

Improving pork oxidative stability with phytochemicals

Phytochemicals – or plant-based substances – can play a role in supporting pork meat oxidative stability. That knowledge is important to know for animal nutritionists, livestock farmers and food industry professionals.

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Animal husbandry must maintain the well-being and performance of the entire animal flock or herd to achieve optimal productivity and economic gain. It is also essential to preserve the quality of animal products, such as meat, eggs and milk, from production to human consumption. In addition to the energy and nutrients provided by carbohydrates, fats and proteins, it is essential to incorporate natural antioxidants into feeds to support animal health and well-being, maintain performance and productivity, improve the functional aspects of zotechnical-interest proteins, and ensure the quality of the animal products that consumers use.

Impact of oxidative stress

Oxidative stress is caused by an imbalance between the production of free radicals, also called reactive oxygen and nitrogen species, and the body's ability to detoxify them and repair the resulting cellular damage. While reactions between free radicals and other molecules can have some benefits, they are generally associated with developing sub-clinical diseases and reduced performance in farm animals. Furthermore, free radicals could induce biological damage to DNA, protein and lipids, which is related to various health effects that negatively alter production capacity in farm animals. That may lead to lower quality and shorter shelf life of animal-sourced food products, such as pork meat. However, using antioxidants can help extend the shelf life of these products, providing a reassuring solution and instilling confidence in the quality of off-farm products.

Free radicals from various sources can overwhelm the animal's antioxidant defences, causing oxidative stress. For example, reactive oxygen species can attack the intestinal mucosa's surface and prevent nutrient absorption. That reduces nutrient uptake capacity, particularly amino acids, which are essential nutrients for lean meat formation. Moreover, the inflammatory response generated to mitigate the damage caused by the oxidation at the intestinal epithelium changes the metabolic path of amino acids from muscular deposition to fulfil the inflammation nutrient requirement.

Relying upon dietary antioxidants

Dietary antioxidants are vital in restoring that balance and offer numerous benefits on-farm (live pigs) and off-farm (pork meat). Those antioxidants, including vitamins, trace elements, fatty acids and phytochemicals, can be obtained from animal feed and supplements. Constant dietary provision of antioxidants in animals can support animal performance and enhance meat quality, including extending shelf life, improving appearance, flavour and taste, ensuring juiciness and reducing exudation. Ultimately, consuming these enriched animal products benefits human oxidative status. The growing need for safe animal food is a significant challenge for animal scientists and producers. Thus, the interest in using plant-based feed solutions has been expressed. Phytochemical feed solutions are botanical substances derived from plants' secondary metabolism. Among many plant-origin compounds, phenolics are any compound with a benzene ring with one (phenol) or more (polyphenol) hydroxyl groups as esters, methyl-esters and many others, which own a significant antioxidant activity. Phenolic compounds have attracted much research attention in animal nutrition, during the past few decades.

Benefits of phenolic compounds

Apart from a few members of the phenolics family (such as toxic alkaloids), most plant extracts have shown no limitations on being added to animal feed when used in accordance with recommended doses in feed. Dietary inclusion of polyphenols

could enhance the production performance and oxidative stability of food originating from farm animals. Phenolics have natural antioxidant properties and can protect biomolecules (proteins, nucleic acids, polyunsaturated lipids and sugars) from oxidative damage via reactions mediated by reactive oxygen or nitrogen species. The primary mode of action for the anti-oxidative power of phenolic compounds is related to reducing properties, such as hydrogen or electron donation that make those compounds free-radical scavengers. Phenolic compounds have a direct or indirect role in meat quality. For example, thymol or carvacrol, natural sources of polyphenols, reduce lipid oxidation in pork meat. Moreover, dietary-added polyphenols have the potential for neutralising reactive oxygen/nitrogen species at intestinal levels and keeping a better environment on the intestinal surface. This supports optimal amino acid uptake and balanced metabolic utilisation of nitrogen compounds.

Application of plant-based antioxidants

Inclusion of a combination of plant-based polyphenols (such as extracts from grape seed, thyme, oregano, lemon, onion, and garlic) in animal diets, from the growing stage to finishing, may enhance the production of endogenous antioxidant enzymes. The polyphenols present in these plant extracts can be effectively absorbed to improve the antioxidant function within the animals' bodies.

The improvements in the internal redox system, combined with the direct support provided by phytochemical feed solutions, can offer support in antioxidant protection. That, in turn, may reduce the animals' metabolic need for essential nutrients to act as antioxidants. The reduction provides an alternative approach, allowing nutritionists to partially lower

dietary vitamin E levels in the diet, for example, and partially substitute them with polyphenols while maintaining similar antioxidant status and growth performance. Recent studies have indicated that replacing up to 50% of dietary vitamin E with polyphenols did not significantly affect growth performance but could enhance the antioxidant status of swine while supporting growth performance. This could reduce feed costs and promote economically sustainable feed formulation practices.

Conclusions

Plant-based dietary antioxidants are potential solutions for supporting the redox balance in pigs, especially during finishing periods and directly affect meat quality. That emphasises the significance of incorporating botanical compounds, such as polyphenols, into their diet. By implementing innovative feeds enriched with plant-based antioxidants from phytochemical feed solutions, swine nutritionists can support animal welfare, profitability for producers and eventually satisfaction with pork products.

Nevertheless, it is crucial to recognise that not all plant extracts, isolated botanical compounds, or even blends of natural polyphenols can deliver the expected benefits in terms of improved animal performance and meat quality. Producing an effective antioxidant phytochemical additive requires a meticulous selection of bioactive substances based on specific knowledge of the targeted metabolic processes, robust scientific validations and unwavering quality control of the botanical ingredients.

All technical statements are based on scientific literature; references are available upon request.



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Plant-based dietary antioxidants can support pigs during finishing.