Investigating the effect of an essential oils blend on coccidiosis

In 2006 the European Commission banned antibiotics as growth promoters (AGPs) in animal feeds – the 'Precautionary Principle' was invoked due to the growing concern of consumers.

Many studies pointed to an antibiotic resistance acquired by some bacterial strains, limiting the effectivity of conventional antibiotics used to treat the general population. Furthermore, there was a concern regarding the possible presence of antibiotic traces in meat.

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This prohibition triggered an unavoidable reduction in production parameters and the appearance of some diseases such as necrotic enteritis. That made it clear that an alternative had to be found to increase the development of animals, as well as their health, without compromising public health.

Essential oils as an alternative

Essential oils are volatile compounds extracted from plants with a strong aromatic character. Although their use as feed additives is relatively recent, many studies already agree on their positive effect on the animals' intestinal health and production parameters.

The importance of essential oils in animal production is increasing due to their variety of properties, such as antibacterial, antioxidant, antiparasitic, anti-inflammatory, antidiarrheal and antimycotic effects. Therefore, essential oils are considered a potential alternative to AGPs.

One of the most interesting properties of essential oils is the synergistic effect between them and their most bioactive elements, which means that combined they are more effective than individually.

The characteristics of each element will define the final effects of each oil and, at the same time, different oil combinations will result in different properties. This particularity offers a wide range of possibilities for the industry.

The combination of essential oils chosen for this trial aimed to be an efficient blend of essential oils and their bioactive components to optimise their synergy.

The blend was composed of essential oils like oregano, garlic or ginger and some of their isolated main elements, such as thymol, carvacrol and cinnamaldehyde.

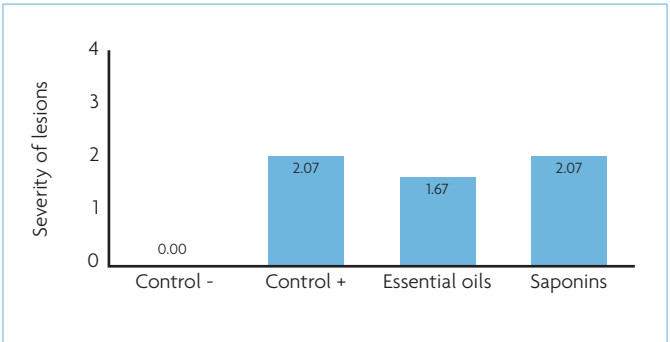
Recently, the antibacterial effect of its most important components was demonstrated during an in vitro trial. It also confirmed the synergistic effects existing between some of those components.

Most essential oil combinations used in the trial demonstrated a notable increase of antibiotic activity compared to their isolated components against the different bacteria used. The combination of cinnamaldehyde, thymol, carvacrol and clove achieved the best antibacterial results, with a MIC_{50} (Minimal Inhibitory Concentration) of 150ppm against Escherichia coli, Salmonella enterica ssp. enterica and Clostridium perfringens, followed by the combination of cinnamaldehyde and carvacrol.

The result of this study confirms that the antibacterial activity of some essential oils and their components can be increased when used in combination.

Alternatively, other studies suggest that some essential oils may have antiparasitic properties, therefore the following step was to assess the potential of this combination of essential oils against an important pathogenic agent within the poultry industry, Eimeria tenella.

Fig. 1. Average severity of lesions caused by E. tenella on day 21 according to Johnson & Reid scale.



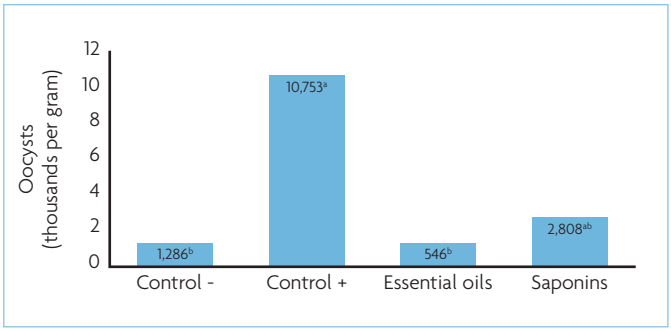


Fig. 2. Oocysts per gram (opg) in caecal content on day 28.

Eimeria tenella

Eimeria tenella is one of the responsible protozoa that induce avian coccidiosis, the parasitic disease that probably causes the most economic losses in poultry farming.

From all the agents that produce the disease, Eimeria tenella is the most pathogenic, mainly affecting the bird's caecum and causing high mortality on the farm.

Although it is quite easy to find low concentrations of this parasite on the farm, under normal conditions animals are not affected because the main route of infection is the intake of a high concentration of oocysts.

If another factor affects the immune status of an animal, Eimeria tenella will start producing lesions and multiplying, causing the infected animal to shed high quantities of oocysts to the exterior and therefore affecting those birds that were healthy until then.

Many infected animals do not show any visible lesions even though their development has been impacted. This is called subclinical or asymptomatic infection.

This is very important because it causes severe economic losses due to the producers not being able to see the real extent of the infection.

Experimental trial

An in vivo trial was designed to analyse the real effect of this particular combination of essential oils in chickens, comparing it against saponins which are also natural additives with antiprotozoal properties, used in animal nutrition.

A total of 180 one-day-old male broilers divided into groups of 15 individuals were assigned to four treatments, three replicates each, for 42 days.

The animals from treatments 2, 3 and 4 were inoculated with 8,500 oocysts of Eimeria tenella on day 14.

The treatments were as follows:

- T1. Negative control (NC): with no inoculations or additives.

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- T2. Positive control (PC): NC + E. tenella.
- T3. PC + essential oils at 1kg/t.
- T4. PC + saponins at 1kg/t.

To determine the intestinal health effect on the animals, 15 chickens per treatment were euthanised on day 21 of treatment to identify post mortem lesions in the caecum (according to Johnson & Reid scale), seven days post-inoculation following commonly employed models of infection. On day 28, 15 more animals were slaughtered to quantify the concentration of oocysts in the caecum content.

Furthermore, usual production parameters were recorded: average daily food intake (ADFI), average daily gain (ADG), feed conversion ratio (FCR) and final weights.

Results

- **Eimeria tenella lesions (day 21).** The Johnson & Reid scale classifies lesions caused by Eimeria tenella with a number that goes from 0 to 4 depending on their severity, 0 being the absence of lesions and 4 the most severe. To be able to compare results between treatments, the average lesion score was calculated for each treatment with data obtained after the post mortem inspection (Fig. 1).

As expected, no lesions were observed in animals from the negative control as no inoculation took place. As for infected animals, the results indicated that the broilers from both the positive control and the saponins treatments had the same average scoring, 2.07.

On the other hand, animals treated with essential oils scored 1.67 on average so it was capable of reducing the severity of the lesions by 19.3%.

- **Oocysts per gram in caecal content (day 28).** Data obtained during the oocyst quantification in the caecal content demonstrated that it was possible to limit the oocyst concentration (opg) by supplementing the combination of essential oils, having even lower levels than the negative control (1,286, non-pathological levels of the parasite).

Compared to the animals from the positive control (10,753opg), broilers treated with essential oils had a significantly lower (P≤0.05) presence of oocysts in the caecal content (546opg), being able to reduce it by 94.92%. When contrasted with those obtained from the saponins treatment (2,808opg), it can be concluded that the difference in the results was not significant, although the essential oils decreased the load of oocysts 80.55% more. Results are represented in Fig. 2.

- **Production parameters (0-42 days).** All results can be observed in Table 1. The best weights at the end of the trial (Fig. 3) came from the animals treated with the essential oils (3,037g) suggesting a trend of better weights than those from the saponins treatment (2,804g).

No significant differences for the negative (2,976g) and positive controls (2,982g) were seen.

Significant results were only obtained regarding the FCR, where the birds from the negative control had a better FCR (1.46) than those from the positive control (1.55) and saponins treatment (1.61), with no significant differences for the animals treated with essential oils (1.53).

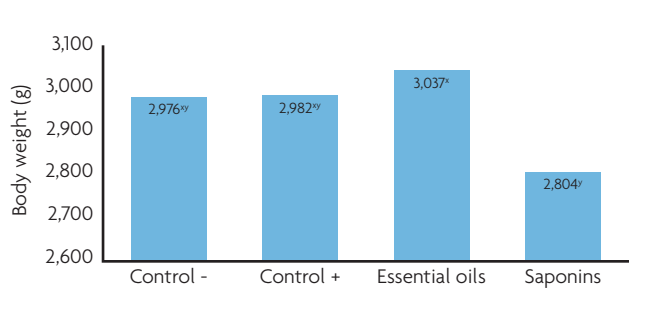
For ADG and ADFI there were no significant findings, but for both parameters a trend was observed suggesting better results for the treatment with essential oils.

In the first case, ADG, when comparing it against the saponins treatment (71.2g and 65.6g respectively). For ADFI, essential oils obtained better results than the negative control (108.8g and 101.5g respectively).

Treatment	Control -	Control +	Essential oils	Saponins	SEM	P
Weight (g)	2,976[ab]	2,982[ab]	3,037[a]	2,804[b]	56.2	0.0817
ADG (g/d)	69.7[ab]	69.9[ab]	71.2[a]	65.6[b]	1.34	0.0817
ADFI (g/d)	101.5[b]	108.1[a]	108.8[a]	105.9[ab]	1.65	0.0513
FCR (g/g)	1.46[a]	1.55[bc]	1.53[ab]	1.61[c]	0.025	0.0126

Table 1. Production parameters (0-42 days).

Fig. 3. Body weight at the end of the trial (42 days)



Conclusions

The results observed during the quantification of oocysts in caecal content demonstrated that this particular combination of essential oils was capable of acting against the biological cycle of Eimeria tenella and, therefore, against one of the most pathological agents that cause coccidiosis.

Considering other data, like the reduction in the severity of the post mortem lesions and the optimisation of production parameters, this trial confirms that the essential oil blend is multifunctional and capable of acting at different levels to improve intestinal health as well as the commercial performance of chickens. ■

References are available from the author on request