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Original Research

Shelf Stability of Cookies Incorporated with Spent Hen Meat Powder in Aerobic Packaging at Ambient Temperature (37±1°C)

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Abstract

The aim of present study was to prepared cookies with incorporation of spent hen meat powder replacing with pearl millet flour. Birds were dressed properly, boneless spent hen meat packed in LDPE bags and stored overnight at 4±1°C for ageing. Thawed meat chunks were minced in meat mincer and dried in hot air oven at 60-70° C for 20-22 hrs and subsequently used for cookies preparation. The investigation such as physico-chemical quality, proximate composition microbial counts and sensory attributes were carried out. During storage at ambient temperature (37±1°C), the scores for all the sensory attributes as well as pH, protein, ash and fat declined but moisture content inclined with the progress of storage period upto 60 days. Similarly, TBA, tyrosine, TPC, yeast and mould counts increased considerably throughout the storage period but were within the spoilage limit up to 60 days.

Keywords: Hot Air Oven, Meat Mincer, Pearl Millet Flour, Spent Hen Meat Cookies

Introduction

The word cookie word comes from the Dutch word *'koekje'* means 'little cake'. The word cookie is used only in North America. In Britain, these cup cakes are known as biscuits, although English biscuits are generally smaller than North American cookies and tend to be almost crunchy rather than soft and chewy. Biscuits and cookies are generally accepted as snacks and are consumed by people of India with tea. Children like to eat these baked well; mothers use them as pacifiers and unwell people often like biscuits and cookies rather than any other foods (Vaidehi *et al.*, 1985). The possibility to enrich biscuits with animal proteins and dietary fiber is almost unexplored. So far, few workers had previously attempted for extrusion of meat, dried offal meat, minced fish flesh (Ibrahim 2009), mechanically deboned chicken and dried or semi-dried ground meat (Singh *et al*., 2011), chicken meat (Verma *et al*., 2012), with nonmeat ingredients such as corn starch, rice starch or flour, soy flour/grit/protein isolate and gums, etc., for the manufacture of meat-based snacks. Pearl millet is an important source of calories, essential micronutrients, phytochemicals, vitamins, phenolic compounds, minerals and nutrients and an essential component of food security in developing countries (Amadou *et al.,* 2014).

Materials and Methods

Birds were dressed and connective tissue, fat, tendons etc. were separated and boneless spent hen meat was packed in LDPE bags for overnight period at 4 ± 1^0C. After adequate thawing at room temperature were cut into small chunks and minced in meat mincer. Minced meat was dried in hot air oven at temperature $60\text{-}70^0$ C for 20-22 hours. The dried meat properly ground in food grinder and sieved thoroughly subsequently used for dough preparation. The dough was sheeted on a wooden board with rolling pins, moulded and cut into desire shapes using cookies cutter. Mould cookies were baked at 155^0C for 20 min., and were cooled at room temperature. These cooled cookies were packed in pre-sterilized LDPE bags and stored at ambient temperature (37 ± 1^0C) till further analysis. The cookies were prepared as per the method prescribed by Sai Manohar and Haridas (1999) with slight modification.

Table 1: Basic formulation of spent hen meat cookies

Ingredients %	Control (T_0)	50% (T_1)
Spent hen meat powder	0	50
Pearl millet flour	90	40
Wheat flour	10	10
Vanaspati ghee	35	35
Sugar	40	40
Glucose	5	5
Milk powder	20	20
Egg albumin	15	15
Vanilla powder	2	2
Baking powder	1.5	1.5
Salt	1.5	1.5

In the physical-chemical parameter, the pH was determined with a digital pH meter by AOAC (1995). TBA and tyrosine value determined according to the method described by Strange *et al.* (1977) with slight modifications. The proximate composition was determined by the AOAC method (1995). The microbiological quality of spent hen meat cookies was assessed using the APHA method (1992) for the total plate count (TPC) and yeasts and molds count during storage. The various sensory attributes, namely color, juiciness, consistency, taste and overall acceptability, were determined using an 8-point hedonic scale (Keeton, 1983).

Statistical Analysis

The data generated during the study were analyzed by Analysis of Variance technique following standard procedure (Snedecor and Cochran, 1989).

Results and Discussion

Physico-chemical Properties

The observations on storage related changes in physico-chemical properties of spent hen meat cookies at ambient temperature (37±1ºC) are presented in Table 2.

Table 2: Storage related change in physico-chemical characteristics of control cookies and spent hen meat cookies during storage at ambient temperature (37±1°C)

Type of Product	Storage Period (Days)							Treatment mean
	0	10	20	30	40	50	60	
	pH							
Control	6.39±0.00	6.35±0.03	6.30±0.03	6.21±0.03	6.00±0.04	5.97±0.03	5.49±0.03	6.10^{a}±0.01
50%	5.96±0.03	5.87±0.04	5.67±0.04	5.54±0.04	5.47±0.04	5.31±0.04	4.96±0.04	5.53^{b}±0.01
Storage Period Mean	6.18^{a}±0.02	6.11^{a}±0.02	5.98^{b}±0.02	5.87^{c}±0.02	5.74^{d}±0.02	5.64^{d}±0.02	5.23^{e}±0.02	
	TBA (mg malonaldehyde /Kg)							
Control	0.68±0.04	0.70±0.04	0.75±0.04	0.91±0.04	1.05±0.04	1.16±0.04	1.39±0.04	0.94^{a}±0.02
50%	0.37±0.04	0.38±0.04	0.43±0.04	0.61±0.04	0.72±0.04	0.94±0.04	1.16±0.04	0.65^{b}±0.02
Storage Period Mean	0.53^{a}±0.04	0.54^{ab}±0.04	0.59^{b}±0.04	0.76^{c}±0.04	0.89^{d}±0.04	1.05^{e}±0.04	1.28^{f}±0.04	
	Tyrosine (mg/g)							
Control	0.24±0.03	0.26±0.04	0.34±0.04	0.58±0.03	0.73±0.03	0.84±0.04	0.98±0.04	0.75^{b}±0.01
50%	0.80±0.04	1.16±0.04	1.25±0.04	1.30±0.04	1.36±0.04	1.58±0.03	1.61±0.03	1.29^{a}±0.04
Storage Period Mean	0.52^{a}±0.03	0.71^{b}±0.03	0.80^{b}±0.03	0.94^{c}±0.03	1.05^{c}±0.03	1.21^{d}±0.03	1.30^{d}±0.03	

Means with common superscript did not differ significantly (P<0.05); NS = Non-Significant

The observations revealed that the pH of cookies differ significantly (P<0.05) throughout storage period. However, decrease in pH was non-significant (P>0.05) up to 10th day of storage. The decrease in pH of spent hen meat cookies stored at ambient temperature might be due to increase in level of spent meat powder and formation of lactic acid due to addition of milk powder in spent hen meat cookies. It is fact that a decrease in pH is due to metabolic activity of bacteria (Jay, 1996). Control cookies recorded highest pH during storage as compare to cookies incorporated with 50% spent hen meat powder. Present findings are in agreement with Jaiswal *et al.* (2014) and Goswami *et al.* (2017). During storage at ambient temperature, TBA values of control cookies was observed to be significantly (P<0.05) higher as compare to 50% spent hen meat powder incorporated cookies. TBA value for control cookies was 0.68 mg malonaldehyde/kg which decreased significantly low to 0.37 mg malonaldehyde/Kg in cookies incorporated with 50% spent hen meat powder. Among the treatments the TBA values differ significantly. An increase in TBA values at the end of storage (60th day) is indicative of oxidative rancidity. Similar findings were reported by many research workers Berwal *et al.* (2013), Jaiswal *et al.* (2014) and Kumar *et al.* (2016).

Tyrosine value has been considered as good index for meat protein breakdown and could be useful for the assessment of spoilage in meat and meat products (Pearson, 1968). Inclining trend was recorded in tyrosine values during entire storage of spent hen meat cookies. The tyrosine values were significantly (P<0.05) higher in cookies incorporated with 50% spent hen meat powder which might be due to initial higher tyrosine value in fresh cookies. The increase in tyrosine values may be due to aerobic packaging of product and oxygen permeability of packaging material (Brewer *et al.*, 1992) that led to rapid lipid oxidation. Similar findings were observed by More (2017) and Bhumre (2018).

Proximate Composition

The results with respects to changes in proximate composition in cookies incorporated with 50% spent hen meat powder and control cookies are presented in Table 3. The moisture content of 50% spent hen meat powder incorporated cookies were significantly (P<0.05) higher than control cookies. It might be due to more moisture content in spent hen meat as compared to pearl millet flour. This might be due to moisture transmission rate through packaging film. Jaiswal *et al.* (2012) reported increase in moisture content with increase in storage period. Similar findings were also observed by Berwal *et al.* (2013). The protein content of spent hen meat cookies incorporated with 50% spent hen meat powder was significantly (P<0.05) higher than control cookies, it might be due to higher protein content of spent hen meat powder than pearl millet flour. On 60th day of storage, the protein content of spent hen meat cookies declines non-significantly (P>0.05). The decrease of protein content in spent hen meat cookies with increase in storage time could be due to denaturation of protein during storage. Concentration of enzymes and

presence of other compounds govern the process of protein denaturation (Rahman 1999). Similarly decline trend in protein content was reported by Modi *et al.* (2004) and Jaiswal *et al.* (2012).

Table 3: Storage related change in proximate composition of control cookies and spent hen meat cookies during storage at ambient temperature (37±1°C)

Type of Product	Storage Period (Days)		Treatment mean
	0	60	
	Moisture%		
Control	2.85±0.05	3.43±0.05	3.14^{b}±0.04
50%	3.16±0.05	3.71±0.05	3.43^{a}±0.04
Storage Period Mean	3.00^{a}±0.04	3.57^{b}±0.04	
	Protein%		
Control	9.68±0.19	9.75±0.19	9.72^{b}±0.14
50%	13.52±0.19	13.42±0.19	13.47^{a}±0.14
Storage Period Mean	11.60^{a}±0.14	11.59^{a}±0.14	
	Fat %		
Control	20.83±0.40	19.50±0.38	20.17^{b}±0.39
50%	23.15±0.45	22.75±0.44	22.95^{a}±0.44
Storage Period Mean	21.99^{a}±0.42	21.13^{b}±0.41	
	Ash %		
Control	1.50±0.05	1.47±0.05	1.49^{b}±0.04
50%	2.67±0.05	2.64 ±0.05	2.66^{a}±0.04
Storage Period Mean	2.09^{a}±0.04	2.06^{a}±0.04	

Means with common superscript did not differ significantly (P<0.05); NS = Non-Significant

The fat content of spent hen meat cookies incorporated with 50% spent hen meat powder was significantly (P<0.05) higher as compare to control cookies. This attribute may be due to higher fat content of spent hen meat powder than pearl millet flour. The fat content of cookies differ significantly (P<0.05) during storage on 60 days. These findings are close agreement with More (2017) and Bhumre (2018). The ash content of cookies incorporated with 50% spent hen meat powder was significantly (P<0.05) higher than control cookies. It might be due to combined effect of spent hen meat powder and pearl millet flour. Similar findings were observed by Yashoda *et al.* (2008). During storage, the ash content of cookies declined non significantly (P>0.05) on 60 days storage period. It might be due to moisture catch by cookies transmitted through packaging film. These results are corroborated with Jaiswal *et al.* (2012) for development of chicken meat biscuits at ambient temperature in aerobic packaging.

Microbial Quality

It is observed from Table 4 that the TPC for spent hen meat cookies incorporated with 50% spent hen meat powder were significantly higher than those of the control cookies, which might be caused by an easy availability of carbohydrate substrates in spent hen meat cookies, which favour the microbial growth. These results are in accordance with Kapse (2016) and More (2017) who observed increase in total plate count with increased storage period. There was steady increase in count upto 10^{th} days of storage but afterwards count increased significantly (P<0.05) with the progress of storage period upto 60 days. This might be due to the favourable condition such as temperature, moisture and nutrients for the growth of mesophilic bacteria at the end of storage. Present findings are in close agreement with the observations of Berwal *et al.* (2013).

It is observed from Table 4, that the yeast and mould count were not detected upto 10^{th} day storage after that count increased significantly (P<0.05) with the progress of storage period of 60 days. The yeast and mould count for spent hen meat cookies incorporated with 50% spent hen meat powder were significantly higher than those of the control cookies. This might be due to the availability of optimum temperature and moisture for the growth of yeast and moulds. The present findings are consonance with Jaiswal *et al.* (2012) and also by Bhumre (2018) who reported

increasing yeast and mould counts with progress of storage days.

Table 4: Storage related change in microbiological quality of control cookies and spent hen meat cookies during storage at ambient temperature (37±1°C)

Type of Product	Storage Period (Days)							Treatment mean
	0	10	20	30	40	50	60	
	Total plate count (log cfu / g)							
Control	3.55±0.28	3.61±0.14	3.76±0.14	3.88±0.14	3.97±0.14	4.03±0.14	4.10±0.30	3.84^{b}±0.20
50%	3.66±0.13	3.68±0.13	3.84±0.14	3.97±0.14	4.11±0.14	4.18±0.14	4.22±0.14	3.96^{a}±0.14
Storage Period Mean	3.60^{a}±0.22	3.65^{a}±0.13	3.81^{b}±0.14	3.92^{c}±0.14	4.04^{d}±0.14	4.11^{e}±0.14	4.17^{f}±0.24	
	Yeast and mould count (log cfu/g)							
Control	0.00±0.00	0.00±0.00	3.46±0.11	3.58±0.11	3.64±0.11	3.84±0.12	3.88±0.12	2.63^{b}±0.11
50%	0.00±0.00	0.00±0.0	3.57±0.11	3.66±0.12	3.82±0.12	3.89±0.12	4.00±0.12	2.71^{a}±0.11
Storage Period Mean	ND	ND	3.52^{b}±0.11	3.62^{bc}±0.11	3.73^{c}±0.12	3.87^{d}±0.12	3.94^{d}±0.12	

Means with common superscript did not differ significantly (P<0.05); NS = Non-Significant

Sensory Attributes

Storage related changes in sensory attributes of cookies incorporated with 50% spent hen meat powder and control cookies are presented in Table 5.

Table 5: Storage related change in sensory attributes of control cookies and spent hen meat cookies during storage at ambient temperature (37±1°C)

Type of Product	Storage Period (days)							Treatment
	0	10	20	30	40	50	60	
	Appearance							
Control	7.17±0.20	7.00±0.20	6.67±0.20	6.50±0.20	6.17±0.25	6.00±0.20	5.83±0.20	6.48^{b}±0.08
50%	7.33±0.20	7.17±0.20	7.00±0.20	6.83±0.20	6.67±0.20	6.50±0.20	6.33±0.20	6.83^{a}±0.08
Storage Period Mean	7.25^{a}±0.14	7.08^{ab}±0.14	6.83^{bc}±0.14	6.67^{cd}±0.14	6.41^{de}±0.14	6.25^{e}±0.14	6.08^{e}±0.14	
	Flavour							
Control	7.33±0.22	7.17±0.22	6.83±0.22	6.67±0.22	6.50±0.22	6.17±0.22	5.83±0.22	6.64^{b}±0.08
50%	7.50±0.17	7.33±0.22	7.16±0.22	6.83±0.22	6.68±0.22	6.50±0.22	6.33±0.22	6.91^{a}±0.08
Storage Period Mean	7.42^{a}±0.16	7.25^{a}±0.16	7.00^{ab}±0.16	6.75^{cd}±0.16	6.58^{cd}±0.16	6.33^{de}±0.16	6.08^{e}±0.16	
	Juiciness							
Control	7.50±0.22	7.17±0.31	7.00±0.26	6.67±0.21	6.50±0.22	6.17±0.30	5.67±0.21	6.67^{b}±0.25
50%	7.67±0.21	7.50±0.22	7.17±0.31	7.00±0.33	6.67±0.31	6.50±0.26	6.17±0.22	6.95^{a}±0.22
Storage Period Mean	7.58^{a}±0.21	7.33^{ab}±0.26	7.08^{bc}±0.28	6.83^{bc}±0.23	6.58^{cd}±0.21	6.33^{de}±0.26	5.92^{e}±0.26	
	Texture							
Control	6.67±0.33	6.50±0.22	6.33±0.21	6.00±0.00	5.83±0.17	5.67±0.21	5.50±0.22	6.07^{b}±0.21
50%	7.83±0.17	7.67±0.21	7.50±0.22	7.17±0.31	6.83±0.31	6.50±0.22	6.33±0.13	7.12^{a}±0.24
Storage Period Mean	7.25^{a}±0.26	7.08^{a}±0.21	6.92^{ab}±0.21	6.58^{bc}±0.21	6.33^{cd}±0.24	5.08^{d}±0.21	5.92^{d}±0.21	
	Overall Palatability							
Control	7.50±0.22	7.33±0.21	6.83±0.30	6.50±0.22	6.17±0.30	5.67±0.33	4.83±0.30	6.41^{b}±0.28
50%	7.67±0.21	7.50±0.22	7.16±0.31	6.67±0.33	6.17±0.31	6.00±0.26	5.50±0.22	6.67^{a}±0.23
Storage Period Mean	7.58^{a}±0.22	7.42^{ab}±0.22	7.00^{bc}±0.31	6.58^{cd}±0.28	6.17^{de}±0.31	5.83^{e}±0.30	5.17^{f}±0.27	

Means with common superscript did not differ significantly (P<0.05); NS = Non-Significant

The sensory scores for appearance of control cookies and cookies incorporated with 50% spent hen meat powder decline significantly (P<0.05) during storage period of 60 days. This might be due to pigment breakdown and lipid oxidation resulting in non-enzymatic browning. Among the treatments, the appearance scores differed significantly,

the maximum score was for the spent hen meat cookies incorporated with 50% spent hen meat powder incorporated cookies as compared to control cookies. Similar findings of decreasing scores were noticed by Berwal *et al.* (2013) and also observed by Kumar *et al.* (2016). The flavour scores of control cookies and cookies incorporated with 50% spent hen meat powder decline significantly ($P<0.05$) during storage period of 60 days. Irrespective of storage, spent hen meat cookies incorporated with 50% spent hen meat powder recorded significantly higher scores for flavor over control cookies. In both cookies, there was no any detectable off flavor throughout the storage period. The decline in flavour score in spent hen meat cookies could be attributed due to fat loss fat content of meat product during storage which has greater role in development of flavour as reported by Pearson and Gillet (1997). Similar findings for reduction in flavour scores were recorded by Sumathi *et al.* (2007) and also by Jaiswal *et al.* (2015).

Irrespective of the type of cookies, the juiciness scores were significantly ($P<0.05$) affected within the treatments. Among the treatment's cookies incorporated with 50% spent hen meat powder recorded significantly ($P<0.05$) higher juiciness scores than that of control cookies. Replacement of pearl millet flour with 50% spent hen meat powder had significant effect on meat intensity of spent hen meat cookies compared to control cookies. Similar findings were reported by Prasad *et al.* (2011) also by Jaiswal *et al.* (2015). The sensory score for texture decline significantly ($P<0.05$) during storage period upto 60^{th} day. Irrespective of storage, control cookies recorded significantly lower scores for texture over cookies incorporated with 50% spent hen meat powder. Non-significant reduction in texture scores particularly at the later part of storage period of 60^{th} day was observed. It might be attributed due to increased hardening of product and also due to breakdown of fat and protein. Present findings are corroborated with that of Yashoda *et al.* (2008) and also by Jaiswal *et al.* (2015).

Significant difference ($P<0.05$) in overall palatability scores of control cookies and cookies incorporated with 50% spent hen meat powder was noticed during the storage at ambient temperature (37±1°C). Cookies incorporated with 50% spent hen meat powder registered superior overall acceptability scores than control cookies throughout the storage period. The decreased overall palatability scores might be due to the lowering scores of appearance, juiciness and texture scores. Similar types of decrease in overall palatability scores were noticed by Berwal *et al.* (2013) and Jaiswal *et al.* (2015).

Conclusion

Based on above observations, it is concluded that value added, nutritionally rich and well accepted cookies can be prepared by incorporation of 50% spent hen meat powder and safely stored in LDPE upto 60 days at ambient temperature (37 ± 1^0C) without adversely affecting its quality.

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Conflict of Interests

There is no conflict of interest.

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