

PINUS TAEDA POLYPHENOLS ADDITION IN BEEF FEEDING: EFFECTS ON VOLATILE COMPOUNDS AND ANTIOXIDANT ENZYME ACTIVITY

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I. OBJECTIVES

Natural antioxidants obtained from leaves, seeds, or flowers of plants, containing bioactive substances such as phenolic compounds, flavonoids, and volatile oils, have been used in animal feeding. Consumers perceive this strategy positively, as these compounds have an effectiveness also in human health, they are natural, and usually they are from agricultural byproducts, in a context of increasing circularity of the economic activities. The aim of the work was to evaluate the effects of *Pinus taeda* Hydrolyzed Lignin (PTHL) polyphenols' inclusion on the volatile organic compounds (VOC) profile and antioxidant enzyme activity of beef meat stored at 4°C for 15 d of aging.

II. MATERIALS AND METHODS

Forty Limousin bulls (340 ± 42 kg) were fed *ad libitum* on a total mixed ration (TMR) for 120 d. The control group received exclusively TMR, while the experimental group received the same TMR as the control group but supplemented with PTHL polyphenols (Oxifenol, I-Green, Padua, Italy; 35 g/d per head at 1–90 d and 70 g/d per head at 91–120 d). Samples of *longissimus thoracis* muscle (mean weight of 2,000 ± 100 g) were removed from the right carcass side between the 11th and 13th thoracic vertebra from each animal and placed in a dry aging meat chamber (2°C, 82% of humidity) until analyses. Steaks of 2.5 cm of thickness were obtained from the sample at 2 different storage times (1 and 15 d) and analyzed. At each aging time, samples were grill cooked at 130–150°C for 5 min, and VOC profile was performed by solid-phase microextraction and gas chromatography-mass spectrometry. Moreover, superoxide dismutase, catalase, and glutathione peroxidase meat activity were detected on raw samples at both aging times and in both experimental groups. VOC profile and enzyme activity were determined by gas chromatography-mass spectrometry and the spectrophotometric method, respectively, and the results obtained were analyzed using a nested analysis of variance using the general linear models procedure by SAS software (version 9.4, SAS Institute Inc., Cary, NC), where aging time and PTHL polyphenols' inclusion were set as independent variables. Means were compared using the Tukey test for repeated measures.

III. RESULTS

Ketones and aldehydes were the most common VOC from cooking meat, representing around 60% of the total VOC. The ketones showed to be produced less in meat from the polyphenols group at 15 aging days ($P < 0.01$); however, they increased in both groups during aging ($P < 0.01$). They usually derived from lipid oxidation, in particular from fatty acid oxidation, and showed how these processes are probably characterized by lower intensity if

animals are fed with added polyphenols. Also aldehydes, derived from lipid oxidation although through different pathways than ketones, did not show any difference between groups ($P > 0.05$). However, they increased after aging ($P < 0.05$). Superoxide dismutase and catalase activity did not change during aging, with no differences between groups ($P > 0.05$); instead, glutathione peroxidase activity showed different trends between experimental groups, increasing during aging time in PTHL group ($P < 0.01$) and decreasing in the control group ($P < 0.05$), with higher activity in meat from animals fed with polyphenol additives at 15 aging days ($P < 0.01$).

IV. CONCLUSION

Some changes are present in beef meat after grilling cooking, and these changes involved primarily those indicative of lipid oxidation, with less production in animals fed with PTHL polyphenols.

Keywords: aging time, antioxidants, enzymes, volatile organic compounds