P-05-33

Oxidative stability of pork patties as affected by cooking and addition of *Ganoderma lucidum* extract (#591)

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Introduction

The higher proportion of unsaturated fatty acids in pork meat facilitates the lipid oxidation process (LOX), and consequently increases the loss of its oxidative stability (Huang et al. 2011). Synthetic antioxidants such as the butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), tert-bytylhydroquinone (TBHQ) and propyl gallate (PG) are commonly used in meat products to prevent oxidative changes, but their addition in uncontrolled concentrations is also a widespread practice (Kahl & Kappus, 1993). The oxidative stability depends upon the balance and interaction among endogenous antioxidant systems composed by non-enzymatic lipophilic and hydrophilic constituents such as vitamins, carotenoids, and polyphenols, among others (Serpen et al. 2012; Falowo et al. 2014). However, during industrial thermal processing or home cooking of meat (roasting, microwaving, frygin and grilling), the oxidative stability can decrease (Domínguez et al. 2014). Also, it has been extensively reported that the oxidative stability could be enhanced by adding natural antioxidants (Falowo et al. 2014). *Ganoderma lucidum* is an mushroom from the traditional Chinese medicine widely used for the treatment of hypertension, bronchitis and arthritis. Also, their antioxidant activity has been previously demonstrated (Yen & Wu, 1999). Hence, the aim of this study was to evaluate the oxidative stability of pork patties under the effects of cooking and the addition at three levels of a *Ganoderma lucidum* aqueous-ethanolic extract (GLE).

Methods

Bioactive compounds of *Ganoderma lucidum* powder were extracted with water (1:10) and the extraction was assisted by ultrasound method (42 KHz/ 25 °C/ 30 min). Inmediately, the mixture was centrifuged (4,200 x g/ 10 min) and the resulted solution was filtered (Whatman No. 4 filter paper), concentrated under reduced pressure, lyophilized and stored at -20 °C under dark, until further analysis. Total phenolic content (TPC) and antiradical activity [2,2-diphenyl-1-picrylhydrazyl free radical (DPPH▪); and 2,2′-Azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt radical cation, ($ABTS^{\bullet+}$)] of *Ganoderma lucidum* extract (GLE) were determined by the Folin-Ciocalteu, as well as by the DPPH▪ (2,2′-diphenyl-1-picrylhydrazyl) and $ABTS^{\bullet+}$ (2,2-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid) antiradical methods (Ainsworth & Gillespie, 2017; Re et al. 1999; Molyneux, 2004). Thereafter, minced pork meat (M. *semimembranosus*, 24 h *postmortem*) was mixed with fat (10% in final formulation, w/w), salt (1.5%, w/w), and water (5%, v/w). In each replication (twice) pork patties were assesed in four treatment as follow: control (with out natural antioxidant); GLE0.5%, patties treated with 0.5% of GLE; GLE1.0%, patties treated with 1.0% of GLE. Patties were grilled until reaching an internal temperature of 71 °C. Cooked samples were cooled (at 25 °C, during 1 h). Raw and cooked patties were subjected to analyses of total antioxidant activity (TPC, DPPH▪, and $ABTS^{\bullet+}$) (Huang et al. 2011). Data were subjected to ANOVA and means were separated by the Tukey's test ($P<0.05$).

Results

As shown in Figure 1, TPC values decreased ($P<0.05$) in cooked pork patties, and the highest ($P<0.05$) TPC values (17.4 mg gallic acid equivalents/g of meat) were reached in patties treated with GLE. Upon cooking the $ABTS^{\bullet+}$ values also decreased ($P<0.05$) (Figure 2) for pork patties whereas DPPH▪values increased ($P<0.05$) (Figure 3) in all samples. The highest ($P<0.05$) $ABTS^{\bullet+}$ and DPPH▪inhibition values (14.2 and 67.1%, respectively) of pork patties were found for the GLE 1.0% treatment.

Conclusion

The antioxidant activity of mushroom extracts is commonly associated with the presence of some phenolic acids such as caffeic, *p*-coumaric, gallic, gentisic, protocatechuic, syringic, vanillic, among others (Nowacka et al. 2014). Meat is a food with a complex physical structure and chemical composition that is very susceptible to the oxidation process (Serpen et al. 2012). Additionally, it has been reported that natural extracts added to meat and meat products can increase their polyphenol content, and hence, their oxidative stability (Huang et al. 2011; Serpen et al. 2012; Falowo et al. 2014). The TPC method relies on the electrons transfer in alkaline medium from the antioxidant (phenolic compound, ArOH) to phosphomolybdic/phosphotungstic acid complexes (colorimetric reagent Folin-Ciocalteu) (Ainsworth & Gillespie, 2017). Therefore, the electron-donating ability of ArOH is responsible for the antiradical DPPH▪ and $ABTS^{\bullet+}$ activities of ArOH derived from natural extracts (Re et al. 1999; Molyneux, 2004). The modification of total antioxidant activity of meat upon cooking can be attributed to several factors such as denaturation and exposure of reactive protein sites, and degradation of endogenous antioxidants (Serpen et al. 2012). In this context, the TPC, $ABTS^{\bullet+}$ and DPPH▪ assays can be used to provide additional information regarding changes that occur in meat samples after cooking (Kahl & Kappus, 1993). In conclusion, extracts from *Ganoderma lucidum* are an effective

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source of antioxidants and can increase the total antioxidant activity in meat products upon cooking.

References

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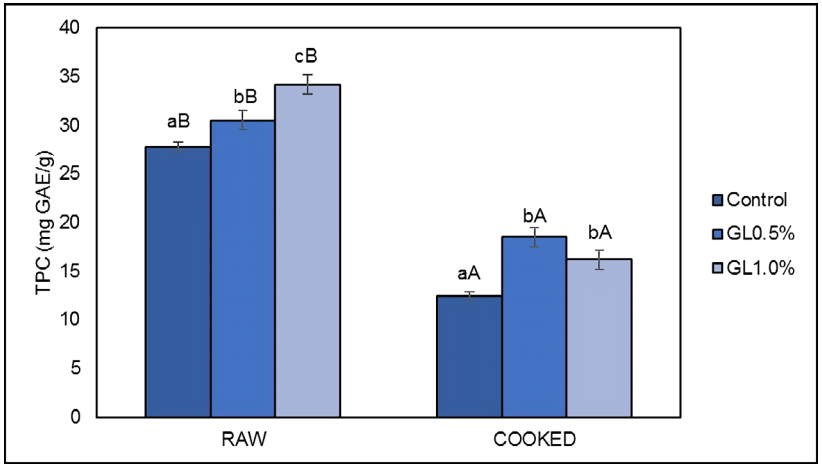

Figure 1

Figure 1. Effect of GLE addition on TPC of raw and cooked of meat. Different literals beared in the same GLE treatment (a-c) or thermal process (A-B) indicate differences (P<0.05).

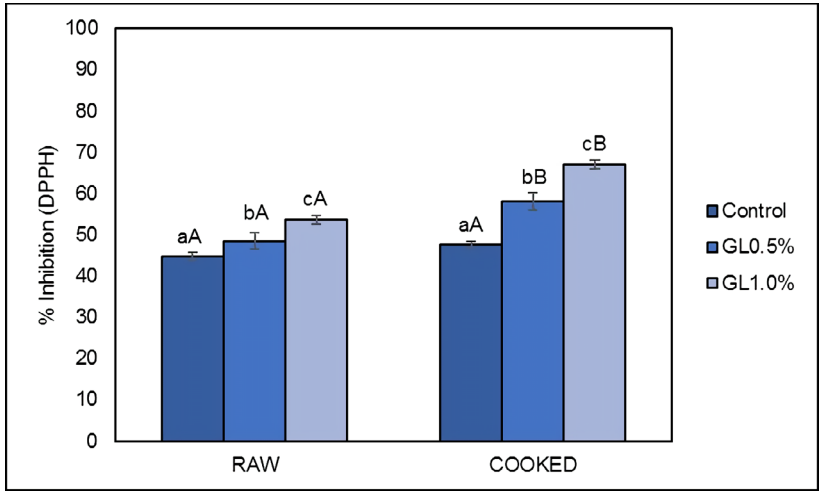

Figure 3 Figure 3. Effect of GLE addition on DPPH• antiradical activity of raw and cooked pork meat. Different literals beared in the same GLE treatment (a-c) or thermal process (A-B) indicate differences (P<0.05).

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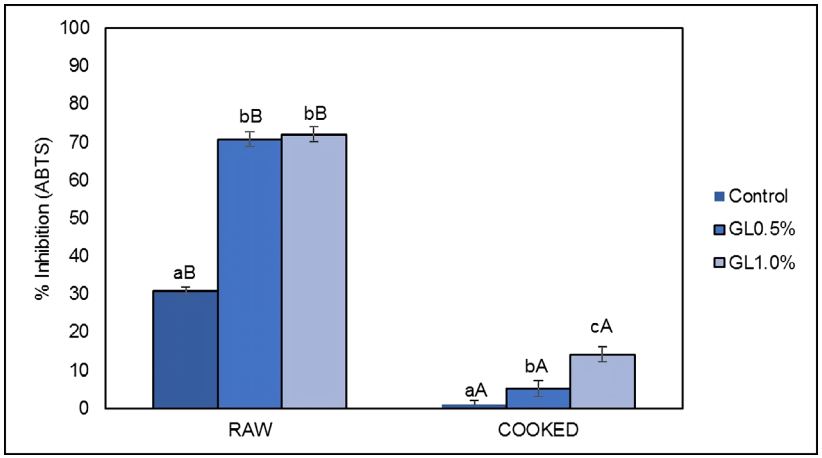

Figure 2 Figure 2. Effect of GLE addition on ABTS$^{\bullet+}$ antiradical activity of raw and cooked of meat. Different literals beared in the same GLE treatment (a-c) or thermal process (A-B) indicate differences ($P<0.05$).

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