Shelf-life extension of ruminant meat with fruit-based natural preservatives

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Industry Sector: Cattle and Small Stock

Research Focus Area: Red Meat Safety, Nutritional Value, Consumerism and Consumer Behaviour

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EXECUTIVE SUMMARY

Introduction

Urbanization and consumer preference towards convenience foods have led to an increase in demand for ready-to-eat foods. Challenges exist in the effort to satisfy this demand as large amounts of food losses are generated along the supply chain before reaching the consumer. Oxidative degradation and microbial spoilage are main contributors to food losses through reduction in shelf life, sensory quality, nutritional and health value of meat. Processed meat products are the most affected because of their high-water activity and contents of lipids, and large surface area due to comminution. Large surface area increases interaction between pro-oxidants, enzymes and lipids. Synthetic preservatives have largely been used to inhibit and/or delay oxidative processes and microbial spoilage of processed meat. However, synthetic preservatives have been associated with diet related health problems such as cancer and allergies. As a result, there is a paradigm shift towards preference and trust in natural preservatives, as they are deemed to be nutritional, safe and healthy. Several sources of natural preservatives have been investigated including extracts from grape and citrus fruit by-products. Grapes and citrus are major fruit crops in South Africa, with an annual production of approximately 1.6 and 2.9 million metric tons, respectively. Of this, 20-30% and 50-70% end up as grape pomace, and orange peel and pulp, respectively. These wastes pose serious processing, storage and disposal challenges to the fruit industry. Extracts from grape and orange by-products are, however, good sources of valuable bioactive phytochemicals that exhibit antioxidant and antimicrobial properties. Regrettably, there is lack of scientific evidence regarding the *in vivo* antioxidative and antimicrobial efficacy of crude extracts from winery and citrus by-products. To this end, valorisation of fruit by-products as natural preservatives for processed ready-to-eat meat products is important.

Objective Statements

- Characterize the bioactive phytochemical composition of red grape pomace (GPE), grape seeds (GSE) and clementine mandarin orange peel and pulp (OPE) extracts;
- Evaluate the in-vitro antioxidant and antimicrobial activities of GPE, GSE and OPE extracts;
- Determine the effect of GPE, GSE and OPE extracts on shelf life of beef patties and;
- Assess the effect of GPE, GSE and OPE extracts on sensory quality of beef patties.

Project Aims

The aim of the current study was to evaluate the meat preservative potential of red grape pomace, grape seed and clementine mandarin orange peel and pulp extracts.

Results

Concentrations of individual and total flavonoids, flavones, flavanones, hydroxycinnamic acids, limonoids and diterpenoids were greater in clementine mandarin orange peel and pulp (OPE) compared to grape seeds extract (GSE) and grape pomace extract (GPE) whose concentrations were not different from each other. Grape seed extract had the greatest concentrations of individual phenolic acids followed by GPE and OPE, respectively. Individual and total flavanols and total phenols concentrations were greater in GSE than GPE and OPE, whose concentrations were similar to each other. The concentration of the identified benzenediols and terpenoids followed the order: OPE>GPE>GSE. Ascorbic acid was only detected in OPE, which also had the greatest titratable acidity and lowest pH values. Total phenols and carotenoids contents were greatest in GPE followed by GSE and OPE. Grape pomace extract and GSE had greater anthocyanins than OPE. Proanthocyanidins content was greatest in GSE followed by GPE and OPE. The in-vitro antioxidant activity of the extracts followed the order of GSE> GPE>OPE while in-vitro antimicrobial activity of the extracts was in the order of OPE>GSE>GPE.

Type of extract and retail display period influenced redness (a*), yellowness (b*), Hue (H*) and chroma (C*) values in beef patties. The order of a* values from greatest to lowest was sodium metabisulphite (SMB)>GSE>GPE=OPE>control (CTR). Antioxidant activity values of beef patties followed the order of SMB>GSE>GPE=OPE>CTR. The order of TBARS and carbonyls values of the beef patties was CTR>GPE=OPE>GSE>SBM, while that of bacterial loads (i.e., lactic acid bacteria, total viable and coliform counts) was CTR>GSE=GPE>OPE>SBM. The CTR patties had the greatest cohesiveness values with fruit extracts having intermediate values and SMB the lowest. Overall intensity and beef-like aromas, and flavor showed differences across treatments with OPE beef patties having greater values than other treatments.

Conclusion

Grape pomace extracts had the greatest contents of total phenols, tannins and carotenoids whereas GSE and OPE had the greatest contents of proanthocyanidins and ascorbic acid, respectively. Grape seed extract exhibited the greatest in-vitro antioxidant activity whereas OPE exhibited greatest in-vitro antimicrobial activity. Consistently, GSE was more effective than GPE and OPE in reducing lipid and protein oxidation in beef patties. Clementine mandarin orange peel and pulp extract was the most potent in lowering microbial spoilage of beef patties but had minor effects on sensory quality compared to other fruit extracts. Follow-up studies are warranted to compare the effectiveness of crude versus purified extracts and

determine the optimum concentrations of purified GSE and OPE required to extend shelf life of beef patties without affecting sensory quality.

Popular Article

Title for Popular Article

Winery and citrus by-products: From waste to meat preservatives

1 January 2021

A study conducted by an interdisciplinary team of researchers at Stellenbosch University found that extracts from winery and citrus by-products commonly disposed as waste could be used to preserve processed meat. The study compared beef patties treated with a commercial preservative and extracts of either clementine mandarin orange peel and pulp, grape pomace or seeds for their effects on shelf life and sensory quality. Grape pomace extract was more effective than the other fruit extracts in reducing lipid and protein oxidation in beef patties. Clementine mandarin orange peel and pulp extract was the most potent in lowering microbial spoilage of beef patties but had minor effects on sensory quality compared to other fruit extracts. Grape seed extract and orange peel and pulp extract have potential to replace synthetic antioxidants and antimicrobials, which have been associated with negative human health effects.

Authors

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