.12$ kg/d, V 7.0, $s = 0.31$ kg/d, respectively).

The effect of oregano on sow fertility may only be speculated. If oregano stabilizes gut microflora, decreases populations of undesirable microorganisms, and increases the digestibility of the feed, the general health of the sows should be improved and postparturient activation of the immune system may be positively influenced by diminishing "delayed immune response" and "reduced leucocytary activity" of the sow's uterus (8). Such an effect might improve uterine involution and protect the sow from possible postpartum urogenital infections. Faster uterine involution positively influences subsequent farrowing rates, and antiinflammatory and antioxidant treatment decrease the prevalence of MMA (8).

Some criticisms for this article include the need for basic research to clarify the effect of oregano on the gastrointestinal, immune, and urogenital systems, and possible residual problems. Also, not evaluating piglet weights may have been an omission of this study. Finally, mortality was higher in older sows and, unfortunately, more detailed data on sow mortality in this study was not available.

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