Original Research

Quality Assessment of Rice and Soya Flour Extended Quail Meat Balls Stored At Refrigeration Temperature

U. V. Dhond*, A. A. Devangare[1] and A. M. Chappalwar

Department of LPT, College of Veterinary and Animal Sciences, Parbhani, Maharashtra, INDIA

[1]Department of LPT, College of Veterinary and Animal Sciences, Udgir, Maharashtra, INDIA

***Corresponding author:** anitachappalwar@rediffmail.com

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Abstract

The aim of this work was to analyze quality of refrigerated stored quail meat balls extended with rice and soy flour. Prepared quail meat balls were packed in LDPE (low density polyethylene) pouches, stored at refrigeration temperature (4±1°C) and analyzed for its quality at a regular interval of four days. The analyses were focused on the physico-chemical and microbiological quality. During the study, pH, TBA, Tyrosine values as well as total plate count and psychrophilic count were increased significantly (P<0.05), but were within the spoilage limit upto 20 days of storage period. E. coli was not detected throughout the study in control as well as extended quail meat balls. Upshot from the study specifies that quail meat balls with or without extenders could be safely stored for 20 days without adversely affecting quality.

Key words: Extenders, Microbial Quality, Quail Meat Ball, Refrigeration Storage, Rice Flour, Soy Flour

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Introduction

A moment ago, quails are reared as an alternative to other food animals built-in as sources of animal protein (Faitarone *et al.*, 2005). They were first domesticated in Japan (Mizutani, 2003) and scattered in the world over large areas of Asia, Europe and Africa. During 1974, quails were first time kept in India at Central Avian Research Institute, Izatnagar, thereafter widen in Andhra Pradesh Agricultural University, Hyderabad and Bidhan Chandra Rai Krishi Viswavidyalaya. The species *Coturnix coturnix japonica* i.e. Japanese quail is most commonly used for human consumption. Slaughter age of these quails is about six weeks (Boni *et al.*, 2010). Quail meat is an ideal food having low calorific value with high protein and less fat content than chicken and duck meat (Ionita *et al.*, 2016). The flesh of quails has distinctiveness due to its unique taste and tenderness (Runjun and Sethi, 2014). Meatball is a traditional product, which is a

popular food item in the non-vegetarian group of people. The demand for various meat based convenient and fast foods is increasing day by day, however cost is one of the limiting factor, hence to conquer cost of the ready to eat products as well as to enhance the processing characteristics certain food ingredients such as extenders, binders, emulsifiers or stabilizers of non-meat source are added in the process to develop the product without adversely affecting its quality.

Food and Drug Administration (FDA) approved the "Soy Protein Health Claim" on October 26, 1999; thereafter soybeans became popular in food applications. All over world, soybeans (*Glycine max*) supply is plentiful and available at cheap cost. As soyabean is a good source of high-quality vegetable protein for humans, many soy protein products were developed, such as defatted soy flour, soy protein concentrates, and soy protein isolates (Fukushima, 2004). These soy products are also high in polyunsaturated fats fiber, vitamins, and minerals and low in saturated fat (Krauss *et al.*, 2000). The FDA confirmed that 25 g of soy protein a day, may lower cholesterol and reduce the risk of coronary heart disease. Therefore the use of soy flour to replace foods high in animal protein that contain saturated fat and cholesterol may absolutely benefits to cardiovascular health (Sacks *et al.*, 2006). Rice is the one of the world's most important cereal food. Rice flour has good nutritional value as it has a very low allergic effect, low sodium content and high digestibility (Demirkesen *et al.*, 2013). Finely milled rice flour has approximately 80% starch as a main component which would-be used to improve gelatinization properties and binding capacity of meat products (Barbosa *et al.*, 2006). These properties of rice flour may contribute in the retention of water during the cooking process and subsequent improve the shelf-life as well as deliver the desired texture.

Recently, refrigeration method commonly used for the preservation of meat and meat products at house hold as well as fast food centers due to easy availability and affordable cost of the refrigerators. However, refrigerated storage condition extends the shelf life of product with a limiting factor that this method only slows down the growth of the micro- organisms due to which with advancement of storage many undesirable changes such as microbial spoilage and lipid oxidation develops especially in the meat and its products due to its neutral pH, high in nutritive value, which is threat. Hence quality assessment of meat products is very important during preservation for the protecting consumer's health. Looking to the actual conditions and need, the work planned to assess the shelf life of soy and rice flour extended quail meat ball during refrigerated storage.

Materials and Methods

Quail meat for the study was obtained from six weeks old live broiler quails, which were procured from the local market of Parbhani city, slaughtered and dressed with optimum care to avoid contamination. After removal of body fat, tendons and separable connective tissues slaughtered birds were kept in deep freezer at (–18±1°C) overnight, thawed and minced. Minced meat of quail mixed with spices, condiments and

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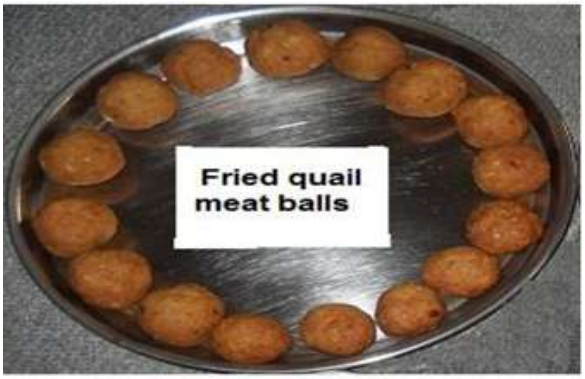
extenders (2.5% soya and 5% rice flour) and used for preparation of quail meat balls. Prepared quail meat balls were packed in LDPE pouches and stored at refrigerated temperature (4 ± 1^0 C) to assess its shelf life. The samples were analyzed at regular interval of four days for various physico-chemical parameters viz. pH, tyrosine and TBA value as well as microbiological quality.

Raw non meat ingredients used for preparation of quail meatballs

Rice flour and Soya flour extenders used in quail meatballs



Fried quail meatballs

Physico-Chemical Parameters

pH

The pH of quail meat balls was measured using digital pH meter as per the method suggested by Troutt *et al.* (1992).

Tyrosine Value

The procedure of Strange *et al*. (1977) was used with slight modification for determination of tyrosine value of the refrigerated stored quail meat balls.

Thiobarbituric Acid Value (TBA value)

Thiobarbituric acid value of the stored samples was determined following the modified method described by Strange *et al.* (1977).

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Microbiological Quality

The microbiological quality of quail meat balls were assessed on the basis of Total plate count (TPC), psychrophilic count (PPC) and *Escherichia Coli* count which were determined as per the procedure of American Public Health Association (APHA, 1984).

Preparation of Serial Dilutions

Serial dilutions were prepared as per the procedure described in ICMSF (1986) in a horizontal laminar flow by maintaining all possible aseptic conditions.

Total Plate Count

Plate count agar (23.5 g) (Hi-media Pvt Ltd) was suspended in one liter of distilled water and pH was adjusted to 7.00±0.02. It was heated to dissolve completely and sterilized by autoclaving at 15 lbs pressure for 15 min. Pour plate technique was followed for plating using 1 ml of inoculum from 10^{-4} dilution in which 15-20 ml of plate count molten agar was poured and plates were incubated at 37±1°C for 48 hrs. The colonies were counted expressed as $\log_{10}$cfu/g of sample.

Psychrophilic Plate Count

The procedure followed for determination of psychrophilic count was similar to that of total plate count, except that the plates were incubated at 4±1°c for one week in a refrigerator. The number of colonies were counted and expressed as $\log_{10}$ cfu/g of sample.

***Escherichia Coli* Count**

E. coli count was determined by pour plate method. One ml of inoculum from10^{-4} dilution was transferred in a sterilized petri dish in which 15-20 ml pre-sterilized molten Eosin Methylene Blue (EMB) agar was pour plated. Plates were allowed to set, incubated at 37°C for 48 hrs. Bluish purple coloured colonies with greenish metallic sheen were indicative of *E. coli*, which were counted and expressed as log cfu/g of sample.

Statistical Analysis

The data obtained during the experiment was analyzed using one way analysis of variance following the procedure described by Snedecor and Cochran (1989).

Result and Discussion

Comments with respect to quality assessment of soya and rice flour quail meat balls stored at refrigeration temperature were categorized under the following headings.

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Physico-Chemical Properties

The data on various physic-chemical parameters like pH, tyrosine and TBA (Thiobarbituric acid) value of the quail meat balls during refrigerated storage period were presented in Table1.

Table 1: Storage related change in physico-chemical characteristics of quail meatballs during period refrigerated storage (4 ± 1°C)

Type of Product	Storage (days)							Treatment Mean
	0	4	8	12	16	20	24	
	pH							
Control	6.23	6.24	6.25	6.27	6.3	6.33	6.36	**6.28^{a}**
Soya (2.5%)	6.21	6.22	6.24	6.26	6.28	6.32	6.36	**6.27^{a}**
Rice (2.5%)	6.21	6.22	6.24	6.25	6.28	6.32	6.36	**6.27^{a}**
Storage mean	**6.22^{a}**	**6.23^{a}**	**6.24^{ab}**	**6.26^{b}**	**6.29^{c}**	**6.32^{d}**	**6.36^{e}**	
	TBA (mg/Kg)							
Control	0.25	0.27	0.29	0.36	0.45	0.56	0.66	**0.40^{a}**
Soya (2.5%)	0.23	0.25	0.28	0.37	0.42	0.5	0.67	**0.39^{a}**
Rice (2.5%)	0.23	0.25	0.29	0.33	0.38	0.46	0.57	**0.36^{b}**
Storage mean	**0.24^{a}**	**0.26^{a}**	**0.29^{a}**	**0.35^{b}**	**0.42^{c}**	**0.51^{d}**	**0.63^{e}**	
	Tyrosine (mg/100g)							
Control	17.23	17.27	17.33	17.47	17.63	17.79	18.12	**17.55^{a}**
Soya (2.5%)	15.93	15.96	15.99	16.04	16.09	16.19	16.43	**16.09^{c}**
Rice (2.5%)	16.8	16.89	16.95	17.01	17.12	17.25	17.42	**17.06^{b}**
Storage mean	**16.65^{a}**	**16.71^{a}**	**16.76^{a}**	**16.84^{a}**	**16.95^{ab}**	**17.07^{b}**	**17.32^{c}**	

Means bearing dissimilar letter in column are significantly (P<0.05) different from control group.

The pH of control and treated samples increased with increasing refrigerated storage period. The steadily increase in pH was found during the early storage period i.e. upto 8th day storage which was differed non-significantly, thereafter pH of the quail meat balls increases significantly (P<0.05) with the advancement of storage period i.e. upto 24th day of the storage. The rise in pH of quail meat balls stored at refrigeration temperature might be due to bacterial growth in product, degradation of lactic acid, liberation of protein metabolites by bacterial enzymes (Jay, 1996). However, the pH of quail meat balls did not differ significantly within treatment during refrigerated storage period, showing highest pH for control samples (without extender) than the soya and rice flour extended quail meat balls. Present findings were resembled with the results of Nag *et al.* (1996) for chicken patties, Biswas *et al.* (2011) duck patties and Nagrale *et al.* (2012) for fish patties, who were also, reported increase in pH during refrigerated storage study.

There was a significant (p<0.05) increase in TBA values of the control and treated samples during refrigerated (21 days) storage. Similar to the pH, the differences in TBA values were found non significant up to 8th day of storage, but it shows significant difference (P<0.05) with increase in the storage period of the control as well as treated samples. During storage, TBA values of rice extended quail meat balls was noted significantly lower than the non significant difference showing samples i.e. control and soya treated

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quail meat balls. The increase in TBA values particularly at the end of storage is indicative of oxidative rancidity but the values on 20th day were within the spoilage limit of 0.60 mg/kg where the off flavor was generally detected in the product (Greene and Cumuze, 1982). The subsequent storage after 20th day the TBA values of quail meat balls exceeded the acceptable limits. The increase in TBA values on storage might be attributed to oxygen permeability of packaging material that led to lipid oxidation (Mir and Masoodi, 2017). The findings are exactly similar with findings of Nagrale *et al.* (2012) and Raut (2007) for fish and chicken patties respectively. The results were in accordance with refrigerated stored duck patties (Biswas *et al.* 2011) and enrobed cutlets (Biswas and Kumar, 2006).

The tyrosine value gradually increased in all treatments as well as in control samples during storage period. Tyrosine value for all treatments were found significantly lower than those of control ($p<0.05$) during the refrigerated storage period. Similar increase in tyrosine values was reported by Nagrale *et al.* (2012) for fish patties and Raut (2007) for rice flour extended chicken patties. Biswas and Kumar (2006) were also noted similar increase in the tyrosine value in enrobed cutlets during refrigerated storage. Increase in tyrosine value particularly at the end of storage period might be due to due to hydrolytic changes in meat proteins produced by inherent tissue enzymes and bacterial proteases (Shukla *et al. 2015).*

Microbiological Quality

According to the findings (Table 2), all the treatments showed significantly increased ($p<0.05$) total plate count and psychrophilic count of quail meat balls.

Table 2. Storage related changes in microbiological quality of quail meatballs during refrigerated storage ($4 \pm 1^{o}C$)

Type of Product	Storage period (days)							Treatment Mean
	0	4	8	12	16	20	24	
	Total plate count (log cfu/g)							
Control	2.44	2.56	2.8	2.89	3.14	3.67	3.74	**3.03^{b}**
Soya (2.5%)	2.25	2.37	2.61	2.7	2.97	3.5	3.56	**2.85^{a}**
Rice (2.5%)	2.63	2.76	3.03	3.4	4.11	4.43	4.61	**3.56^{c}**
Storage mean	**2.44^{a}**	**2.56^{a}**	**2.81b^{bc}**	**3.00b^{bc}**	**3.41^{ab}**	**3.87^{b}**	**3.97^{b}**	
	Psychrophilic count (log cfu/g)							
Control	1.72	1.9	2.3	2.77	3.15	3.81	4.79	**2.92^{c}**
Soya (2.5%)	1.3	1.68	2.15	2.43	2.87	3.47	4.12	**2.58^{a}**
Rice (2.5%)	1.38	1.73	2.23	2.5	2.96	4.17	4.71	**2.81^{b}**
Storage mean	**1.47^{a}**	**1.77^{a}**	**2.23^{b}**	**2.57^{b}**	**2.99^{c}**	**3.82^{d}**	**4.54^{e}**	
	E. coli- count (log cfu/g)							
Control	ND	ND	ND	ND	ND	ND	ND	**ND**
Soya (2.5%)	ND	ND	ND	ND	ND	ND	ND	**ND**
Rice (2.5%)	ND	ND	ND	ND	ND	ND	ND	**ND**
Storage mean	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	

Means bearing dissimilar letter (abcde) in column are significantly ($P<0.05$) different from control group. ND- Non detected

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Meat products stored for prolonged periods at refrigeration temperature provides the perfect conditions in which microorganisms grow (Fahad, 2013). The increase in total plate count up to 16th day of the storage was steady, but afterwards the count increased considerable. The comparable count for 0 and 16th day might be attributed to that bacteria generally need some lag phase before rapid multiplications is initiated (Singh *et al.*, 2014). At the end of storage, total plate count of quail meat balls extended with 2.5 percent rice flour were significantly higher than those of the control, which might be caused by an easy availability of carbohydrate in the rice extended quail meatballs to favor microbial growth. The total plate count was far below the inefficient spoilage level of 6.70 log cfu/gm (Vonhally and Hollzafel, 1991). The present findings are in close agreement with the observation of Mundhe (2010) for chicken patties and Nagrale *et al.* (2012) for fish patties. Similar increasing trend was noticed in psychrophilic count of quail meat balls, however count noted for psychrophilic organism was comparatively lower than the total plate count, which might be caused by sufficient heat treatment during frying which drastically injure and kill the psychrophilic population of quail meat balls. Among all treatments, psychrophilic count differed significantly with lowest count in the soya flour treated quail meat balls this might be due to the less availability of energy giving carbohydrate to microorganism in the soya treated products. Similar results for psychrophilic count were reported by Naveena *et al.* (2006) and Wadpalliwar (2015) for finger millet extended chicken patties. During storage study, none of the sample was found positive for the presence of *E. coli* (Table 2). The non-detection of *E.coli* count throughout the refrigeration storage in both control and extended soya and rice quail meat balls might be due to the destruction of these bacteria during frying at 130^{0}C temperature for 15 min, as thermal death point of *E. coli* is 57^{0}C, as well as hygienic practices followed during the preparation and packaging of quail meat balls. Results were in close agreement with Raja *et al.* (2014) and Zargar *et al.* (2014). However, Wadpalliwar (2015) was observed increase in *E. coli* count in chicken nuggets on day 16th of storage period.

The study implies that quail meat balls made with and without incorporation of soya flour and rice flour can be stored safely for a period of 20 days in LDPE package at 4±1^0 C.

Conclusion

From the study it is concluded that, quail meat balls prepared with incorporation of acceptable levels (2.5 %) of soya flour and rice flour, packed in LDPE pouches can be stored safely for a period of 20 days at 4 ± 1^0 C.

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