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Enhancement of Shelf Life of Spent Hen Meat Sausages with incorporation of Ginger Extract

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A B S T R A C T

Spent hens being the byproducts of poultry layer industry are available in abundance. The problem with utilisation of spent hen meat is their perishability while transporting from one place to another place. So the present investigation was undertaken to assess the shelf life of spent hen meat with addition of natural substances like ginger extract so that such byproducts are utilized as protein source and burden on red meat is minimized. The parameters determined were physico-chemical, proximate analysis and sensory evaluation.

Introduction

Poultry meat consumption has increased in the country with annual per capita consumption of poultry meat being 1.8kg (FAO, 2013). With increasing number of meat eating consumers, the cost of meat and meat products is also increasing. Hence there is a dire need to harvest every source of meat to its fullest especially those which can reduce the cost, maintain the quality and meet the increasing consumer demand of meat. Spent hen is one of such cheaper meat source. India produces 65.45 billion eggs annually (FAO, 2012) hence large no of spent hen layers are available which makes around 8.0% of total poultry meat in India. The development of comminuted meat products offers an important avenue for the profitable disposal of spent hens. However, meat of spent hen may promote faster oxidation than broiler meat during processing and storage due to higher content of unsaturated fatty acids. Utilization of natural spices and herbs in various forms like powder, extract or essential oils has been well documented for antioxidant properties for inhibiting the growth of many spoilage bacteria and fungi in foods. Due to the adverse side effects of synthetic antioxidant on man, such as mutagenesis and

carcinogenesis, their use has been limited, while the application of natural antioxidants has been on the rise. Ginger (*Zingiber officinale*) is one of these traditional folk medicinal plants that have been used over the years. Ginger has active substances that have anti-bacterial, anti-flatulent, antimicrobial, anti-inflammatory, anti-diabetic, anti-spasm, anti-cancer and antioxidative properties (Tepe *et al.,* 2006). Thus the present study was designed towards exploring the effects of incorporation of ginger extract in the spent hen meat sausages with the possible extension of shelf life.

Materials and Methods

Spent hen meat sausages were prepared as per Reshi *et al.,* (2016) treated with 7.5% lotus stem. Clean and fresh ginger rhizome was procured from local vegetable market of Srinagar city. Fresh and clean green condiments were procured from local market. Green condiments used in the preparation of sausages consisted of onion and garlic paste in the ratio of 3:2 by weight. Table salt (Tata chemicals Ltd., Mumbai, India) of better quality used in the development of sausages. Low-density polyethylene (LDPE) bags procured from registered dealers were used in the refrigeration storage studies of spent hen meat sausages. The refined mustard vegetable oil was used. The spices used were dried at 60^{o}C for 3 hours to remove some moisture and were ground into powder in a grinder. The spices mixed were Aniseed, Black pepper, Cardamom, Cinnamon Cloves, Coriander seeds, Cumin seeds, Red chilies and Turmeric in g per100 g respectively as 10, 15, 5, 5, 5, 20, 10 and 10 to form the spice mixture. Ginger extract preparation was carried out according to the method established by Indu *et al.,* (2006) with slight modifications. Fresh Ginger rhizome was cut in to small pieces after removing the skin of ginger. Ginger pieces were homogenized in the juicer. The extract obtained was sieved through doubled muslin cloth. The shelf life of sausages during refrigeration storage (4±1^{o} C) for the period of 15 days was checked. The ginger extract was added at the level of 5% (T1) and 10% (T2) replacing equal amount of chilled water and the control (T0) without addition of ginger extract. The physico-chemical parameters (pH, moisture, ash, TBARS), Microbiological (TPC, Yeast and Mould and Coliform count) and sensory analysis was done on every 5th day. While as protein, ether extract and crude fibre were estimated on 0th day and 15th day of storage only. Same experiment was repeated three times with every parameter calculated in duplicates. Means and standard errors were calculated for different parameters. Data obtained in the study were analysed statistically on 'SPSS-20.0' software package for statistical analysis as per standard methods (Snedecor and Cochran, 1994). Duplicate samples were drawn for each parameter and the experiment was replicated thrice (n = 6).

Results and Discussion

The physico-chemical properties of ginger extract treated spent hen meat sausages are depicted in table 1.

The overall mean pH values during the storage of ginger extract treated sausages were higher than control. Mean pH of T2 was significantly ($p<0.05$) higher than control however, the overall mean pH of T1 showed non-significant ($p>0.05$) difference from T0 and T3. Higher pH in treated sausages might be due to higher pH of ginger. The overall mean TBA values of the ginger extract treated sausages were significantly ($p<0.05$) lower than control. This can indicate that the ginger extract used as antioxidants was effective in reducing TBARS formation. El-Diwani *et al.,* (2009) reported that the ginger extracts contain bioactive substances such as phenolic

gingerol related compounds that can inhibit chain reactions during lipid oxidation.

The proximate composition determined in ginger extract treated refrigerated meat is shown table 2.

The mean moisture content of the ginger extract treated spent hen meat sausages did not differ significantly ($p<0.05$) from control. However, with advancement of storage period mean moisture content of control and treated sausages decreased significant ($p<0.05$). Decrease in the moisture with advancement in storage period might be due to moisture loss from sausages during storage. The mean protein content of control was higher than ginger extract treated sausages but the differences were non-significant ($p>0.05$).

Also within ginger extract treated sausages there was non-significant ($p>0.05$) difference in their mean protein contents. However as the storage period progresses the mean crude protein of control and treated sausages on 15^{th} day was significantly higher than the crude protein content of 0^{th} day of storage. During storage period increase in protein content could be attributed to the moisture loss which leads to the concentration of protein content**.** Statically non-significant ($p>0.05$) difference was observed in the mean ether extract content of control and ginger extract treated sausages.

However, with the advancement of storage period significant ($p<0.05$) increase in the mean ether extract content was observed between 0^{th} and 15^{th} day of storage. Non-significant ($p>0.05$) difference was observed in the mean crude fiber content of treatments and control sausages. However with the advancement of storage period significant ($p<0.05$) increase in the mean crude fiber content of control and treated sausages was observed. Increased crude fiber might be due to vapour lose during storage which lead to increase in relative crude fiber content. The mean ash content of the ginger extract treated spent hen meat sausages was non-significantly ($p>0.05$) higher than control. Also the ash content T2 is non-significantly ($p>0.05$) different from T1.

The mean total plate count of ginger extract treated sausages were significantly ($p<0.05$) lower than control. Between the treated sausages total plate count of T2 was significantly ($p<0.05$) lower than T1. Lower count in treated sausages than control might be attributes to the antimicrobial property of ginger extract as reported by many workers (Hindi *et al.,* 2001; Sunilson *et al.,* 2009. Gordon (1996) suggested that the isothiocynates present in ginger can inactivate the extracellular enzymes through the oxidative cleavage of disulphide bonds necessary for survival of various bacteria.

The mean coliform count of ginger extract treated sausages were significantly ($p<0.05$) lower than control. Between the treated sausages coliform count of T2 was significantly ($p<0.05$) lower than T1. Lower coliform count in the ginger extract treated sausages might be due to antibacterial property of ginger extract as reported by Chen *et al.,* (1985), James *et al.,* (1999). With the progress in the storage period there was a significant ($p<0.05$) increase in the mean coliform count of control and treated sausages.

The yeast and Mould counts (YMC) of ginger extract treated sausages were significantly ($p<0.05$) lower than control however, the yeast and mould count of T1 and T2 did not differ significantly ($p<0.05$). Lower yeast and mould count of ginger treated sausages might be due to the antifungal properties of ginger.. Similar results were reported by (Libata, 2010) (Table 3).

Table.1 Effect of incorporation of different concentrations of ginger extract on pH and TBA values of spent hen meat sausages during refrigeration

Treatments	Storage period (days)				
	0	5	10	15	Mean ± S.E
pH					
Control	6.30^{aA}±0.01	6.35^{b}±0.01	6.36^{b}±0.01	6.41^{c}±0.01	6.36^{A}±0.01
T1	6.34^{aB}±0.01	6.37^{ab}±0.01	6.37^{ab}±0.01	6.40^{b}±0.01	6.37^{AB}±0.01
T2	6.36^{B}±0.01	6.38±0.01	6.38±0.01	6.39±0.01	6.38^{B}±0.01
Mean± S.E	6.33^{a}±0.01	6.36^{b}±0.01	6.37^{b}±0.01	6.40^{c}±0.01	
TBA					
T0 (control)	0.24^{a}±0.01	0.58^{bA}±0.01	0.85^{cA}±0.01	1.06^{dA}±0.03	0.68^{A}±0.06
T1	0.23^{a}±0.01	0.39^{bB}±0.00	0.51^{cB}±0.01	0.60^{dB}±0.02	0.43^{B}±0.03
T2	0.22^{a}±0.01	0.34^{bC}±0.00	0.43^{cC}±0.01	0.52^{dC}±0.01	0.38^{C}±0.02
Mean± S.E	0.23^{a}±0.01	0.44^{b}±0.02	0.60^{c}±0.04	0.72^{d}±0.06	

Mean ± SE values bearing different superscripts row-wise (small letters) and same superscripts column-wise (capital letters) differ significantly (P<0.05) n=6

Table.2 Effect of different concentrations of ginger extract on the proximate composition of spent hen meat sausages during refrigeration storage (4±1ºC)

Treatments	Storage period days				
	0	5	10	15	Mean±S.E
Moisture					
T0	60.74^{a}±0.21	60.15^{ab}±0.32	59.27^{bc}±0.31	58.39^{c}±0.28	59.64±0.23
T1	60.84^{a}±0.30	60.63^{a}±0.31	59.44^{b}±0.29	58.52^{c}±0.28	59.86±0.24
T2	60.87^{a}±0.37	60.68^{ab}±0.36	59.78^{bc}±0.33	58.99^{c}±0.18	60.08±0.22
Mean ± S.E	60.82^{a}±0.16	60.49^{a}±0.19	59.50^{b}±0.18	58.63^{c}±0.15	
Ash					
T0	3.12^{a}±0.01	3.12^{a}±.01	3.16^{b}±0.01	3.21^{c}±0.01	3.15±0.01
T1	3.13^{a}±0.01	3.14^{a}±.01	3.17^{a}±0.01	3.21^{b}±0.02	3.16±0.01
T2	3.14^{a}±0.01	3.15^{ab}±.01	3.18^{bc}±0.01	3.22^{c}±0.02	3.17±0.01
Mean ± S.E	3.13^{a}±0.01	3.14^{a}±.01	3.17^{b}±0.01	3.21^{c}±0.01	
Crude protein					
T0	14.53^{a}±0.06	N.D	N.D	14.84^{b}±0.03	14.69±0.06
T1	14.51^{a}±0.06	N.D	N.D	14.74^{b}±0.04	14.63±0.05
T2	14.47^{a}±0.06	N.D	N.D	14.72^{b}±0.05	14.60±0.05
Mean ± S.E	14.50^{a}±0.03	N.D	N.D	14.77^{b}±0.03	
Ether extract					
T0	19.27^{a}±0.03	N.D	N.D	19.71^{b}±0.01	19.48±0.07
T1	19.21^{a}±0.03	N.D	N.D	19.72^{b}±0.02	19.46±0.08
T2	19.19^{a}±0.02	N.D	N.D	19.69^{b}±0.02	19.44±0.08
Mean ± S.E	19.21^{a}±0.01	N.D	N.D	19.71^{b}±0.01	
Crude fiber					
T0	2.38^{a}±0.00	N.D	N.D	2.57^{b}±0.00	2.48±0.01
T1	2.38^{a}±0.01	N.D	N.D	2.59^{b}±0.01	2.49±0.03
T2	2.39^{a}±0.00	N.D	N.D	2.59^{b}±0.01	2.49±0.03
Mean±S.E	2.38^{a} ±0.00	N.D	N.D	2.59^{b}±0.00	

Mean ± SE values bearing different superscripts row-wise (small letters) and same superscripts column-wise (capital letters) differ significantly (P<0.05)

N.D not determined.

Table.3 Effect of different concentrations of ginger extract on the microbiological properties of spent hen meat sausages during refrigeration storage (4±1ºC)

Treatments	Storage period (days)				
	0	5	10	15	Mean± S.E
Total plate count					
T0	2.12^{aA}±0.03	2.97^{bA}±0.01	3.27^{cA}±0.01	3.39^{dA}±0.01	2.94^{A}±0.10
T1	2.00^{aB}±0.03	2.53^{bB}±0.02	2.70^{cB}±0.02	3.01^{dB}±0.04	2.56^{B}±0.08
T2	1.94^{aB}±0.03	2.45^{bC}±0.02	2.69^{cB}±0.03	2.79^{dC}±0.06	2.47^{C}±0.07
Mean± S.E	2.02^{a}±0.03	2.65^{b}±0.06	2.89^{c}±0.07	3.06^{d}±0.06	
Coliform count					
T0	1.38^{aA}±0.06	1.88^{bA}±0.03	1.90^{bA}±0.03	2.22^{c}±0.03	1.84^{A}±0.07
T1	1.28^{aAB}±0.06	1.77^{bAB}±0.04	1.83^{bAB}±0.02	2.15^{c}±0.04	1.76^{B}±0.07
T2	1.19^{aB}±0.04	1.67^{bB}±0.03	1.74^{bB}±0.02	2.11^{c}±0.03	1.68^{C}±0.07
Mean ± S.E	1.28^{a}±0.03	1.77^{b}±0.03	1.83^{b}±0.02	2.16^{c}±0.04	
Yeast and mould count					
T0	0.86^{a}±0.03	1.47^{bA}±0.10	1.54^{bA}±0.10	1.90^{cA}±0.08	1.44^{A}±0.09
T1	0.73^{a}±0.04	1.14^{bB}±0.05	1.20^{bB}±0.04	1.66^{cB}±0.05	1.18^{B}±0.07
T2	0.70^{a}±0.03	1.11^{bB}±0.05	1.16^{bB}±0.05	1.55^{cB}±0.03	1.13^{B}±0.07
Mean± S.E	0.77^{a}±0.03	1.24^{b}±0.06	1.30^{b}±0.06	1.70^{c}±0.05	

Table.4 Effect of different concentrations of ginger extract on the sensory attributes of spent hen meat sausages during refrigeration storage (4±1ºC)

Treatments	Storage period (days)				
	0	5	10	15	Mean ± S.E
	Appearance score				
T0	7.38^{a}± 0.13	7.14^{ab}±0.13	6.86^{bc}±0.14	6.57^{c}±0.11	6.99±0.068
T1	7.48^{a}±0.13	7.24^{ab}±0.12	6.95^{bc}±0.13	6.76^{c}±0.12	7.11±0.09
T2	7.48^{a}±.13	7.29^{ab}±0.12	7.05^{bc} ±0.16	6.76^{c}±0.12	7.14±0.10
Mean ± S.E	7.44^{a}±0.13	7.22^{a}±0.13	6.95^{b}±0.12	6.70^{c}±0.15	
Flavour score					
T0	7.33^{aA}±0.12	7.00^{abA}±0.12	6.76^{bc}±0.12	6.57^{c}±0.11	6.92^{A}±0.09
T1	7.38^{aA}±013	7.10^{abAB}±0.10	6.90^{bc}±.14	6.71^{c}±0.11	7.02^{A}±0.06
T2	6.95^{aB}±0.15	6.71^{abB}±0.14	6.52^{b}±0.13	6.38^{b}±0.11	6.64^{B}±0.07
Mean ± S.E	7.22^{a}±0.08	6.94^{b}±0.07	6.73^{c}±0.07	6.56^{c}±0.06	
Juiciness score					
T0	7.19^{a}±0.15	7.00^{a}±0.14	6.81^{ab}±0.11	6.48^{b}±0.13	6.87±0.07
T1	7.29^{a}±0.16	7.10^{a}±0.14	6.95^{ab}±0.13	6.62^{b}±0.11	6.99±0.07
T2	7.33^{a}±0.14	7.10^{ab}±0.15	6.86^{bc}±0.16	6.62^{c}±0.12	6.98±0.08
Mean ± S.E	7.27^{a}±0.09	7.06^{ab}±.08	6.87^{b}±0.08	6.57^{c}±0.53	
Texture score					
T0	7.29^{a}±0.17	6.95^{a}±0.13	6.71^{ab}±0.11	6.52^{c}±0.11	6.87±0.07
T1	7.43^{a}±0.14	7.14^{a}±0.11	6.90^{b}±0.15	6.71^{c}±0.11	7.05±0.07
T2	7.38^{a}±0.14	7.10^{a}±0.16	6.90^{b}±0.13	6.67^{c}±0.11	7.05±0.07
Mean ± S.E	7.37^{a}±0.09	7.06^{a}±0.08	6.84^{b}±0.07	6.63^{c}±0.06	
Overall palatability					
T0	7.24^{a}±0.14	7.10^{ab}±0.12	6.86^{bc}±0.13	6.57^{c}±0.11	6.94^{A}±0.10
T1	7.48^{a}±0.11	7.24^{ab}±0.12	7.06^{bc}±0.15	6.76^{c}±0.10	7.14^{B}±0.11
T2	7.29^{a}±0.10	7.10^{ab}±0.14	6.90^{bc}±0.15	6.67^{c}±0.11	6.99^{AB}±0.09
Mean ± S.E	7.33^{a}±0.13	7.14^{ab}±0.12	6.95^{b}±0.10	6.67^{c}±0.11	

The overall mean appearance scores of ginger extract treated sausages were higher than control, however the non- significant ($p>0.05$) difference was reported between control, and treated sausages. During storage period the overall mean appearance score of control and ginger extract treated spent hen meat sausages showed significant decrease with increase in storage days. The decrease in mean appearance score during storage could be due to surface dehydration, lose of volatile components and lipid oxidation causing non-enzymatic browning in the sausages in aerobic conditions of storage. Naveena *et al.,* (2004) also reported increase in appearance score of buffalo meat incorporated with ginger. The overall mean flavour score of T1 was non-significantly ($p>0.05$) higher than control (Table 4). While as the mean flavour score of T2 was significantly ($p<0.05$) lower than T1 and control sausages. Increase in the flavour score of sausages at the addition of lower concentrations of ginger extract treated might be due to flavour producing reaction which occurred during cooking. Similar results were reported by (Labell, 1987) in the poultry meat treated with 2% ginger powder. However, the decrease in flavour score with the addition of higher concentration of ginger extract might be due to bitterness of ginger extract which out shades its initial flavour improving effect. During storage period the overall mean flavour score of control and ginger extract treated spent hen meat sausages showed significant decrease with increase in storage period. The decrease in mean flavour score of sausages during storage could be due to microbial growth, oxidative changes and lose of volatile flavour components during aerobic conditions of storage. The overall mean juiciness score of ginger extract treated sausages was higher than control, but the differences were non- significant ($p>0.05$). Improvement in juiciness might be due to retention of more moisture content by treated sausages over control. During storage the significant overall decrease was reported in mean juiciness score of control and treated spent hen meat sausages. Improvements in juiciness score are in agreement with results of the Zia-ur-Rehman *et al.,* (2003). Decrease in juiciness with progress in storage might be due to moisture loss during aerobic storage of sausages. The overall mean texture score of ginger extract treated sausages was higher than control, but the differences were non-significant ($p>0.05$). Decrease in the texture score during storage might be due to the breakdown of fat and protein complex vedamurthy (1998). During storage period general decrease was reported in the overall mean texture score of control and ginger extract treated spent hen meat sausages. Decrease in the texture score during storage might be due to the breakdown of fat and protein complex. The mean overall acceptability score of the T1 was significantly ($p<0.05$) higher than control, but a non-significant ($p>0.05$) difference was reported with T2. Our results were in consistent with the results of Anandh (2013) in ginger extract treated buffalo tripe. However overall acceptability score of sausages with higher concentrations of ginger extract, T2 decreased and was non-significant ($p>0.05$) lower than T1 sausages. Decrease in overall acceptability score at higher concentration maybe due to drastic decrease in the flavour score at higher concentration. During storage period an overall decrease was reported in the overall mean overall acceptability scores of control and ginger extract treated spent hen meat sausages. The decrease in overall acceptability of sausages with storage might be due to the changes like lipid oxidation, protein degeneration, moisture lose and microbial growth.

The refrigeration storage (4±iºC) of 7.5% lotus stem added spent hen meat sausages with the incorporation of different levels of ginger extract improved the shelf life of sausages as evaluated in terms of physico-chemical properties (pH and TBA), microbiological (total plat count, coliform count and yeast and mould count) and sensory attributes could remain fairly acceptable upto 15 days under refrigeration storage. Thus usage of ginger extract in the development of value added comminuted meat products from spent hen meat

like sausages proves a technically viable option for enhancing the utilization of spent hen meat.

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