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Quality of spent hen sausages incorporated with fresh ginger extract

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Abstract

The experiment was conducted to find out the effect of ginger extract on the sensory, physicochemical and biochemical properties of spent hen sausages. For this purpose, sausages were prepared into four different groups. They were as follows: broiler breast meat sausage without ginger extract, spent hen breast meat sausage without ginger extract, spent hen breast meat sausage with 2% ginger extract and spent hen breast meat sausage with 4% ginger extract. All parameters were analyzed at 0, 15th and 30th days of storage time. The proximate compositions of different sausage batters are analyzed and highly significant differences were found in pH, dry matter (DM)%, crude protein (CP)% and ether extract (EE)%, while no significant differences were found in cooking loss (%) and Ash (%) of sausage batter. While analyzing the different types of sausages, DM, CP and EE content of all treatments differ significantly ($p<0.01$). In contrast, DM and CP content increased significantly ($p<0.01$) with the advancement of different days of intervals. The FFA, POV and TBARS values were increased significantly ($p<0.01$) with prolonging the storage time. Significant differences were found among the sausages for its surface color. Flavor and overall acceptability were found significantly higher in broiler breast meat sausage and spent hen breast meat sausage with 2% ginger extract. Juiciness and tenderness were higher in broiler breast meat sausage without ginger extract. Worst results in all sensory parameters were found in spent hen breast meat sausage without ginger extract and spent hen breast meat sausages incorporated with 4% ginger extract. It might be concluded that addition of ginger extract at 2% level increased the overall acceptability of spent hen breast meat sausages to that of broiler breast meat sausages.

Introduction

In commercial layer farming millions of birds should be culled each year after their productive period. These Spent hens are usually used for human consumption with lower price and used in various feed production and concentrated stock preparation (Ajuyah et al., 1992). If the volume of biological matter, labor and associated transportation costs are taken into account, the disposal of layer hens is one of the main economic and environmental problems of the poultry industry (Lyons, 2001). The development of comminuted meat products offers an important avenue for the profitable disposal of spent hens (Mehraj et al., 2017). Chicken sausage is a value added comminuted meat product and are getting popularity day by day (Bithi et al., 2020; Disha et al., 2020; Islam et al., 2019 and 2021; Sarker et al., 2021). One of the major problems in manufacturing and marketing of these meat products is their rapid spoilage quality. In order to prevent spoilage both natural and synthetic antioxidant are widely used to inhibit the oxidation of fat and prolong the shelf life. The synthetic compounds are widely used to inhibit microbial growth in meat products due to their strong antioxidant and antimicrobial activities, their low production cost and high accessibility (Falowo et al., 2014). These synthetic components contribute to the pathogenesis of cancer, atherosclerosis, heart and allergic diseases. Due to concerns about toxicological safety of these synthetic antioxidants naturally derived antioxidants are perceived as better as and safer than synthetics. Meat products containing natural antioxidants, as opposed to synthetic derivatives, are more desirable from consumer point of view (Pokorny, 1991). Moreover, natural antioxidants are reported to be more powerful antioxidants, especially, rosemary, sage, ginger and green tea extracts (Banerjee et al., 2012). Ginger (*Zinger officinale*) is a popular spice, grown everywhere in Bangladesh. It is well known to have antioxidant activity and effective antimicrobial agents. Ginger has bioactive substances that have anti-bacterial, anti-flatulent, antimicrobial, anti- inflammatory, anti-diabetic, anti-spasm, anti-cancer and antioxidative properties (Tepe et al., 2006). The suitability of incorporation of ginger extract to produce healthier meat products with extended shelf life relates to their properties such as water binding capacity, fat emulsification and sensory attributes (Shahidi et al., 1992). The present study was undertaken to find out the effect of incorporation of fresh ginger extract in different levels on the quality of spent hen meat sausages with the possible extension of shelf life.

Materials and Methods

Experimental Design

Four sausage formulations were developed (Table 1), as follows: broiler breast meat sausage without ginger extract, spent hen breast meat sausage without ginger extract, spent hen breast meat sausage with 2% ginger extract and spent hen breast meat sausage with 4% ginger extract.

Table 1. Ingredient composition of different chicken sausage battere with or without ginger extract

Ingredients (g)	Different treatments[1]			
	BS	SHS	SHS+2% GE	SHS+4% GE
Breast meat (g)	1000	1000	980	960
Ginger extract (g)	00	00	20	40
Salt (g)	15	15	15	15
Sodium tripolyphosphate (g)	3.3	3.3	3.3	3.3
Sodium erthorbate (g)	0.37	0.37	0.37	0.37
Maltodextrin(g)	14.8	14.8	14.8	14.8
Spice/seasoning (g)	3.7	3.7	3.7	3.7

[1]BS, SHS and GE refers to broiler breast meat sausage, spent hen breast meat sausage and ginger extract, respectively

Materials Collection

The spent hen was purchased from BAU Poultry Farm and broiler from Kamal Ranjit (K.R) market, Bangladesh Agricultural University, Mymensingh. The hens and broilers were slaughtered; breast meat was collected and transferred to frozen at -20 ° C in Poultry Science Laboratory. Garlic, onion, ginger, meat spices, salt, sugars, sodium tripolyphosphate, sodium erthorbate, jellying powder (corn flour) were also collected from the local market of Mymensingh. Ginger extract was collected from the fresh rhizome.

Sausage Preparation

All visible fat and connective tissue were trimmed off with the help of knife and the meat was grinded with the help of meat grinder. The grinded meat was mixed with meat spices and minced properly. The minced meat was chopped in bowl chopper along with salt (2.5%), Sodium tripolyphosphate (0.25%). The meat was divided into 4 parts. T_1 was manufactured with broiler breast meat without ginger and T_2 was manufactured with spent hen breast meat without ginger. T_3 and T_4 were then compounded with fresh ginger extract at 2% and 4% respectively. Meat from each mixture were taken and wrapped with small square pieces of plastic casing so as to give it a candy like structure. Both ends were then tied with thread in order to check the entry of water and were then placed in to boiling water for cooking. These procedures were practiced for three times to prepare sample and to analyze the first one as fresh basis.

Proximate analysis

Moisture, protein, fat and ash of sausages and batters was determined as per the standard procedures of Association of Official Analytical Chemists (AOAC, 1995).

pH

The pH of emulsion and cooked products was determined by blending 10 g of sample with 50 ml of distilled water using an Ultra Turrax T25 tissue homogenizer (Janke and Kunkel, IKA Labortechnik, Staufen, Germany) at 8,000 rpm for 1 min. The pH of the suspension was recorded by dipping combined glass electrode of Elico digital pH meter, Model LI 127 (Elico Limited, Hyderabad, India).

Cooking loss

To determine cooking loss of sausage batter, weighed 5 g sample and wrapped in a heat stable foil paper and kept in water bath at 80°C for 30 minutes. Samples surface are dried and weighed. Cooking loss was calculated as the percentage of the loss weight of the cooked sample (Symeon et al., 2010)

$$\text{Cooking loss (\%)} = \frac{\text{Uncooked weight} - \text{cooked weight}}{\text{Uncooked weight}} \times 100$$

Color analysis

The surface color (CIE L*, a*, b*) of sausages samples were measured using a Minolta Chromameter (Minolta CR 410, Tokyo, Japan) standardized with a white plate (Y = 93.5, X = 0.3132, y = 0.3198). Five random reading were taken from each type of sausages. The measurements were averaged for each surface and the results were expressed as positive L*(lightness), a*(redness), b*(yellowness).

TBARS assay, peroxide value (POV) and free fatty acids (FFA)

The amount of malondealdehyde (MDA) was established using a procedure described by Buege and Aust (1978).
TBARS = Abs 530 nm × 7.8 (conversion factor) mg malonaldehyde/kg sausage
FFA value was determined according to Rukunudin et al. (1998). FFA was calculated as shown below: FFA (%) = (ml titration × Normality of KOH × 28.2) / g of sample

Peroxide value (POV) was determined according to (Sallam et al., 2004). POV was calculated as shown below:

$$\text{POV}\left({}^{\text{meq}}/_{\text{kg}}\right) = \frac{\text{S} \times \text{N}}{\text{W}} \times 1000$$

Where, S= volume of titration (g/mg of weight); N= normality of sodium thiosulphate and W= weight of the sample.

Sensory evaluation

Different sensory attributes were examined at day 1. Each sausage sample was evaluated by a trained panel of 6-honorable judges at Bangladesh Agricultural University. Recruitment, selection and training of panelist were performed according to sensory evaluation procedure (AMSA, 1995). The sensory questionnaires measured intensity on a 5-point balanced semantic scale (weak to strong) for the following attributes color, smell, tenderness, juiciness and overall acceptability. Sensory evaluation was carried out in individual booths under controlled conditions of light, temperature and humidity. Sensory qualities of the samples were evaluated after thawing of before cook and after cook using a 5-point scoring method. Sensory evaluation was accomplished at 0, 15th and 30th days.

Statistical analysis

The sausage batter data and the sensory evaluation of different sausages analyzed using analysis of variance technique with the principles of Completely Randomized Design, while sausage data during different storage period were analyzed by 4×3 factorial design (where, 4=different sausages and 3=different storage period) (SAS, 2009). DMRT was done to compare variations among means where ANOVA showed significant differences.

Results and Discussion

Proximate, pH and cooking loss of Sausage batter

From Table 2 it was found that dry matter (%), crude protein (%) and ether extract (%) values were significantly higher in spent hen breast meat sausage batters. Significantly lower dry matter content was found in broiler breast meat sausage batter, lower crude protein was found in spent hen sausage batter with 4% ginger extract, and lower ether extract was found in spent hen sausage batter with 2% ginger extract. Cooking loss (%) of sausage batters did not found significant differences ($p>0.05$) while significantly higher pH value was found in broiler breast meat sausage batter. Habiba et al.(2021) analyzed the proximate compositions, cooking loss (%) and pH of different beef sausage batters incorporated with different flours and found highly significant differences in dry matter and crude protein (%) content and significant differences in cooking loss (%), pH (%) and EE (%) content.

Table 2. Proximate composition, cooking loss and pH of different chicken sausage batter with or without ginger extract

Parameters	Different treatments[1]				Level of Significance
	BBS	SHBS	SHBS+2%GE	SHBS+4%GE	
Cooking Loss (%)	7.69±1.22	4.45±0.20	3.87±1.19	3.52±0.04	NS
pH	5.80^{a}±0.01	5.71^{b}±0.01	5.70^{b}±0.01	5.71^{b}±0.02	**
Dry matter (%)	27.74^{c}±0.23	30.27^{a}±0.22	29.37^{b}±0.21	29.42^{b}±0.10	**
Ash (%)	2.43±0.10	2.44±0.01	2.50±0.04	2.36±0.18	NS
Crude protein (%)	23.47^{b}±0.02	26.09^{a}±0.03	22.02^{c}±0.04	20.42^{d}±0.07	**
Ether extract (%)	0.80^{b}±0.05	1.28^{a}±0.03	0.58^{c}±0.08	0.60^{bc}±0.05	**

[1]BBS, SHBS and GE refers to broiler breast meat sausage, spent hen breast meat sausage and ginger extract, respectively. **p<0.01; NS, Non-significant; Means with different superscripts within a row differ significantly (p<0.05)

pH of sausage

Table 3 showed that the range of overall observed cooked pH at different treatment was 5.79 to 5.95 which indicates that there were no significant ($p>0.05$) differences among the treatment. On the other hand, the range of overall observed of different days of intervals of cooked pH was 5.84 to 5.90. The mean values observed in 0, 15th and 30th days of observation indicates that there were no significant ($p>0.05$) differences found among these three days of observation. The mean pH was almost similar in all the groups on all the days of analysis which is similar to the finding of McCarthy et al. (2001). Rokib et al. (2019) did not found any significant differences among broiler meat sausages incorporated with different flours, but significant differences were found in pH at different storage period.

Table 3. pH of different chicken sausages with or without ginger extract during different days of intervals

Parameter	days of interval (D)	Different treatments(T)[1]					Level of Significance		
		BBS	SHBS	SHBS+2%GE	SHBS+4%GE	Mean	T	D	T*D
pH	0	5.99±0.06	5.87±0.02	5.82±0.02	5.83±0.01	5.88			
	15	5.85±0.05	5.84±0.05	5.81±0.01	5.87±0.01	5.84			
	30	6.01±0.01	5.67±0.31	5.99±0.01	5.93±0.01	5.90	NS	NS	NS
	Mean	5.95	5.79	5.87	5.88				

[1]BBS, SHBS and GE refers to broiler breast meat sausage, spent hen breast meat sausage and ginger extract, respectively. **, (p<0.01); NS, (p>0.05).

Proximate components of sausage

The proximate composition of different sausages was analyzed in Table 4 and highly significant differences were found in dry matter (%), crude protein (%) and ether extract (%) among different sausages as well as among different storage time. Significantly higher dry matter (%) was found in spent hen breast meat sausages without ginger extract, while crude protein (%) and ether extract (%) were significantly higher in spent hen breast meat sausages with 2% ginger extract. Both dry matter (%) and crude protein (%)

content increased with increase of storage time. Similar results were found by Rokib et al. (2019). They found significantly ($p<0.01$) lower DM (%) and higher CP (%) in broiler meat sausage without flour. Both DM (%) and CP (%) content were increased with increase of storage time. Yadav et al. (2018) while conducting an experiment reported that protein content decreased significantly in wheat bran (WB) and dried carrot pomace (DCP) incorporated chicken sausage. Ash (%) content did not differ among different sausage types and at different storage interval.

Table 4. Proximate composition of different chicken sausages with or without ginger extract during different days of intervals

Parameter (%)	Days of intervals	Different treatments(T)[1]					Level of Significance		
		BBS	SHBS	SHBS+2%GE	SHBS+4%GE	Mean	T	D	T*D
DM	0	35.0±0.03	36.9±2.16	36.2±0.02	35.6±0.38	37.16^{b}	**	**	NS
	15	36.8±2.77	39.8±0.78	37.8±0.61	34.2±0.22	35.91^{b}			
	30	37.7±0.58	42.0±0.36	39.5±0.05	37.1±0.05	39.05^{a}			
	Mean	36.49^{bc}	39.53^{a}	37.83^{ab}	35.64^{c}				
CP	0	27.3±0.04	26.3±0.02	28.0±0.02	25.6±0.21	26.75^{c}	**	**	NS
	15	29.7±0.09	29.2±0.33	29.8±0.03	27.2±0.62	28.98^{b}			
	30	31.5±0.05	31.1±0.25	32.4±0.53	30.7±0.08	31.40^{a}			
	Mean	29.49^{b}	28.86^{c}	30.07^{a}	27.76^{d}				
Ash	0	2.37±0.04	2.82±0.41	5.90±3.53	4.93±2.26	4.00	NS	NS	NS
	15	3.03±0.12	3.91±0.39	2.67±0.11	2.73±0.16	3.08			
	30	2.25±0.01	2.70±0.25	2.10±0.17	1.90±0.08	2.24			
	Mean	2.55	3.14	3.56	3.18				
EE	0	1.13±0.03	1.43±0.03	1.95±0.55	1.15±0.10	1.34^{c}	**	**	**
	15	1.35±0.3	1.20±0.20	2.13±0.08	1.33±0.13	1.94^{a}			
	30	1.20±0.20	2.05±0.05	2.35±0.05	2.15±0.05	1.71^{b}			
	Mean	1.28^{c}	1.53^{b}	2.19^{a}	1.65^{b}				

[1]BBS, SHBS and GE refers to broiler breast meat sausage, spent hen breast meat sausage and ginger extract, respectively. DM, dry matter; CP, crude protein; EE, ether extract. **p<0.01; NS, Non-significant; Means with different superscripts within a row or column differ significantly.

Instrumental surface color (CIE L*, *a**, *b**) of sausage

Table 5 showed that color score at different treatment for lightness was ranging from 74.33 to 78.68. Significantly higher lightness value was found in spent hen breast meat sausage with 2% ginger extract and lower value was found in broiler breast meat sausage. But there was no significant difference ($p>0.05$) exist between the interaction of treatments and number of days it was stored. The present findings are an agreement with Singh et al. (2014). On the other hand, the redness value of all treatments ranges from -0.48 to 0.77. Significantly highest reading was observed in broiler breast meat sausage and lowest was found in spent hen breast meat sausage with 2% ginger extract group. The mean values observed from 0, 15th and 30th days of observation indicates there were a significant difference ($p<0.01$) found among these days of observation. The data showed that redness score increased gradually with the increase in storage period. This finding is also similar to Singh et al. (2014). Again the range of overall observed color score at different treatment for yellowness was 13.63 to 15.83. Significantly highest score was observed from in spent hen breast meat sausage with 4% ginger extract and lowest was observed from spent hen breast meat sausage with out ginger extract. Different types of sausages, storage period and their interaction has a significant effect on yellowness value. The data showed that yellowness value changes gradually. This finding is similar to Anna et al. (2011). Ali et al. (2007) found lightness decrease by adding rice flour to duck meat sausage.

Table 5. International commission on illumination color measurements (CIE*) in different chicken sausages with or without ginger extract ginger extract during different days of intervals

Parameter	Days of intervals (D)	Different treatments(T)[1]					Level of Significance		
		BBS	SHBS	SHBS+2%GE	SHBS+4%GE	Mean	T	D	T*D
*L**	0	74.8±1.97	76.7±0.86	79.2±0.63	79.3±0.22	77.51			
	15	72.1±3.46	71.9±5.8	79.2±1.16	76.1±3.0	74.85	*	NS	NS
	30	75.5±0.53	75.0±1.3	77.1±0.51	77.6±0.36	76.31			
	Mean	74.33^{c}	75.10^{bc}	78.68^{a}	78.06^{ab}				
*a**	0	0.76±0.18	-0.28±0.12	-0.48±0.08	-0.41±0.06	-0.10^{b}			
	15	0.60±0.37	-0.38±0.19	-0.80±0.04	-0.38±0.08	-0.24^{b}	**	**	NS
	30	0.95±0.11	0.18±0.09	-0.18±0.11	0.31±0.04	0.32^{a}			
	Mean	0.77^{a}	-0.19^{b}	-0.48^{c}	-0.22^{b}				
*b**	0	15.2±0.31	13.6±0.24	13.9±0.38	14.3±0.36	14.26^{b}			
	15	13.5±0.56	13.9±1.11	14.4±0.53	14.7±0.45	14.14^{b}	**	*	*
	30	15.5±0.40	13.4±0.35	14.5±0.39	18.3±2.0	15.42^{a}			
	Mean	14.86^{ab}	13.63^{c}	14.20^{bc}	15.83^{a}				

[1]BBS, SHBS and GE refers to broiler breast meat sausage, spent hen breast meat sausage and ginger extract, respectively. *p<0.05; **p<0.01; NS, Non-significant; Means with different superscripts within a row or column differ significantly.

Biochemical properties

Table 6 indicates that the range of overall observed FFA value at different treatments was 0.53 to 0.63. Treatment have a significant difference ($p<0.05$) and the highest result was found in broiler breast meat sausages. On the other hand, the mean values observed in 0, 15th and 30th days of observation showed a highly significant ($p<0.01$) differences. The FFA value was increased with the increase in storage period. The highest FFA value was observed at 30th days of observation which is similar to the finding of Baker et al. (2013). Similar result was found in case of POV values. Again, the range of overall observed TBARS value at different treatment levels was 0.14 to 0.17. The highest TBARS value was observed in broiler breast meat sausage and lowest was observed in spent hen breast meat sausage with 4% ginger extract. There was a significant difference ($p<0.01$) exist among these three days observation. Similar to POV and FFA value highest TBARS value was observed at 30 day which proves the finding of Yadav et al. (2018). Rokib et al. (2019) found that storage period have significant ($p<0.01$) effect on different biochemical (FFA, POV and TBARS value) values of broiler meat sausages incorporated with different flours.

Table 6. Biochemical properties of different chicken sausages with or without ginger extract during different days of intervals

Parameter	Days of interval	Different treatments(T)[1]					Level of Significance		
		BBS	SHBS	SHBS+2%GE	SHBS+4%GE	Mean	T	D	T×D
FFA (%)	0	0.19±0.01	0.13±0.03	0.13±0.03	0.14±0.01	0.15^{c}			
	15	0.55±0.03	0.43±0.06	0.41±0.03	0.44±0.06	0.45^{b}			
	30	1.15±0.05	1.05±0.05	1.10±0.00	1.00±0.10	1.08^{a}	*	**	NS
	Mean	0.63^{a}	0.54^{b}	0.54^{b}	0.53^{b}				
POV (meq / kg)	0	1.73±0.01	1.56±0.07	1.65±0.02	1.65±0.02	1.65^{b}			
	15	1.77±0.03	1.72±0.02	1.68±0.05	1.72±0.02	1.72^{a}			
	30	1.92±0.02	1.69±0.02	1.72±0.02	1.71±0.02	1.76^{a}	**	**	NS
	Mean	1.81^{a}	1.66^{b}	1.68^{b}	1.69^{b}				
TBARS (mg malonaldehyde/ kg sample)	0	0.11±0.00	0.11±0.01	0.12±0.01	0.09±0.00	0.11^{c}			
	15	0.18±0.02	0.16±0.02	0.14±0.00	0.13±0.02	0.15^{b}			
	30	0.23±0.01	0.19±0.01	0.19±0.01	0.19±0.01	0.20^{a}	**	**	NS
	Mean	0.17^{a}	0.15^{b}	0.15^{b}	0.14^{b}				

[1]BBS, SHBS and GE refers to broiler breast meat sausage, spent hen breast meat sausage and ginger extract, respectively. FFA, free fatty acids; POV, per oxide value; TBARS, thiobarbituric acid reactive substance. *p<0.05; **p<0.01; NS, Non-significant; Means with different superscripts within a row or column differ significantly.

Sensory evaluation

Table 7 shows that significant differences were found in flavor, off-flavor, juiciness, tenderness and overall acceptability. Higher flavor and overall acceptability were found in broiler breast meat sausage and spent hen sausage with 2% ginger extract. Juiciness and tenderness was higher in broiler breast meat sausage. Among the spent hen breast meat sausages significantly better juiciness and tenderness was found in spent hen sausages with 2% ginger extract. The worst results in all sensory parameters were found in spent hen breast meat sausages without ginger extract and in spent hen sausage with 4% ginger extract.

Table 7. Sensory properties of different chicken sausages with or without ginger extract

Parameters	Different treatments(T)[1]				Level of Significance
	BBS	SHBS	SHBS+2% GE	SHBS+4% GE	
Color	4.45±0.20	4.07±0.11	4.15±0.17	4.22±0.17	NS
Flavor	5.28^{a}±0.17	4.63^{b}±0.13	5.02^{ab}±0.10	4.65^{b}±0.15	**
Off-flavor	2.17^{b}±0.10	3.02^{a}±0.05	2.22^{b}±0.09	3.12^{a}±0.08	**
Juiciness	4.98^{a}±0.14	4.38^{b}±0.12	4.58^{b}±0.06	4.43^{b}±0.08	**
Tenderness	5.12^{a}±0.07	4.42^{c}±0.09	4.67^{b}±0.07	4.52^{bc}±0.05	**
Overall acceptability	4.87^{a}±0.07	4.43^{b}±0.11	4.90^{a}±0.10	4.58^{b}±0.05	**

[1]BBS, SHBS and GE refers to broiler breast meat sausage, spent hen breast meat sausage and ginger extract, respectively. **p<0.01; NS, Non-significant; Means with different superscripts within a row or column differ significantly.

Conclusion

It might be concluded that sensory, physicochemical, biochemical, proximate and microbiological studies show that addition of ginger extract at 2% level increased the overall acceptability of spent hen breast meat sausage to that of broiler breast meat sausage.

Conflict of interest

There is no conflict of interest among the authors.

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