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Review article

# Herbs and spices inclusion as feedstuff or additive in growing rabbit diets and as additive in rabbit meat: A review

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ABSTRACT

The European ban on the non-therapeutic use of antibiotic growth promoters and limits on the use of other drugs have increased digestive disorders and mortality in growing rabbits. In addition, consumers demand natural products, and therefore synthetic active compounds should be replaced by natural ones. This has increased the search for alternatives, such as herbs, spices and their extracts (botanicals) as replacers. Plants (whole plants, leaves or seeds, mainly used as feedstuffs) and their extracts (considered as additives) are being increasingly used in animal nutrition as appetisers, digestive and physiological stimulants, colorants, and antioxidants, and for the prevention and treatment of certain pathological conditions. The digestive effects of herbs and spices have been tested primarily in humans and laboratory animals, and few trials have been performed on farm animals. Studies on the dietary inclusion of herbs and spices or their extracts in rabbit meat production are quite scarce, and the overall benefit remains unclear due to discrepancies in results, such as the use of plant preparations as galactagogues in rabbit does. Some positive results have been shown their potential, however. The dietary inclusion of *Foeniculum vulgare* Mill. seeds with oregano leaves has been observed to improve diet utilisation, whereas the dietary inclusion of a mixture of *Lupinus albus* L., *Trigonella foenum-graecum* L., and *Cassia senna* L. has acted as growth promoter. Antimicrobial effects are derived especially from plant volatile oils. In the rabbit, a stabilizing effect on microbiota was observed when the diet was supplemented with thyme oil. When diets were supplemented with thyme leaves and spirulina algae, an antimicrobial effect on *Clostridium coccoides, Clostridium leptum* in the caecum was observed. Black cumin seeds have been shown to exert anti-inflammatory, anti-bacterial and immunomodulatory effects. Several herbs and spices (green tea, rooibos, oregano, rosemary and thyme) provide antioxidant effects through rabbit dietary supplementation or inclusion in meat and meat products. Research in the use of herbs or/and spices has demonstrated their potential as feed additives and/or antioxidants, but further research is recommended to optimize effects on rabbits before practical proposals can be drafted.



**Contents**



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## 1. Introduction

In growing rabbits, particularly weaners, digestive disturbances are the main cause of the morbidity and mortality that create important economic losses for rabbit farmers (Marlier et al., 2006; Licois, 2004). Weaning is the period in which the kits are separated from their mothers, milk is substituted with solid feed, and the kits' immune system is still immature (Carabaño et al., 2006; Gidenne et al., 2005).

Digestive disturbances may originate from infection, bacteria (enteropathogenic *Escherichia coli* (EPEC), and *Clostridium spp.*) or parasites (Coccidia), or may be included under the term "non specific enteritis", in which feeding and animal stress seem to be the most likely triggering agents that provoke different and atypical clinical symptoms, intestinal lesions and diarrhoea, in particular.

The gastrointestinal syndrome known as Epizootic Rabbit Enteropathy (ERE) characterized by aqueous diarrhoea, abdominal bloating, and the distension of the stomach or the small intestine, has been observed in Europe since 1997. Although ERE is responsible for very high morbidity and mortality rates (up to 70% in growing rabbits), the aetiology of this intestinal disease remains difficult to establish. Some authors (Marlier et al., 2006; Szalo et al., 2007; Marlier, 2015) have postulated that the presence of *Clostridium perfringens* may be involved.

The European ban on AGPs in animal feeds and restrictions in the use of other drugs began in 1986 (Barug et al., 2006). As a consequence of the ban, researchers and feed companies have increased their efforts to develop safer and more natural feed additives, improving both the intestinal health and productivity of broiler rabbits in the meantime.

Researchers must now face the challenge of meeting the requests of increasingly informed and demanding consumers for products that provide similar effects of natural and controlled origin, the so-called pronutrients (Rosen, 1996). These natural additives can be divided into probiotics (Guarner and Schaafsma, 1998), prebiotics (Gibson and Roberfroid, 1995), enzymes (García-Ruiz et al., 2006; Choct, 2006) and organic acids (Skřivanová and Marounek, 2002; Romero et al., 2011).

Herbs, spices, and their extracts (botanicals) are classified by habitat, part used, therapeutic value, and type of administration. Although the distinction between herbs and spices is blurred, it has been suggested that herbs tend to be of leaf origin and spices of stem, bark, and seed origin (Collin, 2006). They cover a wide range of activities and some have been associated with improvements in animal performance and increased nutrient availability. Plants have developed a range of low molecular weight secondary metabolites that help them to prevent physiological and environmental stress, and oppose pathogens (Wenk, 2003a). Most of these active secondary metabolites are isoprene derivatives, flavonoides and glucosinolates. Reports on the effects of this category of feed additives on rabbit growth performance (Omer et al., 2012), antioxidant, and antibacterial activity (Al-Turki, 2007), meat quality (Cardinali et al., 2012), blood biochemical parameters (Al-Jowari, 2012), reproductive performance (El-Nattat and El-Kady, 2007) and doe milk production (Eiben et al., 2004) are still fairly scarce, however.

## 2. Herbs and spices as feed additives

Worldwide interest in herbal products has grown significantly. As described by Viegi et al. (2003) cattle, horses, sheep, goats and pigs represent about 31%, 14%, 17%, 17% and 7%, respectively, of the animals treated with herbal remedies, followed by poultry (9.1%), dogs (5.3%) and rabbits (4.3%). This is not only due to a general trend toward the use of natural products for curing illnesses but also the availability of mounting evidence regarding the efficacy of herbal remedies.

Herbs, spices and botanicals have been shown to offer a wide range of activities, including animal performance and increasing nutrient availability. When compared to antibiotics or inorganic chemicals, they present less toxicity and are free of unwanted residues, and also act as growth promoters when used as supplements in animal diets, rabbit feed included (Falcao-E-Cunha et al., 2007).

Plants and their extracts are therefore being increasingly used in animal nutrition as appetisers, digestive stimulants, stimulants of physiological functions, colorants, and antioxidants, as well as for the prevention and treatment of certain pathological conditions.

### 2.1. Plant secondary compounds and biological plausibility

Plants produce chemical compounds as part of their normal metabolic activities. They can be divided into primary (sugar and oils) and secondary compounds (phytochemicals). These organic chemical compounds may affect animal health when administered.

Phytochemicals can be classified by their therapeutic values (antibacterial, antifungal, anti-inflammatory, antiulcer, antioxidant, antiviral, anticancer, or immune stimulants) and preparation modes (tincture, decoction, maceration, syrup, inhalation and infusions). The sub-classes that comprise the phytochemicals are mainly herbs, valued for their medicinal properties, flavour or scent. As noted above, herbs are flowering plants whose stem does not become woody and persistent. Spices are defined as any of a class of pungent or aromatic substances of vegetable origin such as pepper (*Piperaceae* Family), cinnamon (*Cinnamomum zeylonicum*), and cloves (*Syzygium aromaticum*) used as seasonings, preservatives *etc.* A botanical is a drug (extract) made from a part of a plant (roots, stem, bark, leaves, seeds, flowers, fruits). Fungi, algae, and lichens are also considered botanicals. Depending on the extraction method, botanicals can be found as essential oils (steam distilled) that are highly concentrated and volatile, or botanical oils (cold pressed or extracted by heat) that are fatty and non-volatile (Wenk, 2003b; Hashemi and Davoodi, 2011).

Plant extracts or essential oils have distinct odours and are used mainly in the production of perfumes, flavours and pharmaceuticals. They are a rich source of biologically active compounds and have been recognized as having antifungal (Daouk et al., 1995), antioxidant (Burits and Bucar, 2000), and antimicrobial (Cox et al., 2000; Soultos et al., 2009) actions. Most active phytochemicals are believed to act as antibiotics or antioxidants both *in vivo* and in food (Wenk, 2003a). Several authors have dedicated attention to physiologically active secondary plant metabolites (Rhodes, 1996) and the mechanisms of their antioxidant features (Halliwell et al., 1995).