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ORIGINAL ARTICLE

Preparation, storage stability and palatability of spent hen meal based pet food

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Abstract Extruded pet foods were prepared by extrusion process incorporating dry rendered spent hen meal (SHM) at 10 and 20% levels, and packed in LDPE bags before storage at room temperature (35 ± 2ºC) up to 45 days. The colour of the pet foods was uniformly brown with pleasant meaty odour. The thiobarbituric acid, tyrosine values, free fatty acid content and acid value and total bacterial counts increased gradually during storage but *E .coli, Salmonella* spp*, Clostridium* spp*, Staphylococci* spp and fungi were not detected during storage. The pet owners rated the pet foods as good. The body weight of the adult pet dogs did not decrease during the feeding trial of one month and the health condition of pets was good. The cost of production per kg of pet food containing 10 and 20% SHM was Rs 18.00 and Rs 22.75, respectively. It was concluded that a pet food (whole meal) with good nutritive quality and palatability to dogs can be prepared by incorporating 10–20% of spent hen meal which can be safely stored up to 45 days at room temperature.

Keywords Spent hen meal · Extruded pet foods · Dog feeding trials · Storage stability

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Introduction

Poultry industry in India is a well organized, most dynamic and rapidly expanding segment of the livestock economy. Spent hen meat is tough, dry and sinewy (fibrous) and hence there is limited demand for spent hens in the meat market. Poultry protein meals are a popular high quality protein source used in pet foods (Aldrich 2006). Preparation of pet foods incorporating spent hen meal could be a profitable way of utilization of spent hens (Haque et al. 1991).The pet population is also increasingly being fed with commercially prepared pet foods. The present study was planned to assess the palatability and storage stability of pet food containing dry rendered spent hen meal for use in pet foods.

Materials and methods

Preparation of spent hen meal: Spent hens, (*Gallus gallus*) weighing 1.0–1.5 kg each, were collected from M/s Aishwarya Poultry Farms, Trichy. The birds were transported early in the morning and slaughtered by decapitation using a sharp knife. The crushed whole spent hen carcasses were processed by dry rendering in the laboratory by cooking at 100°C for 20 min, sterilization at 140°C (3 bar pressure) for 20 min and drying at 100°C for about 60 min. The fat in the cooked material was separated by centrifugation in the basket centrifuge at 1000 rpm for 20 min. The spent hen meal (SHM) was cooled, dried and pulverized through a hammer mill and packed in the low density polyethylene (LDPE, 250 gauge) bags and stored at room temperature (35 ± 2°C) in cool dry place.

The SHM was analyzed for moisture, crude protein, ether extract, crude fibre, total ash, Ca, P, nitrogen free extract and metabolizable energy as per AOAC (1995). The amino acid composition of SHM was determined by NIR Spectroscopy at Degussa laboratory, Feed Additives Division, Nariman Point, Mumbai, India.

Pet food formulations: Based on the nutrient specification of AAFCO (1995) and NRC (2006) for the adult dog's

maintenance diet a whole meal was formulated incorporating SHM at 10 and 20% levels. The ingredients were mixed and 15% water was added, after 15 min of preconditioning, the mix was extruded through a BTPL-Lab Twin Screw Extruder (model TSE 002, Kolkata, India). The extruded pet food was cooled and packed in LDPE bags (250 gauge) and stored at room temperature (35 ± 2°C).

Quality analysis: The analysis of the pet foods was done at fortnightly interval during storage. The parameters were similar to those for SHM. The ME (kcal/kg) was calculated as 3.5 × CP + 8.5 × EE + 3.5 × NFE (AAFCO 2004).

Thiobarbituric acid (TBA) value was estimated by extraction method described by Witte et al. (1970) and was expressed as mg malonaldehyde per kg of pet food. The procedure of Strange et al. (1977) was followed for the tyrosine value with slight modifications. Tyrosine value was calculated and expressed as mg of tyrosine per 100 g of sample. Estimation for the free fatty acid content was done by using modified (AOAC 1995) method and expressed in% oleic acid. The acid value was estimated according to AOAC (1995) and it was expressed as ml per g of sample. The microbiological quality of pet foods was assessed in respect of total plate count, *E. coli, Staphylococci* spp*, Clostridium* spp*, Salmonella* spp*,* yeast and mould count as per the method prescribed by Quinn et al. (1994). Bacterial count was expressed as log cfu /g sample.

Feeding trials in pet dogs: Selection of pet dogs for feeding trials was based on AAFCO (1994). Twenty four adult dogs (about one year of age) of different breeds were randomly selected in Namakkal town. They were divided into 2 groups of 12 each for feeding trial with pet food containing 10 and 20% SHM. Daily allowance for dogs was calculated as per NRC (1974) as 22 g of dry matter consumption per kg of body weight. Each dog was allowed a switch over period of about 15 days for adapting to the new pet food by offering gradually increasing amount of pet food every day. Dog owners were advised to feed the dog with complete replacement of regular diet with the given pet food. The body weights of pet dogs were recorded on the first day of the feeding trial and subsequently on the 15th and 30th day. Feeding trial was conducted with complete replacement for 30 days and at the end of the feeding trial again a switch over period of about 15 days was observed to start routine food. The cost of production of the pet food was calculated based on the market price of the ingredients. The cost of spent hen meal and fat was taken as Rs 70 and Rs 5 per kg, respectively.

Statistical analysis: The data (3 replicates) were subjected to analysis of variance (ANOVA) as per Snedecor and Cochran (1989) using Statistical Analytical System (SPSS 1999) version 10.0 for Windows. Significant differences ($p < 0.05$) were tested by Duncan's multiple range test.

Results and discussion

Chemical composition of SHM, ingredient composition and chemical composition of the pet food diets containing 10 and 20% SHM are presented in Tables 1 and 2. Use of spent hen meal in pet food formulation was justified by Ockerman and Hansen (1988) and Aldrich (2006) as it provided high quality protein with good balance of amino acids. Aldrich (2006) reported that rendered fats and oils like tallow, lard, poultry fat and fish oil provide a supplementary source of energy, flavour, texture and nutrients in pet foods. Strombeck (1999) stated that ethoxyquin is a safe and effective antioxidant and it is used at the rate of 0.015% in pet foods. Corbin (2001) recommended extrusion as the most acceptable method for commercial pet food production.

The NRC (2006) has recommended that the dry type of pet food should contain 6–10% moisture, 7–20% fat, 16–30% protein, 41–70% carbohydrate and 2800–4050 kcal ME/kg feed. Hence, the pet foods prepared in the present study can be categorized as dry pet foods. The visual colour of pet foods prepared was uniformly brown with pleasant meaty odour.

Storage stability of pet foods: The TBA values of pet foods increased gradually ($p < 0.01$) from 0.49 to 2.6 mg MA/kg and 0.41 to 2.5 mg MA/kg, respectively in pet foods containing 10 and 20% SHM during 45 days of storage (Table 3). Watts (1962) reported the threshold levels of TBA at 1–2 mg/kg for rancidity in fresh meat. The slightly higher TBA values in pet foods as recorded in the present study may be due to higher dry mater content. The tyrosine values also increased gradually ($p < 0.01$) during storage (Table 3). Dainty et al. (1975) opined that the increase in the concentration of tyrosine, tryptophan, ammonia and non

Table 1 Chemical composition of spent hen meal

Moisture , %	5.5 ± 0.44
Crude protein , %	72.1 ± 1.13
Ether extract , %	9.5 ± 0.48
Crude fiber , %	0.2 ± 0.02
Total ash , %	12.3 ± 0.25
Ca , %	4.4 ± 0.06
P , %	2.2 ± 0.04
Amino acid as % protein	
Methionine	1.61
Cystine	1.75
Lysine	5.14
Threonine	3.87
Tryptophan	0.85
Arginine	6.35
Isoleucine	2.31
Leucine	4.27
Valine	3.01
Histidine	1.30
Phenylalanine	2.43

(n = 12)

Table 2 Formulation and chemical composition of pet food containing spent hen meal (SHM)

Ingredients, %	10 % SHM	20 % SHM
Maize flour	39.6	15.2
Broken rice flour	8.6	35.1
Deoiled rice bran	1.0	7.0
Spent hen fat	12.0	12.0
Soybean meal flour	25.2	8.5
Spent hen meal	10.0	20.0
Dicalcium phosphate	2.6	1.3
Vitamins A,B_2,D_3,K mix (Hyblend[1])	0.01	0.01
Vitamin B Complex (Meriplex[2])	0.03	0.03
Choline chloride (60%)	0.3	0.1
Mineral mixture[3]	0.1	0.1
Common salt	0.8	0.8
Ethoxyquin (antioxidant)	0.02	0.02
E Care Se	0.02	0.02
Chemical composition, %		
Moisture	4.9 ± 0.03	4.9 ± 0.05
CP	22.3 ± 0.11	22.7 ± 0.06
Ether extract	12.3 ± 0.09	12.5 ± 0.04
Crude fibre	2.9 ± 0.03	2.6 ± 0.12
Total ash	4.3 ± 0.06	4.2 ± 0.04
Ca	1.1 ± 0.07	1.3 ± 0.04
P	0.8 ± 0.01	0.9 ± 0.02
Nitrogen free extract	53.3 ± 0.02	58.0 ± 0.07
ME, kcal/kg	3863.4 ± 1.20	3889.2 ± 0.77

[1]One gram of vitamin AB_2D_3K supplement contained 82500 IU of vitamin-A, 50 mg of vitamin-B_2, 12000 IU of vitamin-D_3 and 10 mg of vitamin-K [2]One gram of B-complex supplement contained 8 mg of vitamin-B_1, 16 mg of vitamin-B_6, 80 mcg of vitamin B_{12}, 80 mg of vitamin-E, 120 mg of niacin, 8 mg of folic acid, 80 mg of calcium pantothenate and 86 mg of calcium [3]Mineral mixture contained copper sulphate 1.746%, potassium iodide 0.181%, sodium selenite 0.013%, calcite 83.728% and zinc oxide 14.332% ME: Metabolizable energy.

Table 3 Biochemical and microbial quality of pet foods during storage at room temperature

Storage period, days	TBA, mg MA/kg	Tyrosine, mg/100 g	FFA, % oleic acid	Acid value, ml/g	Moisture, %	TVC, log cfu/g
			10% SHM			
0	0.5 ± 0.02^c	40.6 ± 0.90^c	2.5 ± 0.28^d	0.9 ± 0.03^d	4.9 ± 0.03	2.5 ± 0.01^d
15	1.3 ± 0.06^b	56.4 ± 2.18^b	3.9 ± 0.00^c	0.8 ± 0.03^c	4.9 ± 0.06	3.6 ± 0.01^c
30	2.5 ± 0.08^a	74.2 ± 0.88^a	5.4 ± 0.28^b	0.9 ± 0.00^b	5.1 ± 0.09	4.8 ± 0.00^b
45	2.6 ± 0.05^a	77.8 ± 0.53^a	6.8 ± 0.00^a	1.1 ± 0.03^a	5.2 ± 0.04	5.9 ± 0.00^a
			20% SHM			
0	0.4 ± 0.03^c	42.4 ± 0.90^c	2.8 ± 0.00^d	0.5 ± 0.00^d	4.9 ± 0.06	2.5 ± 0.01^d
15	0.9 ± 0.03^b	64.5 ± 1.52^b	4.2 ± 0.28^c	0.7 ± 0.00^c	4.7 ± 0.12	3.6 ± 0.00^c
30	2.4 ± 0.06^a	73.1 ± 0.22^a	6.2 ± 0.00^b	0.9 ± 0.03^b	5.0 ± 0.03	4.9 ± 0.00^b
45	2.5 ± 0.04^a	76.0 ± 0.60^a	7.3 ± 0.00^a	1.1 ± 0.00^a	5.1 ± 0.07	6.0 ± 0.00^a

Means bearing different superscripts differ significantly ($p < 0.01$) between storage period n= 2 ; TVC: Total viable count MA: Malonaldehyde

protein nitrogen occurs due to microbial activity producing proteolytic enzymes.

The free fatty acid and acid value increased ($p < 0.01$) in pet foods during storage up to 45 days. The free fatty acid value and acid value of the rendered animal fat were 0.5% and 1.0%, respectively (Anon 1978). The moisture content in both the pet food formulations increased marginally during the storage (Table 3). Monitoring of the moisture content of the final product was emphasized by Anon (2005) as an extremely important to ensure stability during storage and the maximum moisture content for dry expanded foods should be 12%. In the present study the moisture content of the pet foods on 45 days of storage was much below this value.

The total viable count increased ($p < 0.01$) from 2.5 to 5.9 and 2.5 to 6.0 log cfu/g, in pet foods with 10 and 20% SHM, respectively during the storage for 45 days. The steady increase in microbial count cautioned about the post processing/handling contamination. However, *E .coli, Salmonella* spp*, Clostridium* spp*, Staphylococci* spp and yeast and mould were not detected throughout the storage. These results explain the safety of pet foods and efficiency of the extrusion process for controlling food pathogens.

The physical attributes of the pet foods were preferred by the pet owner as the palatability in pet dogs was also very good. Importance of the use of animal proteins and fat to improve palatability of the pet food was observed by Dust et al. (2005). Necessity of canine palatability of the pet food was also explained by Araujo and Milgram (2004).

Body weight of pet dogs: A marginal increase in the body weight of dogs during feeding trail for 30 days was noticed (Table 4). Both the pet foods were readily accepted by the pet dogs and no digestive disturbance and allergic reactions were observed during the feeding trial. Maintenance of the body weight and absence of any adverse reaction was indicative of the nutritive quality and better palatability of the pet foods.

The cost of production of pet foods with 10 and 20% SHM levels worked out to Rs.18.00/kg and Rs. 22.75/kg, respectively. The cost of commercially available pet food (whole meal) ranged from Rs 60 to 120/kg. Hence, the pet foods (whole meal) developed by incorporating 10 and 20% SHM in the present study will have a good market potential.

Table 4 Live weight (kg)of pet dogs during feeding trial with spent hen meal (SHM)

SHM, %	Feeding period , days		
	0	15	30
10	20.7 ± 5.08	20.9 ± 5.10	21.1 ± 5.15
20	26.0 ± 5.11	26.4 ± 5.17	26.5 ± 5.20

Results not significant ($p > 0.05$) ($n = 12$)

Conclusion

A pet food (whole meal) with good nutritive quality and palatability to dogs can be prepared by incorporating 10 to 20% of SHM which can be safely stored up to 45 days at room temperature (35 ± 2°C) in LDPE bags. A lower production cost of the pet foods prepared in the present study compared to the commercially available pet foods is indicative of its good market potential.

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