

## RESEARCH ARTICLE



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# The Effect of Natural Additives in Drinking Water on Broiler Production Performances: The Case of Green Anise and Fenugreek

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## Abstract

**Background:** Natural additives supplementation in broiler feed is intended to produce organic meat and minimize the use of chemical drugs that have harmful effects on humans, animals, and the environment. Using locally available plants such as fenugreek and green anise is a much safer and inexpensive alternative **Methods:** 318 broiler chicks were randomly assigned to three different experimental groups: birds of the first group considered as the control group received an enrofloxacin-based antistress drug; birds of the second group received an aqueous extract of fenugreek; birds of the third group received an aqueous extract of aniseed. Both natural products were used in gradual levels according to the following dosages and duration of treatment: 7 grams/liter of water during the period from day 15 to day 21 of age; 14 grams/liter of water from day 22 to day 28 and 28 grams/liter of water from day 29 to day 35. For each group, the following zootechnical parameters and carcass characteristics were recorded: mortality rates; Feed Intake (FI), Feed Conversion Ratio (FCR); live weight at slaughter; carcass yield and the weights of the liver, gizzard, and abdominal fat. **Findings:** Fenugreek was found to have the lowest mortality rate (6,60%) compared to 9,34% for the "control" group and 8,41% for the "anise group". Both Fenugreek and aniseed aqueous extracts had similar results to the synthetic antistress on the zootechnical and carcass variables studied. There was no significant difference between the three experimental groups ( $p > 0,05$ ). **Novelty:** Supplementation of fenugreek and anise aqueous extracts in broilers' drinking water has no adverse effect on their zootechnical performance or carcass characteristics. Both natural products could replace synthetic enrofloxacin-based antistress, allowing organic broiler production with reduced costs.

**Keywords:** Trigonella foenum-graecum; Pimpinella anisum; additives; performances; broiler; organic; production

## 1 Introduction

Many feed additives are used to improve the health and performance of animals. Antibiotics have commonly been used as growth promoters<sup>(1)</sup>. However, to meet regulations requirements, organic poultry systems avoid using antibiotics and tend to replace them with natural additives. Studies have shown that natural additives could be a better substitute for antibiotic additives in broilers<sup>(2)</sup> as well as in laying hens<sup>(3)</sup>. Using plant-based additives presents numerous advantages, including safety for birds, humans, and the environment; limiting drug resistance, and diminishing antibiotic residues in poultry products<sup>(4)</sup>. The search for new natural products is in constant growth, along with research to understand their mechanism of action, identify ways to standardize their effects, improve the modes of administration, and increase their effectiveness<sup>(5)</sup>.

Fenugreek (*Trigonella foenum-graecum*) is a herbaceous annual plant of the Fabaceae family. Used as a condiment, the plant is also known for its health-promoting properties and biological effects. Seeds are the most important part of the plant, they have hypoglycemic, antibacterial, antipyretic, antimicrobial, and antioxidant properties<sup>(6)</sup>. They have also an anti-inflammatory activity<sup>(6,7)</sup>. These biological and pharmacological activities are related to the plant's composition in many bioactive molecules such as iron, sulfur, nicotinic acid, alkaloids, saponins, flavonoids, carbohydrates, vitamins A, B1, C, magnesium, calcium, lecithin, and protein (30%)<sup>(8)</sup>.

Anise, (*Pimpinella anisum*) is a cultivated annual herbaceous aromatic plant belonging to the Apiaceae family. The plant's fruit known as anise seed is used as a condiment as well as a remedy in traditional medicine. Anise is used as a symptomatic treatment of digestive disorders such as epigastric pain and bloating<sup>(9)</sup>. The plant also could be an effective treatment against *Aspergillus fumigatus*<sup>(4)</sup>.

Both fenugreek and anise were studied to determine their effect on animal health and performances when used as feed supplementation<sup>(10)</sup>.

The use of fenugreek as a supplementation in animal feed was studied. In ewes, such supplementation resulted in increased lamb growth and milk production<sup>(11,12)</sup> in laying hens the addition of fenugreek in combination with ginger, flax and thyme as feed additives has an effect on coccidiosis. In Algeria, such studies are scarce, despite the importance of its broiler industry and the availability of both fenugreek and anise. The following experimental study aims to replace an enrofloxacin-based additive with the aqueous extract of fenugreek and aniseed. The effect of the different treatments on zootechnical performances and carcass characteristics are compared.

## 2 Material and methods

### 2.1 Birds, diets, and management

All procedures used in this experimental study were approved by the Scientific Council of the Institute of Veterinary Sciences (University of Constantine, Algeria) and are conform to international guidelines concerning animal care and use in research and teaching.

Three hundred eighteen (318), 1-day-old chicks were obtained from a commercial hatchery. Upon their reception chicks were weighed and randomly assigned to three experimental groups: birds of the first group considered as control received an enrofloxacin-based antistress drug; birds of the second group received an aqueous extract of fenugreek; birds of the third group received an aqueous extract of aniseed. Standard management practices of commercial broiler production were applied. Vaccination against gumboro disease and Newcastle disease were performed at the

appropriate ages. Birds were provided standard ad-libitum diets, covering the birds' energy and protein requirements during the three periods of breeding. (starter, grower and finisher) as recommended by<sup>(13)</sup>.

## 2.2 Treatments

Enrofloxacin® 10% (Vetoquinol Biowet Sp. Poland) is an antistress drug based on a fluoroquinolone antibiotic called enrofloxacin. Enrofloxacin 10% was used at the dose of 1 ml/liter in drinking water according to the periods of treatment shown in table1. Fenugreek and anise seeds were purchased from a local herbalist. The two natural products were prepared as aqueous extracts by soaking their grains in water for 24 hours. Table 1 shows dosages and periods of treatment in the three experimental groups.

**Table 1. Dosages and durations of treatments for each experimental group**

Enrofloxacin		Fenugreek		Anise	
Age	Dosage	Age	Dosage	Age	Dosage
1 <sup>st</sup> to 3 <sup>rd</sup> day	10 mg/ Kg	1 <sup>st</sup> to 14 <sup>th</sup> day	No antibiotic treatment	1 <sup>st</sup> to 14 <sup>th</sup> day	No antibiotic treatment
		15 <sup>th</sup> to 21 <sup>st</sup> day	7 gr/ liter	15 <sup>th</sup> to 21 <sup>st</sup> day	7 gr/ liter
13 <sup>th</sup> to 15 <sup>th</sup> day	10 mg/ Kg	22 <sup>nd</sup> to 28 <sup>th</sup> day	14 gr/ liter	22 <sup>nd</sup> to 28 <sup>th</sup> day	14 gr/ liter
		29 <sup>th</sup> to 35 <sup>th</sup> day	28 gr/ liter	29 <sup>th</sup> to 35 <sup>th</sup> day	28 gr/ liter
20 <sup>th</sup> to 22 <sup>th</sup> day	10 mg/ Kg	39 <sup>th</sup> to 42 <sup>nd</sup> day	No treatment	39 <sup>th</sup> to 42 <sup>nd</sup> day	No treatment

## 2.3 Zootechnical parameters and carcass characteristics

For each group, mortality rates were recorded as occurred. Birds, diets, and feed leftovers were weighed regularly to monitor the birds' growth and calculate Feed Intake (FI) and Feed Conversion Ratio (FCR). At the end of the study (day 45), for each experimental group, five birds were taken and weighed to determine their live body weight at slaughter. After sacrificing the birds, carcass yield was determined and gizzards, livers, and abdominal fat were weighed.

## 2.4 Statistical analysis

All analyzes were performed using Minitab 19 software. Data were statistically compared by the ANOVA (one-way analysis of variance) test at the significance level ( $p < 0.05$ ).

# 3 Results and discussion

## 3.1 Mortality rate

Fenugreek group showed the lowest mortality rate (6,60%) compared to the other two experimental groups with respectively (9,34%) for the Enrofloxacin group and 8% for the anise one. The low mortality rate of the fenugreek group could be explained by the anticoccidial effects of *Trigonella foenum-graecum* as reported by<sup>(14)</sup>. The effect of anise in lowering the mortality rate was not as important as the effect of fenugreek. In a study carried out by<sup>(15)</sup>, the addition of anise seeds to broilers feed at different levels (0,3%, 0,6%, 0,9% ) did not affect the mortality rate ( $P > 0,05$ ).

## 3.2 Feed intake and feed conversion ratio

Feed intake and feed conversion ratio were not affected by replacing enrofloxacin antistress with fenugreek and anise aqueous extracts.

Studies on fenugreek supplementation effect on feed intake and feed conversion ratio showed different, sometimes contradictory results depending on the form of the supplementation and the level of inclusion. Also, results can differ between broilers and laying hens. In laying hens supplementation with 5% fenugreek did not have any significant effects on feed conversion<sup>(16)</sup>. In addition, fenugreek supplementation decreased significantly feed consumption compared to control<sup>(16)</sup>.

In another study on hens, the average feed consumption was significantly lower in hens supplemented with 0.5% fenugreek, while a 0.1% fenugreek supplementation gave a better average feed consumption than the control group<sup>(17)</sup>. In broilers, one percent fenugreek powder supplementation improved the feed conversion ratio by 13.8 % compared to birds in the control group<sup>(18)</sup>, also supplementing fenugreek as an infusion resulted in the best feed conversion ratio<sup>(19)</sup>.

**Table 2. Feed intake and feed conversion ratio in the three experimental groups**

	Feed intake (g)		
	Enrofloxacin	Fenugreek	Anise
Starter (1 <sup>st</sup> day - 15 <sup>th</sup> day)	569,10	577,93	571,95
Grower (16 <sup>th</sup> day - 35 <sup>th</sup> day)	2734,59	2898,59	2835,47
Finisher (36 <sup>th</sup> day - 45 <sup>th</sup> day)	1743,56	1865,98	1814,07
Cumulative (1 <sup>st</sup> day - 45 <sup>th</sup> day)	5047,25	5342,50	5221,49
	Feed conversion ratio		
	Enrofloxacin	Fenugreek	Anise
Cumulative (1 <sup>st</sup> day - 45 <sup>th</sup> day)	1,88	1,86	1,75

As for fenugreek supplementation, anise supplementation has different effects depending on the form and the level of supplementation. In a study conducted to compare the effects of feeding birds on diets supplemented with gradual levels of anise oil, anise seeds powder, and their mixture. Results showed that in all treatments the average feed conversion ratio did not differ from the control group during most periods of the experiment<sup>(20)</sup>. In the same study, results indicated that during the whole experimental period, dietary supplementation by two levels of anise seeds powder and a combination between anise seeds powder and anise oil resulted in a slight decrease in feed intake as compared to control and the diets containing only anise seed oil (45 and 90 mg AO/kg diet)<sup>(20)</sup>. A study conducted on broilers<sup>(21)</sup>, showed that adding anise oil to diets did not statistically affect feed intake ( $p>0.05$ ) compared to the group treated with 0.1% added antibiotic (Avilamycin)<sup>(22)</sup>.

### 3.3 Slaughter weight and carcass yield

Fenugreek and anise aqueous extracts showed similar effects as the enrofloxacin based antistress on live weight at slaughter and carcass yield. No significant differences ( $p>0,05$ ) were observed between the three experimental groups as shown in table 3.

**Table 3. Live weight at slaughter and carcass yield in the three experimental groups**

	Enrofloxacin	Fenugreek	Anise	ANOVA test		
				★	★★	★★★
Live weight at slaughter (g)	2936,58 ± 375,28 Min = 2100 Max = 3450	2956,84 ± 372,92 Min = 2370 Max = 3680	2992.38 ± 423.501 Min = 2370 Max = 3700	NS	NS	NS
Eviscerated carcass (g)	2227,37 ± 311,98 Min = 1490 Max = 2600	2264,37 ± 264,35 Min = 1800 Max = 2775	2245,15 ± 379,95 Min = 1640 Max = 2865	NS	NS	NS
Carcass yield (%)	75,82 ± 4,15	76,67 ± 1,54	75,40 ± 7,11	NS	NS	NS

★: Enrofloxacin vs fenugreek, ★★: " Enrofloxacin vs anise, ★★★: " Fenugreek vs anise, NS: not significant difference ( $P>0.05$ )

The positive effect of *Trigonella foenum-graecum* on live weight was reported when using fenugreek supplementation as seeds at 1% fenugreek of the diet<sup>(22)</sup> and (3g/kg feed)<sup>(23)</sup>. This beneficial effect is probably linked to the seeds' content on essential fatty acids and high-quality protein<sup>(24)</sup>, combined with their stimulating effect on the size of intestinal villi of the birds<sup>(25,26)</sup>. According to<sup>(18)</sup> the optimum level of dietary fenugreek that induces positive effects on growth performance is lower than 1%. Supplementation higher than 1% dietary fenugreek has negative effects on feed intake and growth performance. Furthermore, the effect of fenugreek depends not only on the percentage of inclusion but also on the form of inclusion. Using fenugreek as an infusion of the seed powder has no significant improvement on the live weight of the chickens<sup>(27)</sup>, the positive effect of anise on weight gaining was reported by<sup>(20)</sup>. Results showed that diets supplemented with anise oil (45 mg/kg) gave significantly higher final body weight and produced the highest weight gain compared to the control diet. According to<sup>(28)</sup> adding anise seeds powder into the drinking water of broilers can be considered as an effective physiological promoter in broilers by significantly improving their blood profile, improving metabolic processes, and optimizing nutrient utilization in the digestive system. According to the same authors, anise may enhance broiler resistance to various stress factors<sup>(28)</sup>.

As for slaughter weights, carcass yields were similar between the three experimental groups suggesting no adverse effect of the tested aqueous extracts compared with the conventional antistress. the study reported by<sup>(16)</sup> showed no positive effect of fenugreek on carcass yield. However, in another study carried out by<sup>(25)</sup> results showed that adding fenugreek seed powder significantly affected the dressing percentage.

In our study, carcass yield was not affected by the incorporation of anise in the form of aqueous extract in the birds' drinking water, contrary to the results obtained by<sup>(14)</sup> who reported that adding green anise essential oil to the ration had positive effects on the carcass yield of birds.

### 3.4 Liver, gizzard, and abdominal fat

No significant differences ( $p > 0,05$ ) were observed between the three experimental groups concerning liver, gizzard and abdominal fat weights. As shown in table 6, birds treated by fenugreek and anise aqueous extracts showed similar results as birds treated by synthetic antistress. No macroscopic organ anomalies were observed.

Table 4. Weights

	Enrofloxacin	Fenugreek	Anise	ANOVA test		
				★	★★	★★★
Liver weight (gr)	57,90 ±10,97 Min = 40 Max = 80	55,53 ±8,80 Min = 45 Max = 80	55.79 ± 8.20 Min = 45 Max = 75	NS	NS	NS
Gizzard (gr)	36,05 ±9,06 Min = 25 Max = 50	32,90 ±5,85 Min = 25 Max = 40	36,05 ±7,18 Min = 25 Max = 45	NS	NS	NS
Abdominal fat (gr)	55 ±12,36 Min = 35 Max = 90	58,42 ±16,42 Min = 35 Max = 100	57.90 ± 16.45 Min = 30 Max = 90	NS	NS	NS

\*: Enrofloxacin vs fenugreek, \*\*: " Enrofloxacin vs anise, \*\*\*: " Fenugreek vs anise, NS: not significant difference ( $P > 0.05$ )

In our study, liver and gizzard weights were not influenced by the fenugreek aqueous extract supplementation, the same lack of effect was reported when using the seeds as the form supplementation<sup>(16,18,29,30)</sup> or when using the supplementation as an infusion of fenugreek seed powder<sup>(19)</sup>. As for fenugreek, the aqueous extract of anise did not affect the liver and gizzard weights. However, in a study using the oil as the form of anise supplementation<sup>(31)</sup>, results showed a significant increase in the liver and gizzard weights<sup>(31)</sup>.

Concerning abdominal fat, our results are in agreement with other studies<sup>(16,29)</sup> reporting no significant effect on abdominal fat following fenugreek supplementation. However contrary to our results, anise supplementation has been linked to a decrease in abdominal fat percentage in hens receiving diets supplemented with 200 ppm of anise oil<sup>(32)</sup>. Likewise, a study conducted on broilers<sup>(33)</sup>, found that the inclusion of anise oil in the diet significantly decreases the percentage of the birds' abdominal fat. It is worth mentioning that some studies had searched the effect of fenugreek supplementation on the birds' intestines and pancreas.

In one study, fenugreek seeds supplementation increased the weight and length of intestines<sup>(34)</sup>. According to another study<sup>(18)</sup> the incorporation of fenugreek with a percentage of 1% in the diet of broilers has a positive effect not only on the length of the small intestine but also on the weight of the pancreas. The positive effect of fenugreek on the pancreas was also reported by other studies<sup>(11,35,36)</sup>.

## 4 Conclusion

Fenugreek and anise aqueous extracts used as supplementations in broiler drinking water have no adverse effect on the birds' zootechnical parameters and carcass characteristics. Both natural products performed as well as the conventional enrofloxacin-based antistress. Using these natural products as replacements for antibiotic-based antistress drugs would reduce production costs and meet consumer requirements for affordable organic broiler meat. Further studies are necessary to investigate the exact mechanisms behind the positive effects of these two natural products.

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