**Product form**
- Supplied as a fine white agglomerated, free-flowing powder with a mild spicy, aromatic odour.
- Heat stability results from a patented process where the Enviva® EO particles (droplet size <1 μm in diameter) are in a maltodextrin matrix and encapsulated.
- Packed in 20kg polyethylene / aluminium lined paper bags.
- Manufacturing certifications:
  - ISO9000/9001
  - HACCP
  - FAMIQS

**Product application**
- Recommended usage rate is 100 g/tonne feed, included either directly or via a premix. 100 g of product will provide a guaranteed minimum of:
  - 4.5 g cinnamaldehyde
  - 13.5 g thymol
- Heat stable to 85ºC so ideal for pelleted feed applications (see figure).
- Stable when stored at temperatures of up to 22ºC (even in humid conditions) for at least:
  - 18 months in original packaging
  - 6 months in a vitamin/mineral premix
  - 3 months mixed in feed

**Enviva® EO**

- is heat stable at processing temperatures up to 85ºC (185ºF)
- Thymol activity (%) retained in heat treated pelleted feed compared to non-heat treated mash feed

<table>
<thead>
<tr>
<th></th>
<th>Corn-based diets</th>
<th>Wheat-based diets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processed at 85ºC</td>
<td>92%</td>
<td>90%</td>
</tr>
</tbody>
</table>

*Thymol used as the marker*

**Peer reviewed and trial references**
1. In vivo screening of best essential oil candidates from in vitro screening (step 1) to identify which combination provides best bird performance
2. Poultry average performance with antibiotic growth promoters taken from Rosen (1995) - Scientific literature review, based on < 4,000 pig and poultry trials
6. Danisco Animal Nutrition, 7 trials in Germany, France, the Netherlands, Hungary and UK (2008-2009)
7. Amerah et al. (2011), Br Poult Sci (1); 124-132

**Contact your Danisco Animal Nutrition representative or distributor for recommendations about your specific application needs**
Enviva® EO

highly bio-efficacious essential oil blend which supports improved feed intake, gut health and profitability

- Improves feed intake, digestibility\(^1\) and offers comparable live weight gain to Antibiotic Growth Promoters (+4.6%) \(^2,3\) resulting in a net profit improvement of $ 7/tonne feed and yielding a 5:1 return on investment\(^4\)
- Supports gut health, particularly when used with xylanase in viscous diets such as wheat\(^5\)
- Well-documented anti-bacterial qualities of thymol and cinnamaldehyde have been shown to improve food safety by reducing counts of Salmonella\(^6\), Campylobacter\(^7\) and E.coli\(^8\)
- Strong bioefficacy achieved from high concentration blends, the active components of which are also heat stable up to 85ºC\(^9\)
- Patented “encapsulation” process results in free flowing, uniform particles that ensure good distribution in both feed and premixes

Why essential oil feed additives can be “essential” additions to animal feed

Essential oils compounds (EOC) are aromatic molecules that have been extracted from specific plants or plant parts. Deemed “essential” to the plant because they offer varying degrees of antibacterial, antiviral, antifungal, anti-inflammatory and antioxidant properties\(^10\), they can also offer healthy performance and food safety benefits to poultry producers.

To achieve optimum benefits, you need to check the origin and composition of the oils, and the extent of in vitro and in vivo evidence in place to support product claims. The manufacturing process used to create the product is also very important. Essential oil compounds are volatile and prolonged storage or high feed processing temperatures can affect their stability. They can also be absorbed and metabolised rapidly by the animal. It is therefore important that they are used at a high concentration and that the active components are protected to maximize bioefficacy and stability.

Common poultry production challenges

- Production stress can result in loss of appetite and weight loss.
- Young birds’ immature immune and digestive systems are susceptible to disease-causing organisms which can disrupt gut integrity.
- The use of cheaper raw materials has been shown to result in digestive and gut health issues which, in turn, impacts healthy growth performance.
- Consumer pressure from food safety and health scares has called for bans or reduced use of in-feed antibiotics in some countries, so producers have to find other ways of achieving healthy growth performance.

Why choose Enviva® EO essential oil compounds?

Developed following intensive EOC laboratory screening and in vivo research across different diet types and ages of animal, Enviva® EO comprises carefully balanced, high concentration blends of thymol and cinnamaldehyde in nature identical form. Ongoing research has shown that Enviva® EO is a superior solution for resolving common production challenges.

How Enviva® EO can help

- Proven increases in appetite and improved bodyweight gain (see figure) may be due to the aromas and flavours of thymol and cinnamaldehyde.
- Evidence shows that Enviva® EO supports the development of a positive gut microbiota, which results in digestibility benefits and also helps to control populations of certain bacteria that may have a negative impact on production, especially for young animals raised under stressful environmental conditions.
- Research\(^11\) has shown that adding essential oils to xylanase can support monogastric gut health and growth.
- The well documented anti-bacterial qualities of thymol and cinnamaldehyde and their positive effect on non-beneficial bacteria such as Salmonella (see figure), E. coli and Clostridium perfringens have implications for food safety. These benefits - combined with the positive impact they have on profitable growth performance - make them a compelling alternative to antibiotic growth promoters.

Benefits at the feed mill and beyond

Enviva® EO is highly concentrated, and the patented encapsulation\(^5\) process used to protect its active ingredients, means it is highly bio-efficacious and beneficial to the animal. This also guarantees economy and ease of use.

Benefits offered by encapsulation include:

- dust-free with a low odour, enabling safe and convenient handling in the feed mill
- improved dosage control
- reduced storage and transport costs due to low product volume
- guaranteed pelleting and processing stability at temperatures up to 85ºC

Its free flowing particles can also easily be added to premixes and it can be used for pigs as well as poultry, reducing logistics costs.

Benefits offered by encapsulation include:

- guaranteed pelleting and processing stability at high temperatures up to 85ºC
- reduced storage and transport costs due to low product volume
- dust-free with a low odour, enabling safe and convenient handling in the feed mill
- improved dosage control

Benefits at the feed mill and beyond

Enviva® EO supports development of a positive gut microbiota

Quantitative PCR of E. coli

<table>
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<tr>
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<th>Control</th>
<th>Enviva® EO blend</th>
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<tbody>
<tr>
<td>Trial 1</td>
<td>10.0</td>
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<td>9.0*</td>
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<tr>
<td>Trial 4</td>
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<td>8.5*</td>
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<tr>
<td>Trial 5</td>
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</tbody>
</table>

Thymol and cinnamaldehyde positively modulated intestinal microbes of broilers (fewer undesirable microbes)

Reference: Beneficial effects of essential oils on caecal microbiota of broilers

Benefits of Enviva® EO

- **5.4** - 25 kg
- **6.4** - 25 kg

<table>
<thead>
<tr>
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<th>Enviva® EO blend</th>
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<tbody>
<tr>
<td>Trial 1</td>
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<td>Trial 3</td>
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<td>18.0+</td>
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<tr>
<td>Trial 4</td>
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<td>18.0+</td>
</tr>
<tr>
<td>Trial 5</td>
<td>18.0</td>
<td>18.0+</td>
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</table>

**P<0.05    +P<0.10**

Enviva® EO reduces Salmonella count

Reference: Beneficial effects of essential oils on caecal microbiota of broilers

<table>
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<tbody>
<tr>
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<td>Challenged</td>
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**P<0.05    +P<0.10**

Values without a common superscript are significantly different (P<0.1)