

Original Research Article

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## Utilization of Spent Broiler Breeder Hen Meat to Develop Value Added Sausages

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### ABSTRACT

#### Keywords

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Meat from spent broiler breeder hens is sold at a lower price because of its poor texture and acceptability when compared to the broilers. The present study was designed for proper utilization of this less expensive meat to produce cheaper and economically viable nutritious value added chicken sausages. Significantly ( $P < 0.01$ ) higher percent crude protein, total ash, water holding capacity, salt soluble protein extractability, total protein extractability and significantly ( $P < 0.01$ ) lower percent crude fat and moisture were recorded for spent broiler breeder hen meat when compared to the broiler meat. Spent broiler breeder hen sausages had significantly ( $P < 0.05$ ) higher cooking yield, emulsion stability, crude protein, crude fat, total ash and lowest pH, cholesterol, penetration value and sensory scores than broiler meat sausages.

### Introduction

Spent broiler breeder hens produce commercial broilers with high hybrid vigor for meat production and these are heavy birds (4 to 6 kg) with satisfactory amount of meat in

the breast and thighs. Meat from these spent broiler breeder hens is usually tougher and less juicy when compared to broiler meat as it is harvested at the end of the egg laying capacity of the birds. After their production period these spent broiler breeder hens are

usually slaughtered and used in feed production and also for the production of pet food (Ajuyah *et al.*, 1992; Voller-Reasonover *et al.*, 1997). Sale of spent broiler breeder hens at reasonable prices has become more difficult, affecting producers profits (Kondaiah, 1993). Consumption of meat from spent hens is limited by its poorer sensory quality, in particular poorer tenderness, compared to meat from broilers (Grabowski, 2004; Komiyama *et al.*, 2010 and Lyon *et al.*, 2003). For these reasons, the disposal of spent broiler breeder hens is one of the main economical and environmental problems of the poultry industry (Lyons, 2001). The present study was designed for proper utilization of this less expensive meat to produce cheaper and economically viable nutritious value added chicken sausages. The quality and acceptability of spent broiler breeder hen sausages was assessed in comparison with broiler meat sausages by physico-chemical, microbiological and sensory qualities.

## **Materials and Methods**

### **Procurement of raw material and preparation of ingredients**

Spent boiler breeder birds (females) of 72 weeks age and broilers of 6-7 weeks of age were purchased from Chandragiri local market, transported and slaughtered at the Department of Livestock Products Technology, College of Veterinary Science, Tirupati. Slaughter and dressing was performed as per the standard procedure. After chilling overnight, the carcasses were hand-deboned and the meat was kept in freezer ( $-18\pm 1^{\circ}\text{C}$ ) until further use. For each trial, six birds of each group were taken and such six trials were carried out. The work was designed to prepare sausages using meat from breast, thigh and drumstick of birds from each group. Fresh chicken samples were collected from the

thigh and breast muscles of both spent broiler breeder hens and broilers separately after 24 hours of storage at refrigerator temperature ( $4\pm 1^{\circ}\text{C}$ ) and assessed the following physico-chemical attributes.

### **Protein extractability**

Protein extractability was determined according to procedure of Joo *et al.*, (1999). Total proteins (Sarcoplasmic and Myofibrillar) proteins were extracted from 2 g sample using 40 ml of ice-cold 1.1 M potassium iodide in 0.1M phosphate buffer (pH 7.2). The samples were homogenized and kept overnight at  $4^{\circ}\text{C}$  with frequent shaking. Samples were centrifuged at 5000 rpm for 20 min and concentration of protein in the supernatant was determined by the Biuret method.

### **Protein fractionation**

Protein fractionation was carried out as per the method of Kang and Rice (1970). Sarcoplasmic proteins: 20g of meat + 30 ml of chilled distilled water blended in a homogenizer for 2min. Homogenate transferred to volumetric flask and made the volume to 200ml then kept at  $4-5^{\circ}\text{C}$  for overnight and centrifuged at 3000 rpm for 15 minutes. Nitrogen content was measured in the supernatant by micro kjeldhal method.

Myofibrillar proteins: Residue from the above experiment was dispensed in 200ml of 0.67 M NaCl solution. Kept overnight at  $4-5^{\circ}\text{C}$  and centrifuged at 3000 rpm for 15 minutes. Nitrogen content was measured in the supernatant by micro kjeldhal method.

### **pH**

The pH of the samples was determined by following the procedure of Jay (1964). Meat sample weighing 25 grams was blended with 100 ml of distilled water for one minute in a

mechanical blender. From the total homogenate a 50 ml aliquot portion was immediately used for determination of pH using a digital pH (Systronics  $\mu$  pH system 361) meter after standardizing the instrument with two standard buffers.

### **Water holding capacity**

Water holding capacity (WHC) was determined according to Wardlaw *et al.*, (1973). The 20g of minced meat sample was placed in a centrifuge tube containing 30 ml NaCl (0.6 M) and was stirred with glass rod for 1 minute. The tube was then kept at refrigeration temperature ( $4\pm 1$  °C) for 15 min, stirred again and centrifuged at 3000 rpm using refrigerated centrifuge (model) for 15 min. The supernatant was measured and amount of water retained by sample were expressed as WHC in percentage.

### **Proximate composition**

The per cent moisture, crude protein, crude fat and crude fibre were estimated as per the procedures outlined by AOAC (1994).

### **Standardization of spent broiler breeder hen chicken sausages in comparison with broilers**

#### **Procurement of raw materials**

On the next day of the slaughter, both spent broiler breeder hen and broiler chicken carcasses were deboned and meat was harvested. All subcutaneous fat and inter muscular fat was removed from the meat and used as the fat source.

The spice ingredients purchased from local market were cleaned thoroughly and dried in a hot air oven at 50°C per 60 minutes. The ingredients were ground separately in a Blender (Model: Panasonic MX-AC 3005) and sieved through a fine mesh. The powders

were mixed in suitable proportions to obtain the spice mix and were stored at room temperature in air tight container for further use.

Other Non meat ingredients like sugar, salt, garlic, onions, binder were purchased from local super market. Onions and garlic were peeled off and made a fine paste in the ratio of 3:1 with help of mixer grinder.

### **Preparation of sausages**

Both control and treatment chicken sausages were manufactured separately by using formulation as shown in Table 1. The steps in the preparation of sausages are shown inflow chart. Control sausages were formulated with broiler meat where as treatment sausages were formulated with spent broiler breeder hen meat. Meat and fat were separately subjected to thorough mincing a meat mincer (Continental CCE 89/189) through 6 mm diameter grinder plate to obtain a uniform mix and later through 4mm diameter plate. Minced meat was chopped with salt, sugar, phosphate, fat, ice flakes, refine wheat flour, spices and condiments for 8 min in a bowl chopper (Schadfen 58452 written).

The treatment and control batters were stuffed into synthetic cellulose casings (SCC21) using horizontal sausage stuffer (SIRMAN – V15, Italy) and then linked, tied and cooked at 80°C/40 min in moist heat. The batches of both control and treatment cooked sausage samples, after cooling to ambient temperature were subjected to evaluate physic chemical, proximate and organoleptic parameters.

### **Percent cooking yield**

Cooking yield was estimated by recording the difference between the pre and post cooking weights of meat sausages and expressed in percentage.

% Cooking yield=  
Weight of sample after cooking  
-----×100  
Weight of sample before cooking

### Percent emulsion stability

The Emulsion stability of the sample was determined by the method followed by Baliga and Madaiah (1970).

Twenty five grams of emulsion was taken in a sealed polythene bag and cooked at 80°C for 30 minutes in a water bath. Cookout was drained, cooked mass was cooled and weighed, and same was expressed as percent emulsion stability.

### Hardness

#### Penetration value

The hardness of the product was measured in terms of penetration value (penetration value×10-1 mm) with the help of cone penetrometer as described by Dixon and Parekh (1979).

The product was placed on the platform of the cone penetrometer (ISI model, United scientific co. Madras) in such a way that the point of penetration was at least 2.5cm away from the edge of the dish and the platform was so adjusted that the tip of the cone just touched the sample.

The cone assembly was allowed to descend in to the sample for exactly 10 sec. The distance through which the cone penetrated into the product was measured on the dial of the penetrometer.

### Proximate composition

The per cent moisture, crude protein, crude fat and crude fibre were estimated as per the procedures outlined by AOAC (1994).

### Cholesterol

Lipid extract was used as per the method described by Wybenga *et al.*, (1970) as modified by Rajkumar *et al.*, (2004). Lipid extract was prepared by taking one gram of the sample and adding 10 ml freshly prepared 2:1 chloroform:Methanol solution and homogenized with laboratory model blender.

Homogenate was filtered using WhatmanNo.42 filter paper and to 5 ml of filtrate equal quantity of distilled water was added, mixed and centrifuged at 3000 rpm for 7 minutes.

Top layer (methanol) was removed by suction. Volume of the bottom (chloroform) layer having cholesterol was recorded. From this 25µl of the sample was pipette in a test tube and kept in a water bath (100 °c) for 2-3 min till it got dried.

To this 5 ml of cholesterol reagent was added, mixed and kept in a boiling water bath for 90 seconds for colour development, the optical density of standard and test against blank was taken at 530nm. Total cholesterol (mg%) was calculated as follows,

### Calculation

$$\frac{\text{O.D of the sample}}{\text{O.D of the standard}} \times \frac{\text{Volume of the Chloroform Layer (ml)}}{\text{Weight of the sample taken (g)}} \times 200$$

### Sensory evaluation

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 semi-trained panalists.

## Results and Discussion

### Physico-chemical parameters of spent broiler breeder and broiler meat

The physico-chemical parameters such as pH, water holding capacity (WHC) protein fractionation: salt soluble protein extractability (SSPE), water soluble protein extractability (WSPE) and total protein extractability (TPE) of both spent broiler breeder hen and broiler chicken meat are presented in Table 2.

The pH of meat from spent broiler breeder hen and broiler were  $5.86 \pm 0.00$  and  $5.85 \pm 0.009$  respectively. There was no significant difference in mean pH values between spent broiler breeder hen and broiler. The mean pH value of spent broiler breeder hen meat did not differ significantly with that of broiler meat. However spent broiler breeder hen meat recorded higher mean pH than broilers. This is in agreement with Ali *et al.*, (2007), Bhaskar Reddy *et al.*, (2016), Biswas *et al.*, (2006), Boni *et al.*, (2010), Khwunsiri *et al.*, (2007) and Kumar *et al.*, (2011).

The meat from spent broiler breeder hen had significantly higher WHC ( $47.83 \pm 0.66$ ) than that of broiler ( $43.75 \pm 0.18$ ). The SSPE of meat from spent broiler breeder hen and broiler were  $9.64 \pm 0.04$  and  $9.35 \pm 0.06$  respectively. Higher ( $P < 0.01$ ) SSPE was observed in spent broiler breeder hen when compared to the broiler. The WSPE of meat from spent broiler breeder hen ( $5.26 \pm 0.05$ ) and broiler ( $5.15 \pm 0.04$ ) did not differ significantly. The TPE of meat from spent broiler breeder hen and broiler were  $14.84 \pm 0.10$  and  $14.45 \pm 0.05$  respectively. Significantly ( $P < 0.01$ ) higher TPE was found to be observed in spent broiler breeder hen than broiler.

The spent broiler breeder hen meat was found to have significantly higher ( $P < 0.01$ ) water

holding capacity, salt soluble protein extractability and total protein extractability when compared to broiler meat. Regarding Water soluble protein extractability did not differ significantly between spent broiler breeder hen and broiler meat. Similar trend is reported by Bhaskar Reddy *et al.*, (2016), Kokoszynski *et al.*, (2016), Kumar *et al.*, (2011), Sutton *et al.*, (1997) and Trindade *et al.*, (2004).

### Standardization of methodology for preparation of sausages

Two batches of chicken sausages were developed from spent broiler breeder hen and broiler meat after conducting preliminary trials for standardization of methodology and also compared the sausages made from meat of both spent broiler breeder hens and broilers based on physico-chemical, proximate and sensory evaluation.

### Physico-chemical properties

The mean  $\pm$  SE values of physico chemical properties of sausages as influenced by type of meat are presented in Table 3.

#### pH

The mean values of pH of sausages prepared from spent broiler breeder hen and broiler were  $6.24 \pm 0.01$  and  $6.20 \pm 0.007$  respectively. Results revealed a significant ( $P < 0.05$ ) difference in mean pH values between spent broiler breeder hen and broiler. The pH of meat and meat products is an important measure to estimate relative acidity or alkalinity which might indicate the potential storage life and quality of the meat and meat products. The mean pH of chicken sausages made from spent broiler breeder hen meat differed significantly ( $P < 0.05$ ) with that of broiler chicken sausages. Significantly ( $P < 0.05$ ) lower mean pH was observed in

chicken sausages made from broiler meat. This might be due to variation in glycogen reserves, quality and quantity of glycolytic enzymes in two types of birds (Brahma *et al.*, 1984). Similar findings are correlated with Bhattacharyya *et al.*, (2007), Biswas *et al.*, (2006), and Govind *et al.*, (2013).

### **Percent cooking yield**

The mean percent cooking yield of sausages prepared from spent broiler breeder hen and broiler were  $87.38 \pm 0.41$  and  $87.87 \pm 0.36$  respectively. Sausages made from spent broiler breeder hen chicken recorded significantly ( $P < 0.05$ ) higher percent cooking yield when compared to the sausages made from broiler. Cooking yield in meat and meat products is of utmost practical importance in meat industry. Sausages made from spent broiler breeder hen meat recorded significantly ( $P < 0.05$ ) higher percent cooking yield when compared to the sausages made from broiler. This might be due to comparatively lower water holding capacity of broiler muscles than spent broiler breeder muscles, resulting in a greater cooking loss and less stable emulsion (Joseph *et al.*, 1992). Similar trend was reported by Bhattacharyya *et al.*, (2007), Biswas *et al.*, (2006), Govind *et al.*, (2013), Kim, (2014) and Singh *et al.*, (2002).

### **Percent emulsion stability**

The mean of percent emulsion stability of chicken sausages prepared from spent broiler breeder hen and broiler were  $87.07 \pm 0.15$  and  $87.56 \pm 0.18$  respectively. Significant ( $P < 0.05$ ) difference was observed in percent emulsion stability between spent broiler breeder hen and broiler chicken sausages. The emulsion stability was expressed as percent loss and hence lower the value, higher the stability of the product. Spent broiler breeder hen chicken recorded significantly ( $P < 0.05$ ) higher percent

emulsion stability than broiler meat sausages. Emulsion stability indicates the ability of the emulsion to hold liquid at the time of performances of the emulsion and it is influenced by fat contents of the emulsion. Higher fat percentage of broiler sausage emulsion resulted in lower emulsion stability. Froning, (1972) reported that the duck patties had low emulsion stability due to higher fat content. Because of the highest stability of emulsion from spent broiler breeder hen meat which results in better retention of water and fat in meat matrix (Girish *et al.*, 2003). These findings are in agreement with Biswas *et al.*, (2006), Bhattacharyya *et al.*, (2007) Ilayabharathi *et al.*, (2012).

### **Hardness**

The mean of percent hardness of sausages prepared from spent broiler breeder hen and broiler were  $25.46 \pm 0.18$  and  $26.12 \pm 0.09$  respectively. The mean percent hardness values of sausages was significantly ( $P < 0.01$ ) affected by type of meat. The mean hardness values of chicken sausages was significantly ( $P < 0.01$ ) affected by type of meat. Broiler meat sausages recorded higher mean penetration value than spent broiler breeder hen chicken sausages. It indicated that later were harder than the former. Spent broiler breeder hen meat produced significantly firmer sausages because of the tougher connective tissue in older birds than in broilers (Baker *et al.*, 1970). Ilayabharathi *et al.*, (2012) noticed higher shear force values for spent hen sausages when compared to broilers.

Added chicken fat at a level of 15% resulted in greater firmness and overall acceptability scores (Kondaiah and Ponda, 1987). Jin *et al.*, (2007) found increased shear force values in sausages with increase in the level of spent hen meat incorporation. Kim (2014) concluded that the addition of spent hen meat resulted in increased hardness in sausages.

**Table.1** Formulation for chicken sausages

S.no.	Ingredients	Quantity(% weight basis)
1.	Chicken meat	85
2.	Chicken fat	15
<b>Total</b>		100
<b>Non meat ingredients</b>		
1.	Salt	2
2.	Sugar	1
3.	Poly phosphate	0.3
4.	Dry spice mix	2
5.	Wet condiment mix*	3
6.	Binder(refined wheat flour)	3
7.	Ice flakes	10

\* Onion : Garlic paste ( 3:1)

**Table.2** Mean±SE values of physico-chemical parameters of spent broiler breeder hen and broiler chicken meat

S.No.	Parameter	SBBH	Broiler	t-value
1.	pH	5.86±0.008	5.85±0.009	0.94
2.	WHC	47.83±0.66	43.75±0.18	5.907**
3.	Salt soluble protein extractability (SSPE)	9.64±0.04	9.35±0.06	4.703**
4.	Water soluble protein extractability (WSPE)	5.26±0.05	5.15±0.04	1.43
5.	Total protein extractability (TPE)	14.84±0.10	14.45±0.05	3.34**

\*\*Significant at 0.01 \*Significant at 0.05 SBBH- Spent broiler breeder hen

**Table.3** Mean ± SE values of physico-chemical parameters of spent broiler breeder hen and broiler meat sausages

S.no.	Parameter	SBBH	Broiler	t-value
1.	pH	6.24±0.01	6.20±0.007	2.54*
2.	% Cooking yield	87.38±0.41	87.87±0.36	2.19*
3.	% Emulsion stability	87.07±0.15	87.56±0.18	2.07*
4.	Hardness (mm)	25.46±0.18	26.12±0.09	3.17**
5.	Cholesterol (mg)	81.45±0.08	83.09±0.04	12.02**

\*\*Significant at 0.01 \*Significant at 0.05 SBBH- Spent broiler breeder hen

**Table.4** Mean ± SE values of proximate composition of chicken sausages as influenced by type of meat

S.no.	Parameter	SBBH	Broiler	t-value
1.	% Moisture	67.14±0.05	68.17±0.11	8.23 <sup>**</sup>
2.	% Crude protein	18.44±0.05	17.32±0.07	12.02 <sup>**</sup>
3.	% Crude fat	10.64±0.08	11.38±0.07	2.149 <sup>*</sup>
4.	% Total ash	1.51±0.03	1.43±0.01	6.68 <sup>**</sup>
5.	% Crude fiber	0.66±0.007	0.56±0.018	5.108 <sup>**</sup>

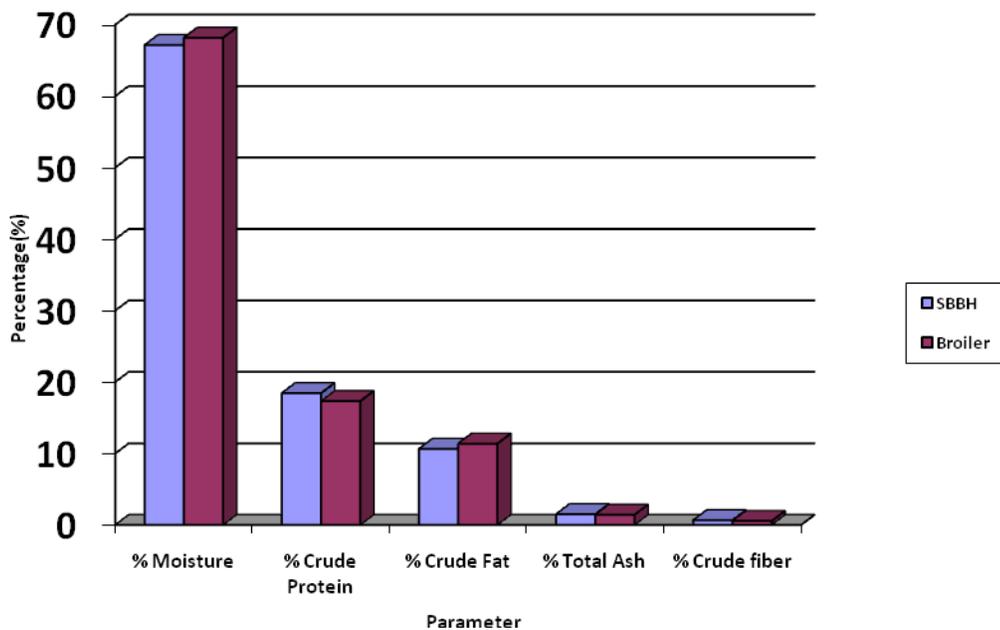
<sup>\*\*</sup>Significant at 0.01    <sup>\*</sup>Significant at 0.05    SBBH- Spent broiler breeder hen

**Table.5** Mean ± SE values of sensory evaluation of chicken sausages as influenced by type of meat

S.no.	Parameter	SBBH	Broiler	t-value
1.	Appearance	7.93±0.15	8.04±0.14	0.493
2.	Flavour	8.31±0.14	8.00±0.18	0.172
3.	Juiciness	7.75±0.16	7.93±0.18	0.753
4.	Tenderness	7.91±0.15	7.98±0.16	0.270
5.	Overall acceptability	7.83±0.14	7.88±0.17	0.228

<sup>\*\*</sup>Significant at 0.01    <sup>\*</sup>Significant at 0.05    SBBH- Spent broiler breeder hen

**Chart.1** Proximate composition of chicken sausages as influenced by type of meat



## **Cholesterol**

The mean of percent cholesterol of sausages prepared from spent broiler breeder hen and broiler were  $81.45 \pm 0.08$  and  $83.09 \pm 0.04$  respectively. Sausages made from spent broiler breeder hen chicken recorded significantly ( $P < 0.01$ ) lower cholesterol values when compared to the sausages made from broiler. Sausages made from Spent broiler breeder hen meat recorded significantly ( $P < 0.01$ ) lower cholesterol values when compared to the sausages made from broiler. This may be because of lower fat content of spent broiler breeder meat than broilers. These findings are in agreement with Ang and Hamm (1982), Jin *et al.*, (2007) and Trindade *et al.*, (2004).

## **Proximate composition of sausages made from spent broiler breeder hen and broiler**

The mean  $\pm$  SE values of proximate composition of sausages as influenced by type of meat are presented in Table 4. Proximate composition of chicken sausages as influenced by type of meat is represented in Chart No.1.

The mean  $\pm$  SE values of percent moisture for sausages prepared from spent broiler breeder hen and broiler were  $67.14 \pm 0.05$  and  $68.17 \pm 0.11$  respectively. The mean  $\pm$  SE values of percent crude protein for sausages made from spent broiler breeder hen and broiler were  $18.44 \pm 0.05$  and  $17.32 \pm 0.07$  respectively. The mean  $\pm$  SE values of percent crude fat for sausages made from spent broiler breeder hen and broiler were  $10.69 \pm 0.08$  and  $11.38 \pm 0.07$  respectively. The mean  $\pm$  SE values of percent total ash for sausages made from spent broiler breeder hen and broiler meat were  $1.51 \pm 0.03$  and  $1.43 \pm 0.01$  respectively. The mean  $\pm$  SE values of percent crude fiber for sausages made from spent broiler breeder hen and broiler were  $0.66 \pm 0.007$  and  $0.56 \pm 0.018$  respectively.

Chicken sausages made from spent broiler breeder hen meat found to have significantly ( $P < 0.01$ ) higher percentages of crude protein, crude fiber, total ash and significantly ( $P < 0.01$ ) lower percentages of moisture, crude fat when compared to the broiler meat sausages. Protein and fat content of two groups of sausages are within the permissible limits of BIS, which specified that the maximum fat content of sausage should not be above 20%. The range of values of crude fiber content in sausages can be attributed to flour, condiments and spices (Biswas *et al.*, 2011). These findings are correlated with Bhattacharya *et al.*, (2007), Ilayabharathi *et al.*, (2012), Jin *et al.*, (2007), Kim, (2014) and Suradkar *et al.*, (2013).

## **Sensory evaluation of spent broiler breeder hen and broiler chicken sausages**

The mean  $\pm$  SE values of sensory parameters like appearance, flavor, juiciness, tenderness and overall acceptability of chicken sausages as influenced by type of meat are presented in Table 5.

The mean  $\pm$  SE values of appearance for sausages made from spent broiler breeder hen and broiler were  $7.93 \pm 0.15$  and  $8.04 \pm 0.14$  respectively. The mean  $\pm$  SE values of flavour for sausages made from spent broiler breeder hen and broiler were  $8.31 \pm 0.14$  and  $8.00 \pm 0.18$  respectively. The mean  $\pm$  SE values of juiciness for sausages made from spent broiler breeder hen and broiler were  $7.75 \pm 0.16$  and  $7.93 \pm 0.18$  respectively. The mean  $\pm$  SE values of tenderness for sausages made from spent broiler breeder hen and broiler were  $7.91 \pm 0.15$  and  $7.98 \pm 0.16$  respectively. The mean  $\pm$  SE values of overall acceptability for sausages made from spent broiler breeder hen and broiler were  $7.83 \pm 0.14$  and  $7.88 \pm 0.17$  respectively. Sausages made from broiler meat recorded uniformly higher scores for all sensory parameters except flavor when

compared to the spent broiler breeder hen meat sausages; however the difference was not statistically significant. Scores of all sensory parameters for two groups of sausages were in the range of 8.31-7.75 (Good acceptability) which indicates acceptability of the chicken sausages. Mean sensory scores of chicken sausages were not significantly ( $P < 0.05$ ) affected by type of meat. However, chicken sausages made from broiler meat scored uniformly higher scores for all sensory parameters except flavour than spent broiler breeder hen sausages. Better scores for broiler nuggets might be attributed to more tender meat and less fibrous meat tissues as compared to spent hen meat (Wenham *et al.*, 1973). Present findings are in close agreement with those of Biswas *et al.*, (2006). Scores of all sensory parameters for two groups of sausages were in the range of 7.75 - 8.31 (Good acceptability) which indicates acceptability of the chicken sausages. Similar trend is reported by Bhattacharyya *et al.*, (2007) in spent duck sausages, Lengkey and Lobo (2016) in comparative study of chicken and rabbit low fat sausages, Pawar *et al.*, (2011) in spent chicken patties and Sreenivasa Rao *et al.*, (2011) in spent hen chicken sausages. Sausages made from spent broiler breeder hen meat had significantly superior scores in physico chemical and proximate analysis than sausages made from broiler meat and also noticed no significant difference in sensory scores between two groups of sausages. Hence, spent broiler breeder hen meat can be used for development of low fat chicken sausages fortified with vegetable oil seed paste as partial fat replacer.

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