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Proximate, microbiological and sensory evaluation of solar and oven dried spent hen meat powder incorporated with phytoingredients

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Abstract
Spent hen meat powder was developed by using oven and solar dryer and by incorporating phytochemicals (10%), which was stored under aerobic and vacuum packaging. Eight samples of spent hen meat powder were evaluated for its proximate, microbiological and sensory evaluation qualities in monthly interval. Addition of phytoingredients did not influence the proximate composition of the products. Significant increasing trend of moisture content and decreasing trend of calorific values were observed in all the samples. Throughout the storage period, absence of TVC, *clostridium*, *E coli*, *Salmonella*, *Staphylococcus* and yeast & mould count were observed in spent hen meat powder. Significant higher sensory scores were observed in treatments compare to control, in solar dried spent hen meat powder compare to oven dried spent hen meat powder and in vacuum packaged product than aerobic packaged product. Thus, economic production of spent hen meat powder is possible by incorporating phytoingredients in solar dryer and stored in low density polyethylene bags up to five months with its good nutritional, microbiological and sensory properties.

Keywords: Microbiological quality, oven drying, proximate analysis, sensory evaluation, solar drying, spent hen meat powder

Introduction
In India, poultry industry records a growth rate of 8% [1] with 24 crores of layers [2]. Effective utilization of layer birds after the end of their productive life is one of the vital requirements of the poultry industry, as 30% of the poultry slaughtered are spent hens [3]. Tremendous growth in layer industry is the foundation of augmented availability of spent hen in many folds in the preceding years and will remain so in years to come. Although, spent hen meat is a good protein source but having minimal economic values because of its higher collagen content and toughness.

Drying is a process of moisture removal due to simultaneous heat and mass transfer. In absence of cold chain, development of technologies for production of low-cost, safe and acceptable shelf stable dehydrated meat products which can be stored / marketed without refrigeration facility is need of the hour for developing countries with warm humid climate. Dried food products are preferred as they require less storage space, no cold chain facility, are easy to transport and useful in natural disasters such as cyclones, floods and earthquakes.

For commercial meat drying operations in rural settings, improved approaches have been developed using solar drying [4]. In contrast to sun drying, where the meat is exposed directly to the sun, the solar drying method uses indirect solar radiation. The principle of the solar drying technique is to collect solar energy by heating-up the air volume in solar collectors and conduct the hot air from the collector to an attached enclosure, the meat drying chamber and the principle is mainly based on greenhouse effect. The advantages of this method of drying is that meat is dried in a more hygienic way as there is no secondary contamination of the products through rain, dust, insects, rodents or birds.

Oxidative rancidity is the most common form of chemical deterioration of meat, which has negative effects on quality of meat and meat products causing changes in physical, chemical, organoleptic and nutritional quality. Antioxidants are used in meat and meat products to reduce lipid oxidation. The antioxidants can be synthetic or natural origin [5]. The demand for natural antioxidants, especially of plant origin has increased in the recent years due to the

growing concern about potential toxicological effects of synthetic antioxidants among consumers [6, 7]. Some natural plant extracts contain flavonoids and phenolic compounds that have anti-oxidative effects [8].

Packaging of poultry meat and poultry based meat products has always been challenging because of their perishable nature due to high sensitivity to spoilage and pathogenic microorganisms [9]. Elimination of oxygen in vacuum packaging also hinders moisture absorption, microbial contamination and lipid oxidation, which ultimately improves shelf stability of dried products.

Considering the above, spent hen chicken powder was prepared in both solar and oven dryer for conversion of low cost layer meat to a high cost value added product. Besides, the abundant untapped solar energy can efficiently and purposefully be used in the energy deficient rural areas of the North Eastern region of India. Further, indigenous herbs and spices with high antioxidant property are added to improve the quality of the spent hen meat powder.

Materials and Methods

A solar dryer (Fig.-1) was fabricated with wood which was composed of drying chamber, collector chamber and assemble box. An aluminium sheet painted with black color was fixed inside the collector chamber as collector plate. The collector chamber was covered with a 4mm thickness glass. A solar energy operated exhaust fan is attached at the top of drying chamber in order to control humidity and temperature. A solar panel was fixed on top of the drying chamber which was connected with solar charge controller, solar battery and digital UPS, which were kept inside the assemble box situated beneath the dryer chamber. A solar operated heater and a bulb was fixed in drying chamber for continuous heating during night times and cloudy days by backup energy stored in solar battery. An automatic digital temperature and humidity measuring apparatus was kept inside drying chamber to measure inside temperature and relative humidity.

Spent hens of commercial breed were obtained from Regional Poultry Breeding Farm, Kyrdemkulai, Ri Bhoi District, Meghalaya, India. Following ante-mortem examination, spent hens were hygienically slaughtered, dressed and deboned in the laboratory. All separable fat, fascia and connective tissue were trimmed off and meat was minced twice through 6 mm sieve in a meat mincer, packed in low density polyethylene (150 µm thickness) bags, and frozen at -18±2 °C till further use.

After conducting preliminary trials on spices and condiments to be incorporated in the preparation, following few spices viz. black pepper, cumin, coriander, cinnamon, clove and paprika powder and condiments viz. onion, garlic and ginger paste were prepared in the laboratory. Refined salt (Tata Chemicals Ltd., Mumbai) was procured from local market. After conducting preliminary trials and literature survey, as potent antioxidant source fruits and vegetables viz. amla (*Phallanthus emblica*), fermented bamboo shoot (*Bamboosa auriculata*), round lemon (*Citrus limon*), green tea (*Camellia sinensis*), and pomegranate (*Punica granatum*) was used in 3:3:1:1:2 respectively as non-meat ingredients for treatment groups (Fig.-2).

After thawing of frozen minced meat, lean minced meat was mixed manually with the non meat ingredients chosen viz. salt, ice cubes, spices and condiments. After thorough mixing minced meat was transferred to a clean glass beaker, which was placed in a pressure cooker containing required amount of water. Pressure cooker was closed and cooked for 5min at 15lbs pressure [10]. Required amount of fruit and vegetables in the form of extracts were added after cooking as shown in the formulation (Table 1).

Cooked meat mix was spread on cleaned stainless steel plates and placed in solar dryer as well as oven dryer (Make: Lab Tech, LBI-150E). The identities of each group were maintained and their weights were recorded. The temperature maintained in the oven dryer was 70 °C but the temperature in solar dryer was 60-70 °C. The drying time allowed in the solar dryer and in oven dryer was 30-35 hours and 20 hours respectively. Along with the treatments, controls were also prepared parallelly without addition of phyto-ingredients.

Dried meat was ground in a kitchen grinder (Make: Havells, Marathon) till fine powder were obtained and sieved by using a sieve (Mesh size No 45, Sieve opening 354µm or 0.354mm) to remove the coarse material from meat powder.

Meat powder was packed in two methods i.e. vacuum packaging and aerobic packaging. Meat powder was placed inside food grade LDPE bag of 150µm thickness and sealed with packaging sealer (Make: Golden Eagle) for aerobic packaging and with vacuum packaging machine (Make: Sevana) for vacuum packaging. Meat powder packets were kept in room temperature by maintaining their identity intact. Finally, following 8 samples (FIG.-3 & 4) were assessed in monthly intervals to determine the Proximate, microbiological and sensory quality parameters.

Sample-A: Solar dried control sample under aerobic packaging
Sample-B: Solar dried control sample under vacuum packaging
Sample-C: Solar dried treatment sample under aerobic packaging
Sample-D: Solar dried treatment sample under vacuum packaging
Sample-E: Oven dried control sample under aerobic packaging
Sample-F: Oven dried control sample under vacuum packaging
Sample-G: Oven dried treatment sample under aerobic packaging
Sample-H: Oven dried treatment sample under vacuum packaging

Moisture

Ten grams of samples were weighed in a pre-weighted aluminium moisture cups and transferred to hot air oven maintained at 100 °C for 16h with the lids kept slightly open. After completion of the drying period, the cups were removed from the hot air oven and placed in a desiccator to cool. The moisture cups with dried meat sample and the lid was weighed and again transferred to the hot air oven. The process was repeated until constant weight of the sample was obtained. The percentage of moisture was calculated by the following formula:

Weight of the solids = Weight of the dried sample with container – Weight of the container

$$\text{Solids (\%)} = \frac{\text{Weight of dried solids}}{\text{Weight of original fresh sample}} \times 100$$

Moisture (%) = 100 – % Solids

Crude Protein

Crude protein contents of the samples were determined by Micro- Kjeldahl method by estimating at first the amount of nitrogen in the sample and thereafter multiplying the amount of nitrogen by 6.25.

For this, 0.2g of moisture free samples were digested in Kjeldahl flask in presence of 10ml of concentrated H_2SO_4 and 3g of digestion mixture (K_2SO_4: $CuSO_4$= 10:1). The digestion was carried out by placing the flasks in the digestion unit of KEL PLUS KES 6L (Make: Pelican equipment, Chennai). The temperature was fixed at 400 °C and the samples were boiled for $1^1/_2$ to 2h until the solutions colour turns into green. The digested samples were allowed to cool to room temperature and distilled in the distillation unit of the instrument (KEL PLUS CLASSIC DX; Make: Pelican Equipment, Chennai). The distillate containing methyl red was titrated against 0.1N HCl.

From the titer of each sample the crude protein content was calculated by the following formula:

$$\% \text{ Crude protein} = \frac{14 \times \text{Normality of the acid} \times \text{titration value} \times 6.25 \times 100}{\text{Weight of the sample} \times 1000}$$

The total protein content of the samples was converted into fresh weight or as such basis.

Crude Fat

One gram of each dried samples were weighed and put into thimbles made of Whatman No. 1 filter paper. The thimbles with samples were then put inside the oil flask of the SOCS INFRA SIS 6 Ether Extractor (Make: Pelican Equipments). Petroleum ether having a boiling point of 60-80 °C was poured into the upper chamber of the extractor and allowed to come down to the oil flasks. The temperature was fixed at 80 °C for the initial 1h and thereafter raised to 180 °C. Ether was collected at the upper chamber of the extractor. The oil flasks containing fat at the bottom were subsequently transferred to a hot air oven (105 °C) to evaporate the residual ether. Oil flasks were then cooled in desiccators and weighed.

$$\text{Crude Fat (\%)} = \frac{(\text{Weight of the oil flask with extract} - \text{Weight of oil flask})}{\text{Weight of the sample}} \times 100$$

The total fat content of the samples were converted into fresh weight or as such basis.

Total Ash

One gram of each of oven dried sample was weighed in a silica crucible and was made smoke free by placing the crucible over an electric heater. The crucible was then placed in a muffle furnace and operated at 525 °C for 10 to 12h till the sample is converted into white ash. On removal from the muffle furnace, the samples were cooled to room temperature by placing the crucibles in desiccators. On cooling the weight of the crucibles containing ash were recorded. The percent total ash was calculated as follows:

Weight of ash= Weight of ash with crucible- Weight of crucible

$$\text{Total Ash (\%)} = \frac{\text{Weight of the ash}}{\text{Weight of the sample}} \times 100$$

The total ash contents of the samples were converted into fresh weight or as such basis.

Carbohydrate

The total percentage of carbohydrate content was determined by the difference method. This method involved adding the total values of moisture, crude protein, crude fat, total ash content of sample and subtracting it from hundred. The value obtained is the percentage of total carbohydrate content of sample.

Thus:

Total Carbohydrate = 100 – (% moisture + % crude protein + % crude fat + % total ash)

Calorific value

The energy content was determined by multiplying the percent values of crude protein, crude fat and total crude carbohydrate by the factor of 4, 9 and 4 respectively and summing up these values [11]. Calorific value obtained is expressed as Kcal/100g of sample.

Total viable count (TVC)

Plate count agar media was prepared as per manufacturer's instructions and enumeration of total viable count was done by following pour plate technique [12]. Ten fold serial dilutions were made and from appropriate dilution 1ml inoculum was transferred to petridish, poured with plate count agar media (melted and cooled to 40-45 °C) and mixed properly by 5 times to and fro, 5 times clockwise, 5 times to and fro at right angle and 5 times anti-clockwise. Plates were incubated at 37 °C for 24h for enumeration of total viable count. Counting was done by using a bacteriological colony counter (Lapiz®) and all those plates yielding >25 and <250 bacterial colonies were taken into account. The counts were expressed as cfu/g of sample.

Presence or absence test for Sulphide reducing *Clostridium* organisms

Broth and semi solid medium of Differential Reinforced Clostridial agar were prepared as per manufacturer's instructions and enumeration of sulphide-reducing clostridia was done [12]. Appropriate dilutions of the samples were first inoculated in Differential Reinforced Clostridial Broth Base and then incubated at 37 °C for 24h in an anaerobic jar. After 24h, semi solid Differential Reinforced Clostridial agar medium was stab inoculated and the tubes were incubated at 37 °C up to 10 days in an anaerobic jar. Tubes were checked routinely for the presence of black coloured colonies of clostridial organisms.

Escherichia coli

EMB Agar (Eosin Methylene Blue Agar) media was prepared as per manufacturer's instructions and enumeration of *E. coli* was done by following pour plate technique [12]. Ten fold serial dilutions were made and from appropriate dilution 1ml inoculum was transferred to petridish, poured with EMB agar media (melted and cooled to 40-45 °C) and mixed properly. Plates were incubated at 42 °C for up to 24h for enumeration of *Escherichia coli* count. Counting was done by using a bacteriological colony counter (Lapiz®).

Salmonella

The media used for detecting Salmonella were Rappaport Vassiliadis medium (pre enrichment broth) and Brilliant

Green Agar (BGA). Plates were prepared by pouring 12-15ml media into sterile petridishes at 45-50 °C. 25 grams of meat powder was mixed with 225ml of 0.1% buffered peptone water and homogenized for 1 minute and incubated at 37 °C for 24 hours. 10ml of culture was transferred to the conical flask containing 100 ml of pre enrichment media (Rappaport vassiliadis media). After that the flask were incubated further at 37 °C for 24 hours. A loop full of culture from the enrichment broth was subcultured onto brilliant green agar and incubated the plates at 37 °C for 24-48 hours. Appearance of pink or red colour colonies indicates presence of salmonella [13].

Staphylococcus counts

Mannitol Salt Agar (MSA) was prepared as per manufacturer's instructions and enumeration of *Staphylococcus* was done by following pour plate technique [12]. Ten fold serial dilutions were made and from appropriate dilution 1ml inoculum was transferred to petridish, poured with Mannitol Salt Agar media (melted and cooled to 40-45 °C) and mixed properly. Plates were incubated at 37 °C for 48 hours for enumeration of staphylococcus counts.

Yeast and Mould counts

Rose Bengal Chloramphenicol Agar media was prepared as per manufacturer's instructions and enumeration of yeast and mould was done by following pour plate technique [12]. Ten fold serial dilutions were made and from appropriate dilution 1ml inoculum was transferred to petridish, poured with Rose Bengal Chloramphenicol Agar media (melted and cooled to 40-45 °C) and mixed properly. Plates were incubated at 25 °C up to 3-5 days for enumeration of yeast and mould counts. Counting was done by using a bacteriological colony counter (Lapiz®).

Sensory evaluation

Dried spent hen meat powder samples were subjected to evaluation for organoleptic qualities by serving the products to a 7-member panel of semi trained judges of different age group and sexes without any conversation or discussion among themselves. All the samples were evaluated for appearance, colour, flavour, texture, taste and overall acceptability by using a 7 point hedonic scale score card [14].

Statistical analysis

A minimum of five batches of the products were prepared for the proposed study. The data obtained from the above study were analyzed statistically following the Duncan Multiple Range Test method by using SAS software.

Result and Discussion

The moisture content of the spent hen meat powders did not differ significantly between control and treated samples in both the drying methods; indicates addition of phytoingredients as source of antioxidants did not influence the moisture content in the products (Table 2). As the storage period was proceeding, corresponding value for moisture content in all the control and treatment groups were also increasing linearly at a uniform rate which might be due to hygroscopic nature of meat powder. Similar increasing trend of moisture content during storage of dry meat was also reported [15]. Although differences were non-significant, consistently lower moisture contents were observed under vacuum packaging compared to aerobic packaging indicating higher moisture absorption by spent hen meat powder from environment under aerobic packaging compared to vacuum packaging.

No significant differences were observed in protein content of meat powder between drying methods, packaging methods and also between control and treatment (Table 3). Non-significantly lower protein content was observed in the treated groups compare to control groups due to substitution of 10% meat with lower crude protein containing phytoingredients in treated groups. A non-significant decreasing trend in protein content was observed as the storage period of products progressed, which might be due to influence of moisture absorption by meat powder [16]. Result is also supported by the findings of reduction in protein content during storage of meat dried by sun and oven drying [17].

Both the drying method had similar effect on the spent hen meat powder as the mean crude fat content did not differ significantly (Table 4). The treatment groups contains lower crude fat content than that of control groups due to substitution of meat with non meat ingredients (phytoingredients) containing very less amount of fat in treatment groups. Although differences are non-significant, there is a decreasing trend of crude fat content in both control and treatment groups, which may be related to increase in moisture content and possible lipolytic activities of the corresponding enzymes during storage. Similar findings of reduction in fat content was also observed during storage of meat dried by sun and oven drying [17].

Total ash contents are higher in treatments than that of control (Table 5), which might be due to incorporation of phytoingredients in treatments. Both the drying method had similar effect on the spent hen meat powder as the mean total ash content did not differ significantly. Although differences are non-significant, the mean values for total ash content during storage period shows a trend of higher ash content in vacuum packaged sample compare to aerobic packaged sample. This might be due to lower moisture absorption by vacuum packaged sample compared to aerobic packaged sample, reciprocally higher total ash contents in vacuum packaged sample. This study may be supported by the findings of decreasing trend in ash content during storage [17, 18].

The carbohydrate content of spent hen meat powder does not differ significantly between drying methods, packaging methods, storage period and also between control and treatment (Table 6).

The calorific value of spent hen meat powder does not differ significantly between drying methods, packaging methods, storage period and also between control and treatment (Table 7). Non-significant variation of calorific value in chicken powder was also reported during 90 days of storage period [19].

The results on microbiological quality revealed that there is absence of total viable count, sulphide reducing *clostridium*, *Escherichia coli* count, *Salmonella*, *Staphylococcus* counts and yeast and mould count in spent hen meat powder throughout the storage period (Table 8), which might be due to the lower moisture content during storage period. It was also reported that none of dehydrated low sodium chicken strips from spent hen meat packed in food grade polythene bags were positive for *Salmonella* during 30 days storage study [20]. Absence of total viable count, sulphide reducing *Clostridium* and yeast and mould count was also reported in ready-to-cook solar and mechanically dried pork products

during 180 days of storage period except few colonies in meat cubes after 150 days of storage period [21].

Significant (p<0.01) differences are observed in sensory parameters viz. appearance, color, flavor, texture, taste and overall acceptability score of spent hen meat powder between packaging methods, storage period and between control and treatment (Table 9-14). Higher scores were observed in solar dried spent hen meat powder compare to oven dried meat powder during whole storage period. Higher scores were also observed in treatments compare to control, which might be due to addition of phytoingredients in treatments, leads to impede oxidation of fat as it contains antioxidant. Similarly higher scores were also observed in vacuum packaged product than aerobic packaged product. This might be due to limited moisture absorption and absence of oxygen in vacuum packaged product which restricts cake formation, proteolysis, lypolysis etc. and thus enhance the consumer acceptance. It was reported that all the sensory characteristics of aerobically packaged dehydrated meat products decrease with increase in the storage period as compared to vacuum packaged products [22]. There is also significant (p<0.01) decreasing trends in sensory scores of both control and treatment during storage period. This might be due to occurrence of mild lypolysis during storage period. It was also reported that there is significant effects on the sensory qualities of the products due to different packaging methods, packaging materials and days of storage [23, 24]. Taste and overall acceptability of spent hen meat powder could not observe on 180th day of storage period, since flavor of the control samples of both drying and packaging methods became undesirable and treated samples of both drying and packaging methods became moderately undesirable.

Table 1: Formulation for preparation of spent hen meat powder

Ingredients (parts per hundred)	Amount (%)	
	Control	Treatment
Minced chicken	**90**	**80**
Non-meat ingredients		
a) Fruits and vegetable as source of antioxidants (Amla, Fermented bamboo shoot, Round lemon, Green tea and Pomegranate)	0	10
b) Salt	2	2
c) Spices (Black pepper, Cumin, Coriander, Cinnamon, Clove, Paprika powder)	1	1
d) Condiments (Garlic: Ginger: Onion = 1:1:2)	4	4
e) Ice cubes	3	3

Table 2: Moisture content (%) of spent hen meat powder during storage periods (Mean±SE)

Storage period (day)	Solar Dried				Oven Dried			
	Control		Treatment		Control		Treatment	
	Aerobic Packaging (A)	Vacuum Packaging (B)	Aerobic Packaging (C)	Vacuum Packaging (D)	Aerobic Packaging (E)	Vacuum Packaging (F)	Aerobic Packaging (G)	Vacuum Packaging (H)
0	$_{c}$4.23±1.14	$_{b}$4.23±1.14	$_{c}$4.40±1.46	$_{b}$4.40±1.46	$_{c}$3.99±0.66	$_{b}$3.99±0.66	$_{d}$3.70±0.76	$_{b}$3.70±0.76
30	$_{bc}$5.46±1.07	$_{ab}$5.29±0.96	$_{bc}$5.67±1.36	$_{ab}$5.20±1.31	$_{bc}$5.55±0.33	$_{ab}$5.08±0.41	$_{cd}$5.14±0.39	$_{ab}$4.73±0.43
60	$_{bc}$5.76±0.96	$_{ab}$5.38±0.70	$_{bc}$5.77±1.14	$_{ab}$5.33±1.30	$_{bc}$5.68±0.57	$_{ab}$5.18±0.58	$_{bcd}$5.26±0.45	$_{ab}$4.84±0.36
90	$_{bc}$5.91±0.58	$_{ab}$5.49±0.87	$_{abc}$6.48±1.19	$_{ab}$5.36±1.07	$_{bc}$5.96±0.60	$_{ab}$5.22±0.28	$_{bcd}$5.83±0.25	$_{ab}$4.85±0.10
120	$_{ab}$6.77±0.61	$_{ab}$6.32±0.72	$_{ab}$6.98±0.79	$_{ab}$6.41±0.87	$_{ab}$6.72±0.46	$_{ab}$5.92±0.33	$_{abc}$6.66±0.44	$_{a}$5.92±0.42
150	$_{ab}$7.49±0.67	$_{a}$6.65±0.72	$_{ab}$7.65±0.76	$_{a}$6.76±0.86	$_{ab}$7.59±0.49	$_{a}$6.37±0.40	$_{ab}$7.52±0.53	$_{a}$6.37±0.43
180	$_{a}$8.11±0.67	$_{a}$6.92±0.71	$_{a}$8.16±0.77	$_{a}$6.98±0.84	$_{a}$8.16±0.52	$_{a}$6.69±0.39	$_{a}$8.16±0.55	$_{a}$6.69±0.43
Mean having different subscripts in the column (small letter) differ significantly (P<0.01), SE=Standard Error, N=5.								

Table 3: Protein content (%) of spent hen meat powder during storage periods (Mean±SE)

Storage period (day)	Solar Dried				Oven Dried			
	Control		Treatment		Control		Treatment	
	Aerobic Packaging (A)	Vacuum Packaging (B)	Aerobic Packaging (C)	Vacuum Packaging (D)	Aerobic Packaging (E)	Vacuum Packaging (F)	Aerobic Packaging (G)	Vacuum Packaging (H)
0	68.86±0.89	68.86±0.89	68.55±1.08	68.55±1.08	69.17±0.78	69.17±0.78	68.80±0.93	68.80±0.93
30	68.31±0.72	68.47±0.75	68.25±0.75	68.39±0.86	68.96±0.72	68.98±0.82	68.54±0.74	68.64±0.78
60	68.20±0.87	68.38±0.73	68.19±0.73	68.30±0.78	68.84±0.82	68.92±0.66	68.48±0.61	68.53±0.69
90	68.14±0.38	68.32±0.28	68.09±0.31	68.27±0.28	68.77±0.10	68.88±0.23	68.41±0.16	68.50±0.36
120	68.06±0.46	68.22±0.31	67.97±0.30	68.21±0.29	68.62±0.11	68.78±0.21	68.22±0.20	68.43±0.37
150	67.96±0.46	68.18±0.31	67.83±0.31	68.14±0.28	68.47±0.10	68.70±0.19	68.08±0.19	68.36±0.36
180	67.85±0.46	68.13±0.31	67.75±0.32	68.09±0.28	68.33±0.10	68.62±0.19	67.97±0.18	68.31±0.35
SE=Standard Error, N=5.								

Table 4: Crude fat content (%) of spent hen meat powder during storage periods (Mean±SE)

Storage period (day)	Solar Dried				Oven Dried			
	Control		Treatment		Control		Treatment	
	Aerobic Packaging (A)	Vacuum Packaging (B)	Aerobic Packaging (C)	Vacuum Packaging (D)	Aerobic Packaging (E)	Vacuum Packaging (F)	Aerobic Packaging (G)	Vacuum Packaging (H)
0	11.15±0.23	11.15±0.23	10.90±0.61	10.90±0.61	11.39±0.52	11.39±0.52	11.06±0.44	11.06±0.44
30	10.95±0.70	10.95±0.76	10.81±0.70	10.84±0.76	11.30±0.60	11.32±0.54	10.89±0.56	11.03±0.57
60	10.79±0.58	10.87±0.57	10.75±0.65	10.81±0.73	11.05±0.70	11.06±0.62	10.78±0.52	10.84±0.60
90	10.79±0.33	10.84±0.22	10.69±0.48	10.80±0.41	10.95±0.40	11.00±0.40	10.74±0.23	10.83±0.44
120	10.70±0.31	10.81±0.21	10.63±0.47	10.79±0.41	10.86±0.40	10.97±0.40	10.67±0.24	10.78±0.45
150	10.61±0.30	10.76±0.21	10.56±0.49	10.76±0.41	10.76±0.40	10.92±0.40	10.62±0.23	10.76±0.45
180	10.40±0.30	10.64±0.19	10.46±0.49	10.73±0.42	10.57±0.40	10.82±0.41	10.52±0.23	10.71±0.45
SE=Standard Error, N=5.								

Table 5: Total ash content (%) of spent hen meat powder during storage periods (Mean±SE)

Storage period (day)	Solar Dried				Oven Dried			
	Control		Treatment		Control		Treatment	
	Aerobic Packaging (A)	Vacuum Packaging (B)	Aerobic Packaging (C)	Vacuum Packaging (D)	Aerobic Packaging (E)	Vacuum Packaging (F)	Aerobic Packaging (G)	Vacuum Packaging (H)
0	9.92±0.41	9.92±0.41	10.17±0.44	10.17±0.44	9.99±0.52	9.99±0.52	10.16±0.38	10.16±0.38
30	9.55±0.48	9.59±0.51	9.67±0.49	9.77±0.58	9.57±0.63	9.67±0.56	9.95±0.63	10.01±0.51
60	9.54±0.21	9.58±0.26	9.66±0.33	9.77±0.37	9.52±0.42	9.58±0.54	9.91±0.40	9.94±0.38
90	9.53±0.32	9.57±0.36	9.66±0.43	9.76±0.51	9.49±0.30	9.56±0.30	9.79±0.39	9.86±0.40
120	9.46±0.32	9.55±0.37	9.64±0.42	9.75±0.52	9.42±0.31	9.53±0.31	9.72±0.38	9.82±0.39
150	9.38±0.30	9.52±0.36	9.61±0.42	9.70±0.53	9.34±0.30	9.50±0.30	9.64±0.35	9.77±0.36
180	9.32±0.31	9.46±0.35	9.54±0.43	9.64±0.52	9.28±0.30	9.47±0.30	9.52±0.32	9.71±0.35
SE=Standard Error, N=5.								

Table 6: Carbohydrate content (%) of spent hen meat powder during storage periods (Mean±SE)

Storage period (day)	Solar Dried				Oven Dried			
	Control		Treatment		Control		Treatment	
	Aerobic Packaging (A)	Vacuum Packaging (B)	Aerobic Packaging (C)	Vacuum Packaging (D)	Aerobic Packaging (E)	Vacuum Packaging (F)	Aerobic Packaging (G)	Vacuum Packaging (H)
0	5.84±1.09	5.84±1.09	5.98±0.91	5.98±0.91	5.46±1.34	5.46±1.34	6.27±1.31	6.27±1.31
30	5.73±1.64	5.70±1.66	5.60±1.52	5.79±1.78	4.61±1.06	4.95±1.42	5.47±1.26	5.59±1.25
60	5.71±0.57	5.80±0.69	5.63±1.14	5.79±0.98	4.91±0.86	5.26±0.54	5.57±0.73	5.85±0.84
90	5.63±0.83	5.77±1.34	5.07±1.27	5.80±1.42	4.83±0.64	5.34±0.76	5.21±0.68	5.96±1.02
120	5.00±1.01	5.10±1.31	4.79±1.06	4.85±1.30	4.38±0.52	4.80±0.68	4.72±0.83	5.04±1.22
150	4.56±1.07	4.90±1.31	4.35±0.92	4.64±1.28	3.84±0.62	4.51±0.76	4.14±0.91	4.73±1.26
180	4.92±1.06	4.85±1.30	4.09±0.85	4.56±1.25	3.66±0.64	4.40±0.74	3.83±0.89	4.59±1.23
SE=Standard Error, N=5.								

Table 7: Calorific value (Kcal/100g) of spent hen meat powder during storage periods (Mean±SE)

Storage period (day)	Solar Dried				Oven Dried			
	Control		Treatment		Control		Treatment	
	Aerobic Packaging (A)	Vacuum Packaging (B)	Aerobic Packaging (C)	Vacuum Packaging (D)	Aerobic Packaging (E)	Vacuum Packaging (F)	Aerobic Packaging (G)	Vacuum Packaging (H)
0	$_{a}$399.18±6.33	$_{a}$399.18±6.33	$_{a}$396.24±9.27	$_{a}$396.24±9.27	$_{a}$401.05±5.42	$_{a}$401.05±5.42	$_{a}$399.87±4.72	$_{a}$399.87±4.72
30	$_{ab}$394.73±6.30	$_{a}$395.26±5.96	$_{a}$392.66±7.96	$_{a}$394.30±8.11	$_{ab}$396.01±5.31	$_{a}$397.61±4.86	$_{a}$b394.07±4.82	$_{a}$396.20±5.35
60	$_{ab}$392.79±7.01	$_{a}$394.52±5.73	$_{a}$392.02±7.61	$_{a}$393.63±9.53	$_{ab}$394.43±6.13	$_{a}$396.27±5.85	$_{ab}$393.25±4.66	$_{a}$395.08±4.52
90	$_{ab}$392.22±5.17	$_{a}$393.94±5.25	$_{a}$388.55±8.04	$_{a}$393.36±7.82	$_{ab}$392.91±4.31	$_{a}$395.90±2.78	$_{ab}$391.21±2.57	$_{a}$395.30±1.55
120	$_{ab}$388.58±5.25	$_{a}$390.54±4.74	$_{a}$386.68±6.51	$_{a}$389.32±7.41	$_{ab}$389.75±3.71	$_{a}$393.05±3.15	$_{ab}$387.81±3.42	$_{a}$390.96±3.16
150	$_{ab}$385.55±5.35	$_{a}$389.15±4.68	$_{a}$383.74±6.57	$_{a}$387.97±7.42	$_{ab}$386.06±3.80	$_{a}$391.14±3.37	$_{ab}$384.50±3.76	$_{a}$389.26±3.18
180	$_{b}$382.30±5.36	$_{a}$387.68±4.59	$_{a}$381.47±6.69	$_{a}$387.16±7.33	$_{b}$383.09±3.98	$_{a}$389.44±3.44	$_{b}$381.86±3.81	$_{a}$387.94±3.23
Mean having different subscript in the column (small letter) differ significantly (P<0.01), SE=Standard Error, N=5.								

Table 8: Microbiological qualities of spent hen meat powder

Sl no.	Parameters	Results
1	Total viable plate count (cfu/g)	Not detected in entire storage period
2	Sulphide reducing *Clostridium* (Presence/ Absence)	
3	*Escherichia coli* count (cfu/g)	
4	*Salmonella* (Presence/ Absence)	
5	*Staphylococcus* count (cfu/g)	
6	Yeast and mould count (cfu/g)	

Table 9: Appearance scores of spent hen meat powder during storage periods (Mean±SE)

Storage period (day)	Solar Dried				Oven Dried			
	Control		Treatment		Control		Treatment	
	Aerobic Packaging (A)	Vacuum Packaging (B)	Aerobic Packaging (C)	Vacuum Packaging (D)	Aerobic Packaging (E)	Vacuum Packaging (F)	Aerobic Packaging (G)	Vacuum Packaging (H)
0	$_{a}6.31\pm0.03^{AB}$	$_{a}6.31\pm0.03^{AB}$	$_{a}6.49\pm0.06^{A}$	$_{a}6.49\pm0.06^{A}$	$_{a}6.17\pm0.08^{B}$	$_{a}6.17\pm0.08^{B}$	$_{a}6.29\pm0.09^{AB}$	$_{a}6.29\pm0.09^{AB}$
30	$_{b}5.89\pm0.12^{B}$	$_{b}6.03\pm0.12^{AB}$	$_{b}6.03\pm0.12^{AB}$	$_{b}6.20\pm0.11^{A}$	$_{b}5.91\pm0.07^{B}$	$_{ab}6.06\pm0.07^{AB}$	$_{b}6.00\pm0.12^{AB}$	$_{b}6.11\pm0.12^{AB}$
60	$_{b}5.80\pm0.07^{C}$	$_{b}5.89\pm0.08B^{C}$	$_{b}6.03\pm0.10^{AB}$	$_{bc}6.17\pm0.10^{A}$	$_{b}5.80\pm0.07^{C}$	$_{b}5.89\pm0.08^{BC}$	$_{b}5.97\pm0.09^{ABC}$	$_{b}6.11\pm0.09^{AB}$
90	$_{c}5.57\pm0.08^{C}$	$_{c}5.66\pm0.07^{BC}$	$_{b}5.86\pm0.08^{AB}$	$_{bc}6.00\pm0.08^{A}$	$_{c}5.57\pm0.08^{C}$	$_{c}5.66\pm0.07^{BC}$	$_{b}5.83\pm0.07^{AB}$	$_{bc}5.97\pm0.07^{A}$
120	$_{d}5.11\pm0.09^{C}$	$_{d}5.34\pm0.09^{B}$	$_{c}5.49\pm0.12^{B}$	$_{cd}5.91\pm0.06^{A}$	$_{d}5.11\pm0.09^{C}$	$_{d}5.34\pm0.09^{D}$	$_{c}5.49\pm0.12^{B}$	$_{bc}5.91\pm0.06^{A}$
150	$_{e}4.37\pm0.06^{C}$	$_{e}4.91\pm0.10^{B}$	$_{d}5.00\pm0.06^{B}$	$_{d}5.83\pm0.03^{A}$	$_{e}4.31\pm0.08^{C}$	$_{e}4.91\pm0.10^{B}$	$_{d}5.00\pm0.06^{B}$	$_{c}5.83\pm0.03^{A}$
180	$_{e}4.23\pm0.06^{E}$	$_{f}4.40\pm0.05^{D}$	$_{d}4.80\pm0.03^{BC}$	$_{e}5.06\pm0.07^{A}$	$_{e}4.20\pm0.07^{E}$	$_{f}4.37\pm0.03^{D}$	$_{e}4.77\pm0.03^{C}$	$_{d}5.00\pm0.05^{AB}$

Mean having different subscripts in the column (small letter) differ significantly ($P<0.01$).
Mean having different superscripts in the row (capital letter) differ significantly ($P<0.01$), SE=Standard Error, N=5.

Table 10: Colour scores of spent hen meat powder during storage periods (Mean±SE)

Storage period (day)	Solar Dried				Oven Dried			
	Control		Treatment		Control		Treatment	
	Aerobic Packaging (A)	Vacuum Packaging (B)	Aerobic Packaging (C)	Vacuum Packaging (D)	Aerobic Packaging (E)	Vacuum Packaging (F)	Aerobic Packaging (G)	Vacuum Packaging (H)
0	$_{a}6.31\pm0.03^{AB}$	$_{a}6.31\pm0.03^{AB}$	$_{a}6.46\pm0.05^{A}$	$_{a}6.46\pm0.05^{A}$	$_{a}6.11\pm0.07^{B}$	$_{a}6.11\pm0.07^{B}$	$_{a}6.26\pm0.05^{AB}$	$_{a}6.26\pm0.05^{AB}$
30	$_{b}5.91\pm0.06^{B}$	$_{b}6.06\pm0.06^{AB}$	$_{b}6.09\pm0.06^{AB}$	$_{b}6.20\pm0.09^{A}$	$_{ab}5.89\pm0.05^{B}$	$_{a}6.00\pm0.05^{AB}$	$_{ab}6.03\pm0.05^{AB}$	$_{a}6.23\pm0.06^{A}$
60	$_{b}5.80\pm0.15^{C}$	$_{bc}5.91\pm0.15^{BC}$	$_{b}6.06\pm0.12^{AB}$	$_{bc}6.14\pm0.17^{AB}$	$_{bc}5.80\pm0.15^{C}$	$_{ab}5.97\pm0.14^{ABC}$	$_{b}6.00\pm0.16^{ABC}$	$_{ab}6.17\pm0.15^{A}$
90	$_{b}5.57\pm0.10^{D}$	$_{c}5.69\pm0.09^{CD}$	$_{b}5.89\pm0.09^{AB}$	$_{bcd}6.00\pm0.12^{A}$	$_{c}5.57\pm0.10^{D}$	$_{b}5.74\pm0.09^{BCD}$	$_{b}5.83\pm0.12^{ABC}$	$_{abc}6.03\pm0.09^{A}$
120	$_{c}5.11\pm0.08^{C}$	$_{d}5.37\pm0.12^{B}$	$_{c}5.60\pm0.11^{B}$	$_{cd}5.94\pm0.12^{A}$	$_{d}5.11\pm0.08^{C}$	$_{c}5.46\pm0.09^{B}$	$_{c}5.54\pm0.14^{B}$	$_{bc}5.97\pm0.09^{A}$
150	$_{d}4.46\pm0.07^{C}$	$_{e}5.03\pm0.07^{B}$	$_{d}5.17\pm0.03^{B}$	$_{d}5.80\pm0.03^{A}$	$_{e}4.46\pm0.07^{C}$	$_{d}5.00\pm0.09^{B}$	$_{d}5.20\pm0.03^{B}$	$_{c}5.80\pm0.03^{A}$
180	$_{d}4.34\pm0.10^{C}$	$_{f}4.51\pm0.09^{C}$	$_{e}4.83\pm0.05^{B}$	$_{e}5.09\pm0.07^{A}$	$_{e}4.37\pm0.07^{C}$	$_{e}4.54\pm0.08^{C}$	$_{e}4.86\pm0.05^{AB}$	$_{d}5.09\pm0.07^{A}$

Mean having different subscripts in the column (small letter) differ significantly ($P<0.01$).
Mean having different superscripts in the row (capital letter) differ significantly ($P<0.01$), SE=Standard Error, N=5.

Table 11: Flavour scores of spent hen meat powder during storage periods (Mean±SE)

Storage period (day)	Solar Dried				Oven Dried			
	Control		Treatment		Control		Treatment	
	Aerobic Packaging (A)	Vacuum Packaging (B)	Aerobic Packaging (C)	Vacuum Packaging (D)	Aerobic Packaging (E)	Vacuum Packaging (F)	Aerobic Packaging (G)	Vacuum Packaging (H)
0	$_{a}6.11\pm0.08^{AB}$	$_{a}6.11\pm0.08^{AB}$	$_{a}6.37\pm0.06^{A}$	$_{a}6.37\pm0.06^{A}$	$_{a}6.03\pm0.09^{B}$	$_{a}6.03\pm0.09^{B}$	$_{a}6.34\pm0.03^{A}$	$_{a}6.34\pm0.03^{A}$
30	$_{b}5.77\pm0.18^{B}$	$_{ab}5.94\pm0.15^{AB}$	$_{b}5.91\pm0.29^{AB}$	$_{ab}6.09v0.27^{A}$	$_{ab}5.80\pm0.17^{AB}$	$_{ab}6.00\pm0.16^{AB}$	$_{b}5.91\pm0.23^{AB}$	$_{ab}6.11\pm0.23^{A}$
60	$_{bc}5.54\pm0.07^{D}$	$_{b}5.74\pm0.03^{CD}$	$_{b}5.93\pm0.07^{ABC}$	$_{ab}6.09\pm0.06^{A}$	$_{bc}5.57\pm0.05^{D}$	$_{ab}5.80\pm0.03^{BCD}$	$_{b}5.89\pm0.08^{ABC}$	$_{b}6.03\pm0.03^{AB}$
90	$_{c}5.40\pm0.07^{D}$	$_{b}5.71\pm0.05^{BC}$	$_{bc}5.76\pm0.03^{AB}$	$_{b}6.03\pm0.03^{A}$	$_{c}5.43\pm0.05^{CD}$	$_{bc}5.74\pm0.08^{AB}$	$_{bc}5.71\pm0.05^{BC}$	$_{bc}5.97\pm0.03^{AB}$
120	$_{d}4.97\pm0.08^{C}$	$_{c}5.37\pm0.10^{B}$	$_{c}5.53\pm0.04^{B}$	$_{b}5.91\pm0.07^{A}$	$_{d}4.97\pm0.08^{C}$	$_{c}5.46\pm0.12^{B}$	$_{c}5.51\pm0.07^{B}$	$_{bc}5.89\pm0.05^{A}$
150	$_{e}4.31\pm0.05^{C}$	$_{d}4.80\pm0.07^{B}$	$_{d}4.97\pm0.06^{B}$	$_{c}5.74\pm0.07^{A}$	$_{e}4.31\pm0.05^{C}$	$_{d}4.80\pm0.07^{B}$	$_{d}4.94\pm0.06^{B}$	$_{c}5.74\pm0.07^{A}$
180	$_{f}1.37\pm0.03^{D}$	$_{e}1.77\pm0.07^{C}$	$_{e}2.11\pm0.07^{B}$	$_{d}2.69\pm0.10^{A}$	$_{f}1.37\pm0.03^{D}$	$_{e}1.80\pm0.06^{C}$	$_{e}2.14\pm0.05^{B}$	$_{d}2.63\pm0.11^{A}$

Mean having different subscripts in the column (small letter) differ significantly ($P<0.01$).
Mean having different superscripts in the row (capital letter) differ significantly ($P<0.01$), SE=Standard Error, N=5.

Table 12: Texture score of spent hen meat powder during storage periods (Mean±SE)

Storage period (day)	Solar Dried				Oven Dried			
	Control		Treatment		Control		Treatment	
	Aerobic Packaging (A)	Vacuum Packaging (B)	Aerobic Packaging (C)	Vacuum Packaging (D)	Aerobic Packaging (E)	Vacuum Packaging (F)	Aerobic Packaging (G)	Vacuum Packaging (H)
0	$_{a}6.23\pm0.03^{AB}$	$_{a}6.23\pm0.03^{AB}$	$_{a}6.46\pm0.13^{A}$	$_{a}6.46\pm0.13^{A}$	$_{a}6.09\pm0.07^{B}$	$_{a}6.09\pm0.07^{B}$	$_{a}6.23\pm0.06^{AB}$	$_{a}6.23\pm0.06^{AB}$
30	$_{a}6.23\pm0.03^{AB}$	$_{a}6.20\pm0.03^{AB}$	$_{a}6.40\pm0.03^{A}$	$_{a}6.40\pm0.05^{A}$	$_{a}6.06\pm0.03^{B}$	$_{a}6.14\pm0.06^{AB}$	$_{a}6.23\pm0.09^{AB}$	$_{a}6.20\pm0.10^{AB}$
60	$_{a}6.20\pm0.13^{A}$	$_{a}6.20\pm0.13^{A}$	$_{a}6.34\pm0.10^{A}$	$_{a}6.37\pm0.07^{A}$	$_{a}6.14\pm0.11^{A}$	$_{a}6.14\pm0.11^{A}$	$_{a}6.20\pm0.09^{A}$	$_{a}6.20\pm0.07^{A}$
90	$_{a}6.03\pm0.12^{A}$	$_{a}6.03\pm0.12^{A}$	$_{a}6.20\pm0.10^{A}$	$_{a}6.23\pm0.07^{A}$	$_{a}5.97\pm0.10^{A}$	$_{ab}5.97\pm0.10^{A}$	$_{a}6.14\pm0.08^{A}$	$_{a}6.14\pm0.06^{A}$
120	$_{b}5.69\pm0.17^{B}$	$_{b}5.74\pm0.17^{AB}$	$_{b}5.86\pm0.18^{AB}$	$_{b}6.00\pm0.12^{A}$	$_{b}5.69\pm0.17^{B}$	$_{b}5.74\pm0.17^{AB}$	$_{b}5.86\pm0.18^{AB}$	$_{a}6.00\pm0.09^{A}$
150	$_{c}4.97\pm0.07^{C}$	$_{c}5.26\pm0.05^{B}$	$_{c}5.14\pm0.05^{BC}$	$_{c}5.63\pm0.12^{A}$	$_{c}4.97\pm0.07^{C}$	$_{c}5.26\pm0.05^{B}$	$_{c}5.14\pm0.05^{BC}$	$_{b}5.63\pm0.12^{A}$
180	$_{d}4.51\pm0.06^{D}$	$_{d}4.80\pm0.06B^{C}$	$_{c}4.94\pm0.06^{B}$	$_{c}5.40\pm0.05^{A}$	$_{d}4.54\pm0.05^{CD}$	$_{d}4.89\pm0.05^{B}$	$_{c}4.97\pm0.05^{B}$	$_{b}5.43\pm0.05^{A}$

Mean having different subscripts in the column (small letter) differ significantly ($P<0.01$).
Mean having different superscripts in the row (capital letter) differ significantly ($P<0.01$), SE=Standard Error, N=5.

Table 13: Taste score of spent hen meat powder during storage periods (Mean±SE)

Storage period (day)	Solar Dried				Oven Dried			
	Control		Treatment		Control		Treatment	
	Aerobic Packaging (A)	Vacuum Packaging (B)	Aerobic Packaging (C)	Vacuum Packaging (D)	Aerobic Packaging (E)	Vacuum Packaging (F)	Aerobic Packaging (G)	Vacuum Packaging (H)
0	$_{a}6.17\pm0.05^{BC}$	$_{a}6.17\pm0.05^{BC}$	$_{a}6.54\pm0.03^{A}$	$_{a}6.54\pm0.03^{A}$	$_{a}6.00\pm0.10^{C}$	$_{a}6.00\pm0.10^{C}$	$_{a}6.29\pm0.06^{AB}$	$_{a}6.29\pm0.06^{AB}$
30	$_{a}6.00\pm0.06^{A}$	$_{a}6.14\pm0.08^{A}$	$_{b}6.09\pm0.12^{A}$	$_{b}6.14\pm0.12^{A}$	$_{a}5.89\pm0.05^{A}$	$_{a}6.00\pm0.08^{A}$	$_{ab}6.01\pm0.10^{A}$	$_{ab}6.06\pm0.04^{A}$
60	$_{b}5.69\pm0.14^{C}$	$_{ab}6.00\pm0.11^{AB}$	$_{b}6.04\pm0.16^{AB}$	$_{b}6.14\pm0.16^{A}$	$_{ab}5.76\pm0.11^{BC}$	$_{a}5.99\pm0.12^{AB}$	$_{b}5.96\pm0.11^{ABC}$	$_{ab}6.07\pm0.14^{A}$
90	$_{b}5.49\pm0.12^{B}$	$_{b}5.83\pm0.10^{A}$	$_{bc}5.87\pm0.11^{A}$	$_{b}6.06\pm0.17^{A}$	$_{b}5.50\pm0.11^{B}$	$_{a}5.79\pm0.12^{A}$	$_{bc}5.84\pm0.09^{A}$	$_{b}5.96\pm0.11^{A}$
120	$_{c}5.03\pm0.07^{C}$	$_{c}5.43\pm0.12^{B}$	$_{c}5.61\pm0.16^{B}$	$_{b}5.94\pm0.15^{A}$	$_{c}5.07\pm0.08^{C}$	$_{b}5.39\pm0.11^{B}$	$_{c}5.61\pm0.16^{B}$	$_{b}5.90\pm0.11^{A}$
150	$_{d}4.31\pm0.08^{C}$	$_{d}5.14\pm0.08^{B}$	$_{d}5.20\pm0.07^{B}$	$_{b}5.86\pm0.09^{A}$	$_{d}4.34\pm0.07^{C}$	$_{b}5.11\pm0.09^{B}$	$_{d}5.20\pm0.07^{B}$	$_{b}5.89\pm0.10^{A}$
180	ND	ND	ND	ND	ND	ND	ND	ND

Mean having different subscripts in the column (small letter) differ significantly ($P<0.01$).
Mean having different superscripts in the row (capital letter) differ significantly ($P<0.01$), SE=Standard Error, ND= Not done, N=5.

Table 14: Overall acceptability score of spent hen meat powder during storage periods (Mean±SE)

	Solar Dried				Oven Dried			
	Control		Treatment		Control		Treatment	
	Aerobic Packaging (A)	Vacuum Packaging (B)	Aerobic Packaging (C)	Vacuum Packaging (D)	Aerobic Packaging (E)	Vacuum Packaging (F)	Aerobic Packaging (G)	Vacuum Packaging (H)
0	$_{a}6.23\pm0.03^{BC}$	$_{a}6.23\pm0.03^{BC}$	$_{a}6.58\pm0.12^{A}$	$_{a}6.58\pm0.12^{A}$	$_{a}6.08\pm0.10^{C}$	$_{a}6.08\pm0.10^{C}$	$_{a}6.35\pm0.09^{B}$	$_{a}6.35\pm0.09^{B}$
30	$_{b}5.83\pm0.08^{D}$	$_{ab}6.01\pm0.07^{BCD}$	$_{b}6.11\pm0.07^{ABC}$	$_{b}6.30\pm0.07^{A}$	$_{b}5.83\pm0.08^{D}$	$_{a}5.96\pm0.04^{CD}$	$_{b}6.09\pm0.10^{ABC}$	$_{ab}6.20\pm0.09^{AB}$
60	$_{bc}5.63\pm0.03^{D}$	$_{b}5.89\pm0.03^{BC}$	$_{bc}5.99\pm0.12^{AB}$	$_{bc}6.20\pm0.15^{A}$	$_{b}5.67\pm0.04^{CD}$	$_{a}5.93\pm0.05^{B}$	$_{bc}5.97\pm0.10^{B}$	$_{ab}6.20\pm0.11^{A}$
90	$_{c}5.43\pm0.05^{C}$	$_{b}5.69\pm0.05^{B}$	$_{c}5.81\pm0.07^{AB}$	$_{cd}6.03\pm0.09^{A}$	$_{c}5.44\pm0.05^{C}$	$_{b}5.70\pm0.05^{B}$	$_{c}5.80\pm0.06^{B}$	$_{bc}6.03\pm0.05^{A}$
120	$_{d}5.00\pm0.06^{C}$	$_{c}5.37\pm0.07^{B}$	$_{d}5.39\pm0.08^{B}$	$_{d}5.94\pm0.10^{A}$	$_{d}5.01\pm0.07^{C}$	$_{c}5.39\pm0.08^{B}$	$_{d}5.40\pm0.08^{B}$	$_{cd}5.91\pm0.07^{A}$
150	$_{e}4.49\pm0.06^{C}$	$_{d}5.03\pm0.08^{B}$	$_{d}5.17\pm0.09^{B}$	$_{d}5.86\pm0.10^{A}$	$_{e}4.43\pm0.04^{C}$	$_{d}5.06\pm0.08^{B}$	$_{e}5.14\pm0.10^{B}$	$_{d}5.80\pm0.07^{A}$
180	ND	ND	ND	ND	ND	ND	ND	ND

Mean having different subscripts in the column (small letter) differ significantly ($P<0.01$).
Mean having different superscripts in the row (capital letter) differ significantly ($P<0.01$), SE=Standard Error, ND= Not done, N=5.

Front View Back View Side View

1. Solar Panel 2. Drying Chamber 3. Hygrometer 4. Solar Collector 5. Air Inlet 6. Exhaust Fan 7. Assemble Box 8. Auto Cut

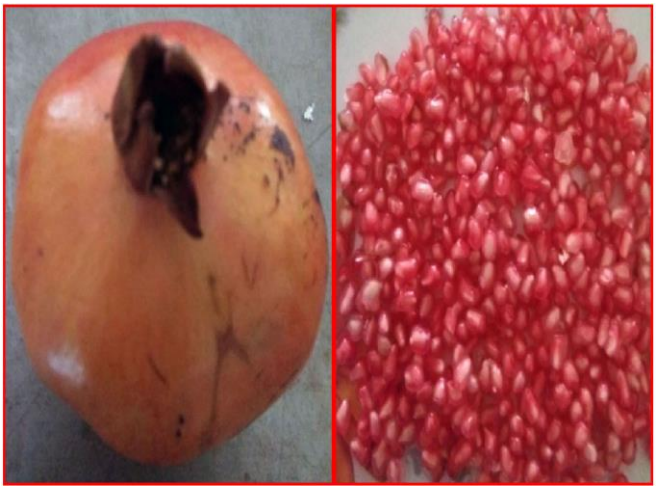
Fig 1: Solar Dryer

Amla (*Phallanthus emblica*)

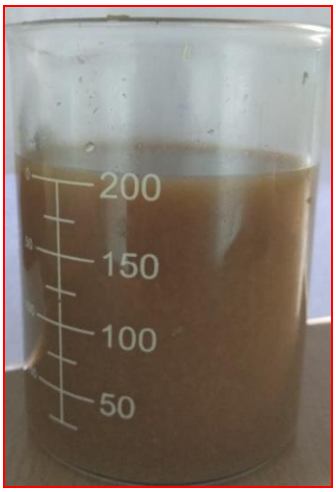
Fermented bamboo shoot (*Bamboosa auriculata*)

Round lemon (*Citrus limon*)

Green tea (*Camellia sinensis*)



Pomegranate (*Punica granatum*)



Antioxidant extract

Fig 2: Phyto-ingredient extracts used as antioxidant

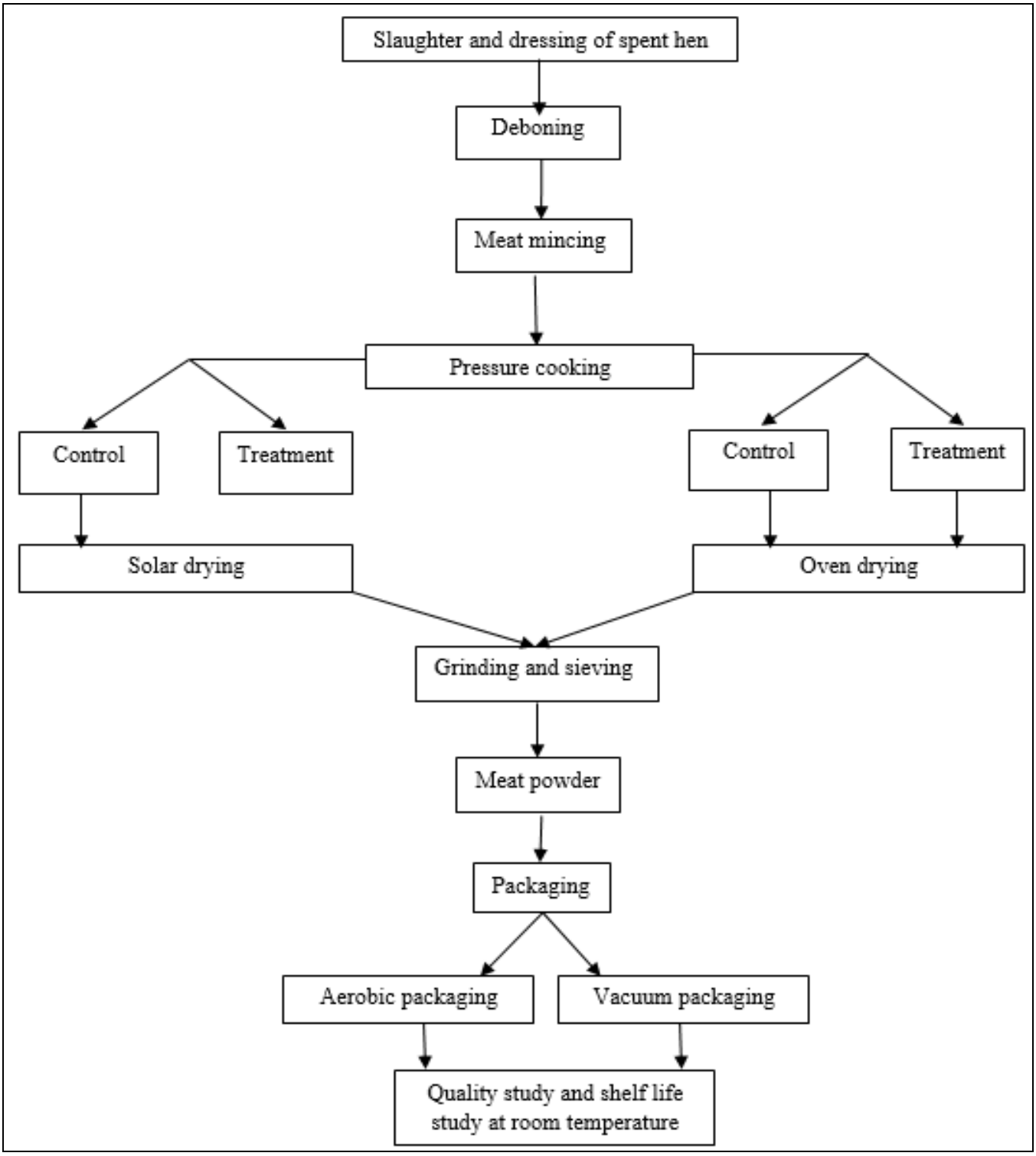
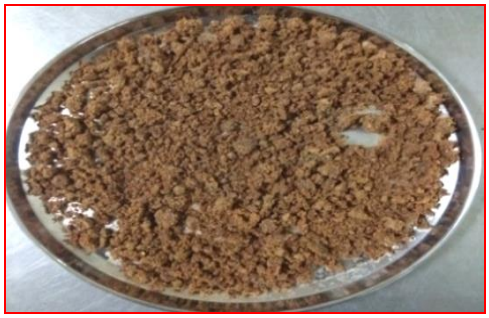


Fig 3: Flow chart for preparation of spent hen meat powder

Deboned Spent Hen

Minced Spent Hen

Cooked Spent Hen



Dried Meat

Aerobic Packaged

Vacuum Packaged

Different Samples For Study

Fig 4: Steps Involved In Preparation of Spent Hen Meat Powder

Conclusion

Spent hen meat powder could be developed incorporating of phytoingredients which exhibit good nutritional, microbiological and organoleptic properties. The solar dryer can be used over oven dryer for preparation of spent hen meat powder economically with similar product quality. Vacuum packaging is better than aerobic packaging to preserve qualities of end product. Spent hen meat powder can be stored in low density polyethylene bags up to five months with its good nutritional, microbiological and sensory properties.

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