Original Research

Onion (*Allium cepa*) suppresses the Lipid Oxidation and Improves the Sensory Quality of Cooked Pork Sausages

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Abstract

Present study was conducted to evaluate the antioxidant and sensory properties of uncured pork sausages incorporated with onion (Allium cepa) at different concentrations and compared with synthetic antioxidant (butylated hydroxytoluene / BHT) at 0.01% throughout the 5 days of storage at 4 ^{0}C. The Onion Powder (OP) at 0.25% exhibited the highest total phenolic content (P< 0.05) and reduced the thiobarbituric acid reactive substances (TBARS) values in cooked pork sausages. Colour (CIE lab L, a* and b*) values of OP, BHT and control samples did not significantly change throughout the storage for 5 days at 4 °C. Whereas taste, texture and overall acceptance increased in OP incorporated sausages compared to control and BHT incorporated pork sausages. In conclusion, the results suggest that use of onion powder could improve shelf stability of the cooked sausage.*

Key words: Antioxidant, Lipid Oxidation, Onion Extracts, Pork Sausages, TBARS Values, Uncured

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Introduction

Lipid oxidation is a major cause of deterioration of shelf life of meat products which may produce changes in meat quality parameters such as colour, flavour, odour, texture and even nutritional value (Masniyom, 2011). In meat, some of products from oxidation are chronic toxicants in human that contribute to the aging process, cancers and cardiovascular diseases (Willcox *et al*., 2004). Hence, different strategies have been attempted to counteract the lipid oxidation of meat products such as using approved synthetic phenolic antioxidants (Shahidi and Zhong, 2010). However, the synthetic antioxidants used currently have been found to exhibit various health effect which have led to growing interest in natural antioxidants in meat

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products (Sasse *et al*., 2009) because of their safety, consumer acceptability and greater application in extending the shelf life of foods (Devatkal *et al*., 2010). Recently, natural antioxidants have become a part of the diet in human nutrition with the aim of decreasing the risk of diseases such as coronary heart diseases, cancers and diabetes (Reische *et al*., 2008). Onion (*Allium cepa*) is important as a functional food in the diet because of their high contents. The active anti-oxidant compounds of onion extracts promote health by preventing lipid oxidation and providing antibacterial, anti-carcinogenic and antiviral ability (Procházková *et al*., 2011).

Some studies have been performed to investigate the anti-oxidative effect of onion and its health related benefits. However, to the best of our knowledge, lack of published reports available on the effect on anti-oxidative capacity of onion incorporated cooked pork sausages and also dearth of literature associated with methods of onion extraction. Therefore, in present study compared the different onion extractions and commercially available onion powder as an anti-oxidant with synthetic antioxidants on prevention of lipid oxidation in pork sausages.

Materials and Methods

The boneless pork meat was obtained from local supermarket. Commercially available onion powder was purchased from Ma's Tropical Food Processing (Pvt) Ltd., Dambulla, Sri Lanka and fresh onion was purchased from the local retail market.

Determination of Total Polyphenol Content (TPC) of Onion Water Extraction and Ethanol Extraction

The extraction method used here is based on the study of Santas *et al.* (2008) with minor modifications. TPC was determined in the extracts according to the method describe by the International Organization for Standardization (ISO) 14502-1: 2005(E).

Experiment I– Preparation of Onion Incorporated Meat Model Systems for Testing the Antioxidant Effect of Onion Extracts

Meat model systems were prepared by mixing minced lean meat with fat emulsion (17% w/w), ice (17% w/w), NaCl (2% w/w). The different concentrations of onion powder (OWE, OEE and OP) based on their TPC relate to onion powder percentages that are described in Table 1 and 0.01% butylated hydroxytoluene (BHT), a synthetic antioxidant were elaborated to evaluate the antioxidant efficacy. All the samples were ground, filled into Pyrex glass beakers, cooked for 40 min. at 72 °C and stored at 4 °C until TBARS analyse.

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Table 1: Different combinations of onion water extracts (OWE), onion ethanol extracts (OEE) and commercial onion powder (OP) in meat model system with the total amount of TPC % at each treatment

Type of Onion Powder	Treatment	Incorporate Onion Level (%)	TPC % in the Treatment
Onion Water Extraction (OWE)	OWE 1	0.1	0.531
	OWE 2	0.2	1.062
	OWE 3	0.3	1.593
	OWE 4	0.4	2.124
	OWE 5	0.5	2.655
Onion Ethanol Extraction (OEE)	OEE 1	0.06	0.531
	OEE 2	0.1	1.062
	OEE 3	0.2	1.593
	OEE 4	0.28	2.124
	OEE 5	0.34	2.655
Commercial Onion Powder (OP)	OP 1	0.05	0.531
	OP 2	0.1	1.062
	OP 3	0.151	1.593
	OP 4	0.21	2.124
	OP 5	0.252	2.655

Experiment II—Preparation of Pork Sausages for Sensory Evaluation and Instrumental Colour Assessment

Pork sausages were prepared by mixing minced lean meat with 17% fat emulsion, 17% ice, 2% NaCl, 0.40% sugar, 0.10% chilli powder, 0.09% cardamom powder, 0.11% cinnamon powder, 0.09% garlic powder, 0.09% ginger powder, 0.35% phosphate, 0.30% pepper, 0.10% monosodium glutamate, 1.08% soy protein isolate, 1.05% soy sauce, 1.20% corn flour, 0.05% mace powder, 0.94% milk powder. 0.25% OP and 0.01% BHT added sausages were compared with a control (00%). All the samples were ground and stuffed into artificial casings, cooked for 40 minutes at 72 °C and stored at 4 °C until analyse.

Analytical Parameters

The extent of lipid oxidation was evaluated by 2-thiobarbituric acid-reactive substances (TBARS) method described by Raharjo *et al*. (1992). The colour measurements were taken with a colorimeter (Chroma Meters CR-453, WPA) and illuminated to calculate colour indices in the CIELAB system, following the recommendations of Ariza *et al*. (2007).

Sensory Evaluation

The sensory evaluation was carried out by an untrained panel consisting of thirty individuals. The acceptance attributes were appearance, aroma, flavour, texture and overall acceptability. The acceptance values were measured using a four-point hedonic scale.

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Statistical Method

Completely randomized design (CRD) was used in the study. Data analysis was conducted with SPSS MAC, version 20.0, SPSS Chicago (US). Means of the treatment and time were separated using the Duncan's Multiple Range test (DMRT). Differences were considered significant at $P < 0.05$.

Results and Discussion

The TPC level significantly high ($P<0.05$) in OP compared to both OEE and OWE.Whereas, TPC level of OEE is significantly high ($P<0.05$) compared to OWE (data not shown). This was in line with the findings made by Min *et al*., 2002, which have been reported that intermediate molecular weight flavonoids can be extracted with the aqueous solutions. High molecular weight flavonoid usually remains insoluble in those solvents. According to present study, water extract contains only the low molecular weight TPC whereas OEE contains low and intermediate molecular weight phenoles. Furthremore, OP may contain even higher molecular weight TPC. Commercial OP producers incorporate outer peels which contains high amount of TPC during processing of OP. Thus, the TPC of the OP was shown significantly higher value. That is in line with the observation of (Park *et al.,* 2007) showed that of 13- 289 mg/ g of TPC in dried onion powder while the quercetin content of dried onion powder was 1.12- 99.68 mg/ g. Table 1 shows the all the treatments used in the experiment I and TPC in the each treatment. In experiment I, the effect of different concentrations of OWE, OEE and OP on TBARS values in pork incorporated meat model systems during the 5 days storage at 4 °C is shown in Fig. 1.

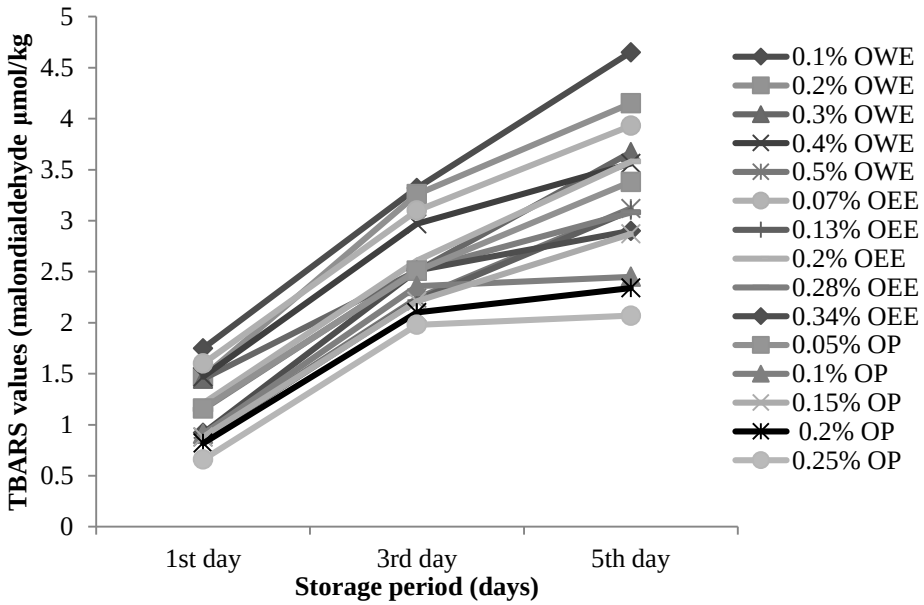

Fig. 1: Effect of different concentrations of onion water extracts (OWE), onion ethanol extracts (OEE) and commercial onion powder (OP) on TBARS values (malonaldialdehyde mg/kg DM) in meat model system stored at 4 C^0. Values are expressed as mean.

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All five concentrations of OWE (0.1%, 0.2%, 0.3%, 0.4% and 0.5%), OEE (0.07%, 0.13%, 0.2%, 0.28% and 0.34%) and OP (0.05%, 0.1%, 0.15%, 0.2% and 0.25%) significantly ($p<0.05$) increase the TBARS values throughout the storage period. That is in line with the study of the Procházková *et al.,* 2005, which have been reported that the oxidative degradation of poly unsaturated fatty acid (PUFA) caused a gradual increase of TBARS during the storage at 4 °C. TBARS of all the treatment increase rapidly. Furthermore, the TBARS value of meat model system, formulated with 0.1% OWE showed the highest value ($p<0.05$) during the storage period while OEE (0.07%) and OP (0.05%) with the same concentration of TPC showed significantly low TBARS value. These observations emphasize that lower molecular weight phenols and high molecular weight phenols behave in a different way in a meat model system. This pattern was evident in all TPC concentration in OWE, OEE and OP.

In experiment II, the effect of different concentrations of OP and BHT on TBARS values in pork sausages during 5 days storage at 4 °C is shown in the Fig. 2. The lowest ($P<0.05$) TBARS value was observed in 0.25% OP over the 0.01% BHT which indicates the strong antioxidant effect of OP compared with the control (% OP). Thus, it indicated that 0.25% OP is sufficient to reduce the lipid oxidation of pork sausages than compared to 0.01% BHT, which is the effective concentration of BHT normally used in meat products. This was in line with the findings of several past studies, which have been reported natural antioxidant has higher capacity than synthetic antioxidant to suppress the lipid oxidation (Formanek *et al*., 2001; McCarthy *et al*., 2001). It has been reported similar antioxidant activities of rosemary in sausages stored at 4 °C. The present study also reveals the possibility of replacing synthetic antioxidant with natural antioxidant like onion which has strong antioxidant activity.

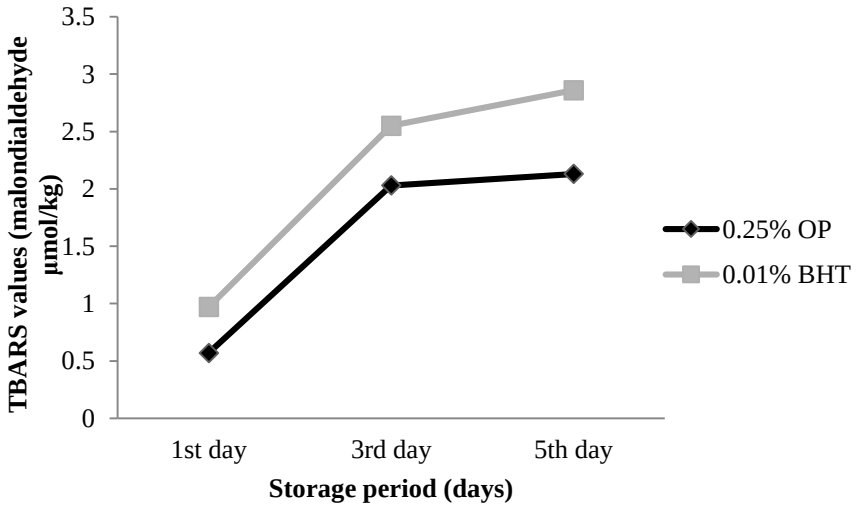

Fig. 2: Effect of 0.25% commercial onion powder (OP) and 0.01% butylated hydroxytoluene (BHT) on TBARS values (malonaldialdehyde mg/kg DM) in pork sausages stored at 4 C^0.

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The results of sensory evaluation are shown in Fig. 3. Taste, texture and overall acceptance of 0.25% OP incorporated sausage sample are significantly (P<0.05) the highest when it is compared with 0.01% BHT and control. There was no significant difference in color among three types of sausages. Hence, addition of 0.25% OP did not have any negative effect on sensory attributes of onion incorporated pork sausages rather than having positive effects on taste, texture and overall acceptance. Furthermore instrumental colour value also did not show significant different in pork sausages.

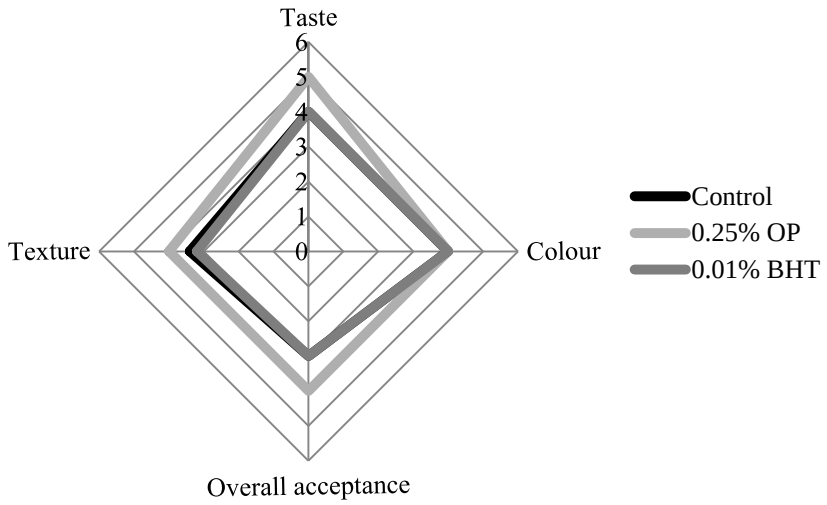

Fig. 3: Spider web analysis for sensory characteristics of 0.25% onion powder (OP), 0.01% butylated hydroxytoluene (BHT) and control in uncured pork sausages.

As shown in the Table 2, colour (CIE lab L*, a* and b*) values of 0.25% OP, 0.01% BHT and control samples did not significantly change throughout the storage for 5 days at 4 °C.

Table 2: Instrumental colour evaluation (CIE lab L*, a*and b*) values of pork sausages treated with 0.25% OP, 0.01% BHT and control

Treatment	1st day			3rd day			5th day		
	L*	a*	b*	L*	a*	b*	L*	a*	b*
0.25% OP	33.25	8.7	15	30.8	8.45	12.85*	31.1	7.55	12.8
0.01% BHT	33.9	7.75	14.65	32.7	8.15	12.70*	33.5	7.95	13.3
Control	31.25	7.6	15.4	31.1	7.8	13.55	31.65	7.05	13.15

Data are expressed as means. Data are expressed as L, lightness; a*, redness; b*, yellowness; in 0.25% onion powder (OP), 0.01% BHT incorporated and respective control pork sausages during 5 day, at 4 °C; * P < 0.05*

But as an exception, there was a high (P<0.05) b* value (yellowness) in 0.25% OP added sausages compared to other sausages in 3rd day of storage at 4 °C. Even though the onion juice had a slightly yellow colour, it has not affected on the colour of cooked product. This was in line with the findings made by Tang

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& Cronin (2007), which has been reported that there were no significant difference of the measured instrumental color parameters between control and onion juice-supplemented turkey rolls in contrast to the present study, which showed the higher ($P<0.05$) b* (yellowness) value in onion powder incorporated sausages at 3rd day storage.

Conclusion

This study concluded that onion powder provides antioxidant benefits to cooked pork sausage during storage at 4 C^0. Pork cooked sausage with onion powder has lower TBARS values and higher taste, texture and overall acceptance than other treatments. Also, 0.25% onion powder produced an antioxidant effect. Therefore, it is suggested that onion powder, as a natural antioxidant, could be used to extend the shelf life of cooked pork sausages, providing the consumer with food containing natural additives. This study demonstrate that desirable pork can be produced if 0.25% of meat is improved with onion powder.

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