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Studies on the Comparative Effect of Rosemary, Green Tea Extracts and Butylated Hydroxy Anisole on the Keeping Quality of Chicken Meat Sausages during Refregeration Storage

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A B S T R A C T

The present study was intended to evaluate the shelf life of chicken meat sausages incorporated with natural antioxidant extracts i.e., rosemary extract (RE) (*Rosmarinus officinalis*) and green tea extract (GTE) (C*amellia sinensis*) each at 0.2 % level and synthetic antioxidant (BHA at 0.01% level) under refrigeration (4±1°c) for a period of 8 days. Significantly (P<0.01) lower values for cooking loss, pH and 2-TBARS content due to the incorporation of GTE at 0.2 % level followed by 0.2 % RE and BHA during refrigeration storage. Also there was a significant (P<0.01) increase in cooking loss, pH, TBARS values and free fatty acid content as the refrigeration storage period progressed from 0 to 8 days. However, emulsion stability and WHC of chicken meat sausages decreased significantly (P<0.01) during the course of refrigeration storage. Organoleptic evaluation indicated that addition of GTE at 0.2% level registered significantly (P<0.01) higher sensory scores for various eating quality attributes than the other treatments. Addition of GTE at 0.2 % would not only protect the product longer against oxidative rancidity but also had higher acceptability than 0.2 % RE and synthetic BHA.

Introduction

Consumer concern for the composition of foodstuff has increased rapidly in recent years, the highest and longest sensory quality of food products is also being demanded. Antioxidants are the substances which can delay or inhibit the oxidation propagation of oxidizing chain reactions in the oxidation process and have many health benefits. Now a day's consumers are well aware about food preservation. Due to concern about toxicological safety of synthetic antioxidants naturally derived antioxidants are perceived as better and safer than synthetics. Recently, natural antioxidants have been gaining increasing popularity. The use of natural antioxidants has the advantage of being more acceptable by the consumers as these are considered as non-chemical. In addition they don't require safety tests before being used. More over natural antioxidants are reported to be more powerful than the synthetics and contain primarily phenolic compounds, which are potent antioxidants. Green tea and Rosemary extracts promote health by preventing lipid oxidation, provide scavenging peroxyl radical and superoxide

anion, protecting the color and flavour of product, antibacterial, anti-carcinogenic and antiviral ability. Hence the present research has been designed to study the shelf life of value added chicken meat sausages with natural and synthetic antioxidants.

Materials and Methods

During this study six batches of chicken meat sausages were prepared with natural and synthetic antioxidants i.e. rosemary extract (RE) at 0.2 % (T_1), green tea extract (GTE) at 0.2 % (T_2) and Butylated Hydroxy Anisole (BHA) at 0.01% (T_3) separately. These sausages were packed in low density polyethylene (LDPE) bags and stored at refrigeration temperature (4±1°C) up to 8 days. The refrigerated samples were drawn at an interval of two days (0, 2, 4, 6 and 8 days) and were analyzed for physico-chemical characteristics and organoleptic quality along with control. Cooking loss was estimated by recording difference between the pre and post cooking weight of meat sausages and is expressed in percentage. Emulsion stability, Water holding capacity, Hardness, $P^{H,}$ TBARS value, Free fatty acids of the product were determined as per the procedures of Townsend *et al*., (1968), Weirbicki *et al.*, (1962), Dixon and Parekh (1979), Jay (1964), *Witte et al.,* (1970), Pearson (1973) respectively. The chicken meat sausages thus prepared as per the standardized formulations were oven cooked separately and subjected to sensory evaluation on a 9 point hedonic scale by a semi-trained five member taste panel. The data thus obtained was subjected to statistical analysis using SPSS MAC, version 20.0, SPSS Chicago (US).

Results and Discussion

Physico-Chemical Characteristics

Cooking loss

The overall mean % cooking loss was significantly (P<0.01) low for 0.2 % GTE added sausages than the other treatments. This might be due to protective role of GTE against protein denaturation thus maintaining the protein integrity which retains more water in cooked meat matrix (Trout 1988) and increased significantly (P<0.01) as the storage period increases irrespective of the treatments. This might be due to lowering of water binding capacity and loss of moisture during storage. Similar findings were observed by Lara *et al*., (2011) in pork patties, Obula Reddy (2014) in chicken meat patties and Indumathi and Obula Reddy (2015) in chicken meat nuggets.

Emulsion stability

Among the treatments chicken meat sausages incorporated with 0.2 % RE had higher emulsion stability and 0.2 % GTE recorded the least but no significant difference was observed among the treatments during refrigerated storage and decreased significantly (P<0.01) as the storage period increases irrespective of the treatments. This might be due to the denaturation of myofibrillar proteins associated with increased storage period and increase in cooking loss. The results were in accordance with Chandralekha (2010).

Water-Holding Capacity

With regard to water-holding capacity no significant difference was observed among treatments and control and decreased significantly (P<0.01) with increased storage period irrespective of the treatments. This might be due to decreased ability of tissues to save its water due to protein denaturation which lower the hydration capacity of proteins (Hamm 1960). The results were in accordance with Mirshekar *et al.,* (2009) in broiler meat and Ahmed *et al.,* (2015) in goat meat.

Hardness: With regard to hardness, no significant (P=0.975) difference was observed

among treatments and control and significantly increased (P<0.01) as storage period progresses. This might be due to loss of moisture during storage and due to higher intensity of protein oxidation reactions leading to formation of cross linking and polymerization in lipids and proteins (Lund *et al.,* 2007). The results were in agreement with Fernandez-Lopez *et al.,* (2004) in refrigerated ostrich liver and Rababah *et al.,* (2006) in refrigerated chicken breast meat.

pH

The overall mean pH values of chicken meat sausages incorporated with GTE at 0.2% had significantly (P<0.01) lower values than control and other treatments and increased significantly (P<0.01) during refrigerated storage which might be due to the accumulation of metabolites by bacterial action (Jay, 1996) in meat in addition to protein and amino acid degradation resulting in formation of ammonia and consequent increase in pH. The results were similar with Lara *et al.,* (2011), Jamwal *et al*., (2015) in chicken meat patties and Nath *et al*., (2016) in chevon patties.

TBARS

In the present study, the overall mean TBA values of chicken meat sausages with GTE at 0.2% was significantly (P<0.01) lower than the control and other treatments during refrigeration storage. This might be due to large amount of poly-phenolic compounds like catechins, epicatechin, epigallocatechin, epicatechin gallate, epigallocatechin gallate, gallocatechin gallate, catechin gallate and gallocatechin (Zandi and Gondon 1999). And observed a significant (P<0.01) increase in the overall mean TBA values of all treatments during refrigerated storage. This might be due to auto-oxidation of lipids over a period of low temperature storage and pro-oxidant nature of added salt. The results were in accordance with Jamwal *et al*., (2015), Jongberg *et al*., (2015) in meat emulsion and Nath *et al*., (2016).

Free fatty acids

The overall mean free fatty acid values (per cent oleic acid) of chicken meat sausages increased gradually with increased storage periods and there was no significant difference among the treatments. This increase might be due to progressive oxidation of lipids during storage. The results were in agreement with Kashyap *et al*., (2012) in chicken meat patties and Indumathi and Obula Reddy (2015).

Sensory Evaluation

Chicken meat nuggets with 0.2% GTE secured significantly (P<0.01) higher colour, flavor, juiciness, tenderness and overall acceptability scores than others. All sensory parameters showed significantly (P<0.01) decreased trend during storage period. Reduced colour might be due to free radicals formed in lipid oxidation process can oxidize haem pigments to methmyoglobin which causes the discoloration of product during storage, oxidative fading and moisture loss. Reduction in flavour score might be due to the overall reduction in the quantum of volatile flavour components and due to fat oxidation during storage. Evaporative losses leading to decline in juiciness, the reduction in mean tenderness scores during refrigerated storage might be due to the relative reduction in moisture and juiciness of the product that led to hardening of the product. Similar reports were noticed by Chandralekha (2010), Indumathi and Obul Reddy (2015), Jamwal *et al*., (2015) and Nath *et al*., (2016).

Table.1 Mean ± S.E values of per cent cooking loss, Emulsion stability, Whater holding capacity and Hardness of chicken meat sausages as influenced by different treatments during refrigerated storage (4±1°C)

Days of storage	Control	Treatments			Overall mean ± S.E.
		T1	T2	T3	
Cooking loss					
0	6.00±0.13	5.83±0.10	4.93±0.15	6.07±0.15	5.71±0.11^{a}
2	9.50±0.31	9.42±0.29	8.25±0.17	9.77±0.12	9.23±0.16^{b}
4	12.95±0.14	12.68±0.27	11.65±0.15	13.04±0.32	12.58±0.16^{c}
6	14.64±0.22	13.83±0.11	12.62±0.16	13.93±0.09	13.76±0.17^{d}
8	19.20±0.17	18.02±0.18	15.74±0.30	18.29±0.19	17.81±0.28^{e}
Overall mean ± S.E.	12.46±0.84^{C}	11.96±0.77^{B}	10.64±0.70^{A}	12.22±0.77^{BC}	
Days of storage	**Control**	**Treatments**			**Overall mean ± S.E.**
		T1	**T2**	**T3**	
Emulsion stability					
0	96.38±0.12	96.50±0.10	96.27±0.32	96.13±0.12	96.32±0.09^{e}
2	94.28±0.12	94.51±0.10	94.36±0.14	94.60±0.27	94.44±0.08^{d}
4	92.22±0.10	92.48±0.17	92.33±0.17	92.48±0.09	92.38±0.07^{c}
6	91.27±0.11	91.64±0.12	91.49±0.16	91.56±0.13	91.49±0.07^{b}
8	88.03±0.31	88.89±0.24	88.09±0.25	88.75±0.22	88.44±0.14^{a}
Overall mean ± S.E.	92.44±0.53^{A}	92.80±0.48^{B}	92.51±0.52^{AB}	92.70±0.48^{B}	
Days of storage	**Control**	**Treatments**			**Overall mean ± S.E.**
		T1	**T2**	**T3**	
Water holding capacity					
0	67.36±0.22	67.88±0.23	67.93±0.25	67.47±0.17	67.66±0.12^{e}
2	62.83±0.07	62.63±0.48	62.92±0.31	62.81±0.47	62.80±0.18^{d}
4	60.95±0.48	60.87±0.47	60.73±0.66	60.82±0.32	60.84±0.23^{c}
6	58.73±0.14	58.73±0.20	58.44±0.59	58.80±0.33	58.67±0.17^{b}
8	56.20±0.27	56.87±0.20	56.96±0.23	56.94±0.35	56.74±0.14^{a}
Overall mean ± S.E.	61.21±0.71^{A}	61.40±0.72^{A}	61.39±0.74^{A}	61.37±0.69^{A}	
Days of storage	**Control**	**Treatments**			**Overall mean ± S.E.**
		T1	**T2**	**T3**	
Hardness					
0	91.83±1.11	91.00±2.31	91.67±2.12	91.17±0.40	91.42±0.78^{e}
2	86.17±0.48	86.00±1.39	86.67±1.31	86.17±0.60	86.25±0.48^{d}
4	80.33±1.20	80.67±1.23	80.50±1.63	80.50±0.89	80.50±0.59^{c}
6	73.50±0.56	73.00±0.45	73.00±0.37	73.17±0.91	73.17±0.29^{b}
8	67.67±1.12	67.67±0.76	67.33±0.49	67.17±0.60	67.46±0.37^{a}
Overall mean ± S.E.	79.90±1.65^{A}	79.67±1.67^{A}	79.83±1.73^{A}	79.63±1.53^{A}	

Table.2 Mean ± S.E values of pH, 2-TBARS values and free fatty acid values of chicken meat sausages as influenced by different treatments during refrigerated storage (4±1°C)

Days of storage	Control	Treatments			Overall mean ± S.E.
		T1	T2	T3	
pH					
0	5.96±0.004	5.94±0.003	5.91±0.005	5.96±0.002	5.94±0.005^{a}
2	6.14±0.002	6.00±0.020	5.93±0.003	6.10±0.020	6.04±0.02^{b}
4	6.20±0.004	6.13±0.005	6.10±0.001	6.19±0.002	6.16±0.01^{c}
6	6.26±0.01	6.19±0.02	6.15±0.01	6.23±0.01	6.21±0.01^{d}
8	6.33±0.003	6.26±0.001	6.21±0.003	6.31±0.004	6.28±0.01^{e}
Overall mean ± S.E.	6.18±0.02^{C}	6.10±0.02^{B}	6.06±0.02^{A}	6.16±0.02^{D}	
Days of storage	**Control**	**Treatments**			**Overall mean ± S.E.**
		T1	**T2**	**T3**	
2-TBARS values					
0	0.17±0.003	0.12±0.006	0.10±0.001	0.14±0.004	0.13±0.01^{a}
2	0.44±0.010	0.19±0.002	0.15±0.001	0.26±0.012	0.26±0.02^{a}
4	0.98±0.010	0.35±0.010	0.25±0.010	0.50±0.020	0.52±0.06^{b}
6	1.40±0.040	0.58±0.010	0.44±0.010	0.74±0.020	0.79±0.08^{c}
8	3.14±0.040	0.94±0.010	0.76±0.010	1.54±0.010	1.60±0.20^{d}
Overall mean ± S.E.	1.23±0.2^{D}	0.44±0.05^{B}	0.34±0.04^{A}	0.64±0.09^{C}	
Days of storage	**Control**	**Treatments**			**Overall mean ± S.E.**
		T1	**T2**	**T3**	
Free fatty acid values					
0	0.013±0.0004	0.011±0.0006	0.009±0.0002	0.012±0.0006	0.011±0.0004^{a}
2	0.015±0.0001	0.012±0.0001	0.010±0.0001	0.013±0.0002	0.012±0.0004^{a}
4	0.017±0.0002	0.013±0.0002	0.012±0.0001	0.015±0.0004	0.014±0.0004^{a}
6	0.020±0.0005	0.014±0.0002	0.013±0.0002	0.017±0.0005	0.016±0.0006^{a}
8	0.084±0.0475	0.025±0.0004	0.020±0.0003	0.028±0.0004	0.040±0.0123^{b}
Overall mean ± S.E.	0.030±0.0102^{B}	0.015±0.0009^{A}	0.013±0.0007^{A}	0.017±0.0011^{A}	

Table.3 Mean ± S.E values of organoleptic characteristics of chicken meat sausages as influenced by different treatments during refrigerated storage (4±1°C)

Days of storage	Control	Treatments			Overall mean ± S.E.
		T1	T2	T3	
Colour					
0	8.52±0.01	8.42±0.02	8.54±0.03	8.43±0.01	8.48±0.01^{e}
2	8.39±0.01	8.44±0.01	8.49±0.01	8.40±0.06	8.43±0.02^{d}
4	8.11±0.03	8.21±0.02	8.27±0.02	8.14±0.02	8.18±0.02^{c}
6	7.78±0.03	7.93±0.02	8.00±0.04	7.86±0.05	7.89±0.02^{b}
8	7.64±0.01	7.75±0.02	7.78±0.03	7.71±0.02	7.72±0.01^{a}
Overall mean ± S.E.	8.09±0.06^{A}	8.15±0.05^{B}	8.22±0.06^{C}	8.11±0.06^{A}	
Days of storage	**Control**	**Treatments**			**Overall mean ± S.E.**
		T1	**T2**	**T3**	
Flavour					
0	7.98±0.35	8.05±0.02	8.26±0.03	8.18±0.06	8.12±0.08^{e}
2	7.79±0.36	7.90±0.12	8.24±0.03	8.12±0.03	8.01±0.09^{d}
4	7.68±0.16	7.90±0.03	8.16±0.15	7.85±0.01	7.90±0.06^{c}
6	7.22±0.21	7.67±0.01	8.07±0.20	7.59±0.01	7.64±0.09^{b}
8	7.00±0.18	7.30±0.06	7.93±0.21	7.23±0.01	7.36±0.04^{a}
Overall mean ± S.E.	7.53±0.13^{A}	7.76±0.06^{B}	8.13±0.07^{C}	7.79±0.07^{B}	
Days of storage	**Control**	**Treatments**			**Overall mean ± S.E.**
		T1	**T2**	**T3**	
Juiciness					
0	8.54±0.01	8.54±0.01	8.60±0.03	8.54±0.01	8.56±0.01^{e}
2	8.37±0.01	8.38±0.01	8.41±0.06	8.34±0.01	8.38±0.01^{d}
4	8.25±0.01	8.26±0.01	8.28±0.01	8.24±0.01	8.26±0.01^{c}
6	7.83±0.02	7.83±0.02	7.85±0.01	7.77±0.01	7.82±0.01^{b}
8	7.58±0.02	7.69±0.03	7.76±0.03	7.46±0.03	7.62±0.03^{a}
Overall mean ± S.E.	8.11±0.07^{B}	8.14±0.06^{B}	8.18±0.06^{C}	8.07±0.07^{A}	
Days of storage	**Control**	**Treatments**			**Overall mean ± S.E.**
		T1	**T2**	**T3**	
Tenderness					
0	8.21±0.21	8.47±0.03	8.62±0.18	8.40±0.04	8.43±0.07^{e}
2	7.91±0.23	8.33±0.02	8.52±0.23	8.22±0.04	8.24±0.08^{d}
4	7.60±0.22	7.85±0.02	8.26±0.21	7.83±0.02	7.89±0.42^{c}
6	7.27±0.21	7.71±0.03	8.03±0.25	7.67±0.02	7.67±0.09^{b}
8	6.97±0.21	7.50±0.03	7.82±0.25	7.47±0.02	7.44±0.05^{a}
Overall mean ± S.E.	7.59±0.12^{A}	7.97±0.07^{B}	8.25±0.11^{C}	7.92±0.07^{B}	
Days of storage	**Control**	**Treatments**			**Overall mean ± S.E.**
		T1	**T2**	**T3**	
Overall acceptability					
0	8.19±0.22	8.45±0.02	8.54±0.02	8.37±0.06	8.39±0.05^{e}
2	7.87±0.34	8.29±0.05	8.40±0.05	8.23±0.02	8.20±0.09^{d}
4	7.68±0.20	8.06±0.07	8.13±0.07	8.00±0.06	7.97±0.06^{c}
6	7.44±0.21	7.78±0.04	7.85±0.04	7.73±0.03	7.69±0.06^{b}
8	7.17±0.20	7.36±0.05	7.60±0.07	7.31±0.04	7.36±0.04^{a}
Overall mean ± S.E.	7.66±0.11^{A}	7.98±0.07^{B}	8.10±0.06^{C}	7.92±0.07^{B}	

In conclusion, from results we concluded that 0.2% GTE recorded significantly (P<0.01) lower values for cooking loss, pH, 2-TBARS followed by 0.2 % rosemary extract. Organoleptic evaluation indicated that addition of GTE at 0.2% to chicken meat sausages registered significantly (P<0.01) higher sensory scores for various eating quality attributes than the other treatments. Hence addition of GTE at 0.2 % would not only extend the shelf life by protecting the product longer against oxidative rancidity but also had higher acceptability than 0.2 % RE and synthetic BHA.

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