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Quality of spent hen sausages incorporated with bee honey

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Abstract

The experiment was conducted to find out the effect of bee honey 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 bee honey, spent hen breast meat sausage without bee honey, spent hen breast meat sausage with 2% bee honey and spent hen breast meat sausage with 4% bee honey. All parameters were analyzed at 0, 15th and 30th days of storage time. Significant differences were found in pH, the percentages of dry matter (DM), crude protein (CP) and ether extract (EE), while no significant differences were found in the percentage of cooking loss and ash of sausage batter. While analyzing the different types of sausages, CP, ash and EE content of all treatments differ significantly ($p<0.05$). In contrast, CP and EE content increased significantly ($p<0.01$), while ash content decreased 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. Lightness *(L*)* and yellowness *(b*)* did not differ among different sausages and time of intervals. Redness *(a*)* was significantly higher in broiler breast meat sausages without bee honey. Redness increased significantly with the advancement of different days of intervals. Flavor and overall acceptability were found significantly lower in spent hen breast meat sausage without bee honey. Bee honey increased the flavor, juiciness, tenderness and overall acceptability of spent hen breast meat sausages similar to broiler breast meat sausage. Although no significant differences were found among broiler breast meat sausage without bee honey and spent hen sausages with 2% or 4% bee honey, but overall acceptability was higher in spent hen sausages with 4% bee honey.

Introduction

Every year millions of birds are culled from commercial layer farming 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 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). In recent years, poultry meat has gained much popularity among consumers. Their distribution in the world spreads over large areas of Asia, Europe and Africa. With growing concern over the presence of chemical residues in foods the demand for nontoxic natural preservatives is increasing. In our country majority of food consumption is still at home. Nevertheless, out of home food consumption is increasing due to increase in urbanization, breaking up of the traditional joint family system, desire for quality, time which translates into an increased need for convenience, increasing number of working women, rise in per capita income, changing lifestyles and increasing level of affluence in the middle-income group had brought about changes in food habits.

Natural antioxidants are reported to be more powerful antioxidants, especially, rosemary, sage, ginger and green tea extracts (Bithi et al., 2020; Disha et al., 2020; Jahan et al, 2017; Saba et al., 2017). Many natural substances in honey bee species with different plant origins may play an important role in functional properties such as anti-oxidative and anti-bacterial activities. Honey is nectar collected from many plants and processed by honey bees (*Apis mellifera*). This natural product is widely appreciated as the only concentrated form of sugar available worldwide (FAO, 1996) and is also used as food preservative (Cherbuliez and Domerego, 2003). Honey has been reported to contain about 200 substances (complex mixture of sugar, but also small amounts of other constituents such as minerals, proteins, vitamins, organic acids, flavonids, phenolic acids and other phytochemicals). It also contains a number of components to act as preservatives; these include tocopherol, ascorbic acids, flavonids, other phenolics and enzymes such as glucose oxidase, catalase and peroxidase (Ferreres et al., 1993). It is suggested that any of these substances owe their preservative properties to their anti-oxidative activity (Akhter et al., 2009; Azad et al., 2021; Cerutti, 1994; Sadakuzzaman et al., 2021; Sarker et al., 2021). Inclusion of natural preservatives with both antioxidants and antibacterial activities, that prolong the shelf life of meat and prevent food-borne illness, is highly desirable. Therefore, the present study was undertaken to find out the effect of incorporation of bee honey in different levels on the quality of spent hen breast meat sausages.

Materials and Methods

Experimental Design

Four sausage formulations were developed (Table 1), as follows: broiler breast meat sausage without bee honey (BS), spent hen breast meat sausage without bee honey (SHS), spent hen breast meat sausage with 2% bee honey (**SHS+2%BH**)and spent hen breast meat sausage with 4% bee honey (**SHS+4%BH**).

Table 1: Ingredient composition of different sausage batter incorporated with bee honey

Ingredients (g)	Different treatments[1]			
	BS	**SHS**	**SHS+2%BH**	**SHS+4%BH**
Breast meat (g)	1000	1000	980	960
Bee honey (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 BH refers to broiler breast meat sausage, spent hen breast meat sausage, and bee honey, respectively

Materials Collection

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

Sausage Preparation

All visible fat and connective tissues 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. Spent hen breast meat sausage with 2% bee honeyand spent hen breast meat sausage with 4% bee honeywere then compounded with fresh bee honey at 2% and 4% respectively. Meat from each mixture were taken and were 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 as much as possible and were then placed into 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 determination

The pH of emulsion and cooked products were 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. After drying, samples surface were 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:

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

Where, S, weight of oil sample; 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 were measured by intensity on a 5-point balanced semantic scale (weak to strong) for the attributes such as 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 cooking using a 5-point scoring method. Sensory evaluation was accomplished at 0, 15 and 30^{th} days of storage.

Statistical analysis

The sausage batter data and the sensory evaluation of different sausages were 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 and crude protein were found in broiler breast meat sausage batter, lower crude protein was found in broiler breast meat sausage batter withoutbee honey and lower ether extract was found in spent hen sausage batter with 4% bee honey. The percentage of ash and cooking loss of sausage batters did not differ among the treatments, while significantly higher pH value was found in broiler breast meat sausage batter. Hossain et al. (2021) found similar type of results while manufactured spent hen sausages with 2 or 4% ginger extract. 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 sausage batter incorporate with bee honey

Parameters	Different treatments				Level of Significance
	BBS	SHBS	SHBS+2%BH	SHBS+4%BH	
Cooking Loss (%)	7.69±1.22	4.45±0.20	6.62±0.27	6.33±0.35	NS
pH	5.80^{a}±0.01	5.71^{b}±0.01	5.72^{b}±0.02	5.67^{b}±0.04	*
Dry matter (%)	27.74^{b}±0.23	30.27^{a}±0.22	30.57^{a}±0.26	30.24^{a}±0.48	**
Ash (%)	2.43±0.10	2.44±0.01	2.39±0.03	2.42±0.01	NS
Crude protein (%)	23.47^{d}±0.02	26.09^{a}±0.03	24.67^{b}±0.01	23.79^{c}±0.04	**
Ether extract (%)	0.80^{bc}±0.05	1.28^{a}±0.03	0.90^{b}±0.05	0.70^{c}±0.05	**

*BBS, SHBS and BHrefer to broiler breast meat sausage, spent hen breast meat sausage, and bee honey, respectively. **p<0.01; NS, Non-significant; Means with different superscripts within a row differ significantly (p<0.05)*

pH of sausage

Table 3 shows 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 5.85 to 5.90. The mean values observed in 0, 15 and 30^{th} days of observation indicates that there were no significant (p>0.05) differences among these three days of observations. Similar results also found by Hossain et al. (2021), who manufactured spent hen sausages with 2 or 4% ginger extract at different days of intervals. Rokib et al. (2019) found no significant differences among broiler meat sausages incorporated with different flours, but significant differences were found in pH at different storage period.

Table 3: pH ofdifferent sausagebatter incorporate with bee honey during different days of intervals

Parameter	days of interval (D)	Different treatments(T)[1]					Level of Significance		
		BBS	SHBS	SHBS+2%BH	SHBS+4%BH	Mean	T	D	T×D
pH	0	5.99±0.06	5.87±0.02	5.86±0.01	5.82±0.00	5.88			
	15	5.85±0.05	5.84±0.05	5.83±0.02	5.88±0.03	5.85			
	30	6.01±0.01	5.67±0.31	5.91±0.01	5.98±0.01	5.89	NS	NS	NS
	Mean	5.95	5.79	5.86	5.89				

[1]*BBS, SHBS and BH refers to broiler breast meat sausage, spent hen breast meat sausage, and bee honey, respectively. **, (p<0.01); NS, (p>0.05); a, b, c Different letters indicate significant difference among the treatments*

Proximate analysis of sausage

The results of proximate composition of different sausages has been shown in Table 4 and highly significant differences were found in crude protein (%), ash (%) and ether extract (%) content among different sausages as well as among different storage time. Although no significant differences were found in dry matter content of different sausages, DM (%) was higher in spent hen sausage with 4% bee honey (p>0.05). Crude protein (%) and ash (%) were significantly higher in spent hen breast meat sausages with 4% bee honey, while ether extract (%) was found significantly higher in spent hen breast meat sausages with 2% bee honey. Both crude protein (%) and EE (%) content increased with increase of storage time, while ash (%) content decreased with decrease of storage time. Rokib et al. (2019) 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.

Table 4: Proximate composition of different sausages batter incorporate with bee honey during different days of intervals

Parameters (%)	Days of intervals	Different treatments(T)[1]					Level of Significance		
		BBS	SHBS	SHBS+2%BH	SHBS+4%BH	Mean	T	D	T×D
DM	0	35.0±0.03	36.9±2.16	38.7±1.03	38.8±5.38	37.33	NS	NS	NS
	15	36.8±2.77	39.8±0.78	36.3±0.13	42.8±0.19	38.94			
	30	37.7±0.58	42.0±0.36	41.7±0.33	42.4±0.54	40.94			
	Mean	36.49	39.53	38.91	41.35				
CP	0	27.3±0.04	26.3±0.02	28.7±0.33	29.8±0.20	28.02^{c}	**	**	*
	15	29.7±0.09	29.2±0.33	30.0±0.13	31.0±0.05	29.97^{b}			
	30	31.5±0.05	31.1±0.25	32.8±0.25	33.8±0.51	32.26^{a}			
	Mean	29.49^{c}	28.86^{d}	30.46^{b}	31.51^{a}				
Ash	0	2.37±0.04	2.82±0.41	3.83±0.42	3.93±0.70	3.23^{a}	*	**	NS
	15	3.03±0.12	3.91±0.39	3.04±0.39	3.59±0.12	3.39^{a}			
	30	2.25±0.01	2.70±0.25	2.63±0.23	2.60±0.02	2.54^{b}			
	Mean	2.55^{b}	3.14^{a}	3.16^{a}	3.37^{a}				
EE	0	1.13±0.03	1.43±0.03	1.45±0.05	1.28±0.13	1.32^{b}	**	**	NS
	15	1.35±0.3	1.20±0.20	1.85±0.15	1.65±0.10	1.51^{b}			
	30	1.20±0.20	2.05±0.05	2.40±0.10	2.26±0.25	1.98^{a}			
	Mean	1.23^{c}	1.56^{b}	1.90^{a}	1.73^{ab}				

*[1]BBS, SHBS and BH refers to broiler breast meat sausage, spent hen breast meat sausage, and bee honey, 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 shows that color score at different treatments for lightness was ranging from 74.33 to 76.43. No significant differences in lightness value were found in spent hen breast meat sausages with or without bee honey and broiler breast meat sausage; although value was lower in broiler breast meat sausage ($p>0.05$). Again, no significant difference ($p>0.05$) exist among days of intervals and the interaction between treatments and days of intervals. Hossain et al. (2021) found significantly higher lightness value in spent hen breast meat sausage with 2% ginger extract and lower value was found in broiler breast meat sausage. They also found similar results in days of intervals and the interaction between treatments and days of intervals in this experiment. Ali et al. (2011) found lightness decrease by adding rice flour to duck meat sausage. On the other hand, the redness value of all treatments ranges from -0.61 to 0.77. Significantly highest reading was observed in broiler breast meat sausage and lowest was found in spent hen breast meat sausage with 4% bee honey group. The mean values observed from 0, 15 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 14.86. No significant differences were found among the treatments and days of intervals, but highly significant differences were found between treatments and days of intervals.

Table 5: International commission on illumination color measurements (CIE*) of different sausages batter incorporate with bee honey during different days of intervals

Parameter	Days of intervals (D)	Different treatments(T)[1]					Level of Significance		
		BBS	SHBS	SHBS+2%HB	SHBS+4%HB	Mean	T	D	T×D
*L**	0	74.8±1.97	76.7±0.86	76.0±1.19	76.2±0.91	75.94			
	15	72.1±3.46	71.9±5.8	76.6±0.52	76.4±1.16	74.27	NS	NS	NS
	30	75.5±0.53	75.0±1.3	74.4±0.72	76.9±1.16	75.46			
	Mean	74.33	75.01	75.76	76.43				
*a**	0	0.76±0.18	-0.28±0.12	-0.56±0.12	-0.93±0.16	-0.25^{b}			
	15	0.60±0.37	-0.38±0.19	-0.41±0.16	-0.80±0.02	-0.24^{b}	**	**	NS
	30	0.95±0.11	0.18±0.09	-0.06±0.03	0.23±0.27	0.32^{a}			
	Mean	0.77^{a}	-0.19^{b}	-0.39^{bc}	-0.61^{c}				
*b**	0	15.2±0.31	13.6±0.24	13.5±0.44	12.8±0.39	13.78			
	15	13.5±0.56	13.9±1.11	15.8±1.53	14.6±0.36	14.47	NS	NS	**
	30	15.5±0.40	13.4±0.35	13.12±0.76	15.2±0.54	14.30			
	Mean	14.86	13.63	13.99	13.85				

*[1]BBS, SHBS and HB refers to broiler breast meat sausage, spent hen breast meat sausage, and bee honey, 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 0.51 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, 15 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) and Hossain et al. (2021). Similar result was found in case of POVvalues. Again, the range of overall observed TBARS value at different treatment levels was 0.14to 0.17. The highest TBARS value was observed in broilerbreast meat sausageand lowest was observed in spent hen breast meat sausage with 4% bee honey. There was a significant difference ($p<0.01$) exist among these three days observation. Similarto POV and FFAvalues, the highest TBARS value was observed at 30 day which is like as findings observed by Yadav et al. (2018) and Hossain et al.

(2021). Rokib et al. (2019) found that storage period have significant ($p<0.01$) effect on different biochemical (FFA, POV and TBARS) values of broiler meat sausages incorporated with different flours.

Table 6: Biochemical properties of different sausages batter incorporate with bee honey 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	0.13±0.01	0.15^{c}			
	15	0.55±0.03	0.43±0.06	0.40±0.03	0.42±0.06	0.45^{b}			
	30	1.15±0.05	1.05±0.05	1.00±0.00	1.00±0.10	1.05^{a}	*	**	NS
	Mean	0.63^{a}	0.54^{b}	0.51^{b}	0.52^{b}				
POV (meq / kg)	0	1.73±0.01	1.56±0.07	1.62±0.02	1.60±0.02	1.63^{c}			
	15	1.77±0.03	1.72±0.02	1.66±0.04	1.65±0.02	1.70^{b}			
	30	1.92±0.02	1.69±0.02	1.63±0.04	1.68±0.02	1.73^{a}	**	**	NS
	Mean	1.81^{a}	1.66^{b}	1.64^{b}	1.64^{b}				
TBARS (mg malonaldehyde/ kg sample)	0	0.11±0.01	0.11±0.01	0.11±0.00	0.10±0.00	0.11^{c}			
	15	0.18±0.01	0.16±0.03	0.14±0.01	0.13±0.01	0.15^{b}			
	30	0.23±0.00	0.19±0.00	0.20±0.00	0.19±0.00	0.20^{a}	**	**	NS
	Mean	0.17^{a}	0.15^{b}	0.15^{b}	0.14^{b}				

*[1]BBS, SHBS and BH refers to broiler breast meat sausage, spent hen breast meat sausage, and bee honey, 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. Significantly lower flavor, juiciness, tenderness and overall acceptability were found in spent hen sausage without bee honey. Among the spent hen breast meat sausages bee honey increases flavor, juiciness, tenderness and overall acceptability similar to broiler breast meat sausage.

Table 7: Sensory properties of different spent hen sausages batter incorporate with bee honey

Parameters	Different treatments(T)[1]				Level of Significance
	BBS	SHBS	SHBS+2%BH	SHBS+4%BH	
Color	4.45±0.20	4.07±0.11	4.20±0.12	4.28±0.14	NS
Flavor	4.68^{a}±0.17	4.03^{b}±0.13	4.70^{a}±0.10	4.94^{a}±0.13	**
Off-flavor	2.17^{b}±0.10	3.02^{a}±0.05	2.35^{b}±0.08	2.12^{b}±0.09	**
Juiciness	4.68^{a}±0.14	4.08^{b}±0.12	4.62^{a}±0.12	4.90^{a}±0.11	**
Tenderness	4.82^{ab}±0.07	4.12^{c}±0.09	4.70^{b}±0.07	4.98^{a}±0.05	**
Overall acceptability	4.87^{a}±0.07	4.43^{b}±0.11	4.85^{a}±0.08	4.94^{a}±0.09	**

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

Conclusions

It might be concluded that sensory, physicochemical, biochemical, proximate and microbiological studies show that addition of bee honey extract up to 4% 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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