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Research Paper

Effect of Addition of Different Levels of Soya Flour and Rice Flour as Extenders on Quality of Quail Meatballs and Economics

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ABSTRACT

The study was undertaken with an aim to develop acceptable quality meatballs from quail meat incorporated with different extenders. Minced quail meat, spices, condiments and extenders (soya and rice flour) were used for preparation of quail meatballs. The extenders were found useful in improving physico-chemical characteristics of quail meatballs. The scores for all sensory attributes viz. appearance, flavour, juiciness, texture and overall palatability decreased gradually with increase in the level of incorporation of soya flour and rice flour up to 2.5% level. Increase in addition of soya flour and rice flour levels in formulation showed significant ($p<0.05$) decrease in all sensory attributes. Among the treatment, the product prepared from quail meat incorporated with 2.5 percent soya exhibited significantly higher score for all sensory attributes and physico-chemical characteristic. Quail meatballs prepared by using rice flour showed gradual decrease in sensory attributes and physico-chemical characteristic. It is also revealed that the cost of production of control meatballs was Rs. 3.39 which was higher than that of soya and rice flour extended meatballs.

Keywords : *Quail meat, Meat balls, Extenders, Soya flour, Rice flour, Cost structure*

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INTRODUCTION

Now-a-days, quail meat has gained much popularity among consumers. Most common breed of quail for human consumption, belong to the species *Coturnix coturnix japonica*. They were first domesticated in Japan (Mizutani, 2003) and distributed wildly over large areas of Asia, Europe and Africa. Quail meat is an ideal food and has no religious taboos. It is tender, delicious with low calorific value and high dry matter. It contains high protein, less fat and it has a higher content of polyunsaturated fatty acids and it is also rich in Phosphatidyl choline and Phosphatidylethanolamine which are essential nutrients for higher nervous activity with brain function. Raising quails for meat production is a genuine alternative to other animals raised as sources of animal protein. Quail meat is low in fat content and high in protein content than chicken and duck. It has the highest amount of Omega 3 fatty acids, high quantity of vitamin A, vitamin C, iron, zinc and phosphorus than the chicken and duck meat (Ionita *et al.* 2009).

The demand for meat based convenient foods is increasing day by day. Meatball is a popular traditional product. Extenders and binders are added during preparation of certain food products not only to reduce the cost, but also to improve the cooking yield, slicing characteristics, emulsion stability, fat and water binding properties. While considering the cost of production, utilization of soy and rice flour may be exploited for reducing the cost of product without impairing nutritional and sensory quality. Thus, the present study was planned to develop meatballs from quail meat and different extenders for better acceptability and economics.

MATERIAL AND METHODS

Quail meat: Six weeks old quails procured from the local market of Parbhani were hygienically slaughtered and dressed according to traditional Halal method in the department of livestock products technology. The body fat, tendons and separable connective tissues were trimmed off and kept in deep freezer at $-18 \pm 1^{\circ}C$, which was then subsequently used for product formulation.

Preparation of quail meatballs: Quail meatballs were prepared as per the method of Mandal *et al.* (1996) by replacing lean meat with extenders. The frozen quail meat kept was thawed at $20^{o}C$, then cut into small chunks and minced in the meat mincer using mincing plate having holes of 6 mm size. Quail meatballs were prepared by incorporation of extenders viz. soya flour and rice flour at different levels (0, 2.5, 5 and 7.5%). Deboned meat was proportionately replaced with soya flour and rice flour individually during the experiment. The

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product was evaluated for its quality on the basis of physico-chemical characteristics viz. pH, cooking yield, emulsion stability, moisture retention, proximate composition (moisture, fat and protein) and sensory evaluation and the best level of extenders was selected. Experiment was replicated thrice.

Table 1: Basic formulation of quail meat balls

Sr. No.	Ingredients	Quantity (% by weight)
1.	Lean meat	68.00
2.	Vegetable oil	05.00
3.	Whole egg liquid	03.00
4.	Bread crumbs	05.00
5.	Ice flakes	05.00
6.	Salt	01.75
7.	Refined soya flour / rice flour	05.00
8.	Spice mix	01.75
9.	Condiments	05.00
10.	Sodium nitrite	00.02
11.	Butylated hydroxyl toluene	00.01
12.	STPP	00.47
		Total = 100.00

Proximate analysis of the product: The moisture, fat and protein contents of fried quail meatballs were determined by following methods of AOAC (1995).

Determination of pH: The pH of quail meatballs was measured using digital pH meter as suggested by Troutt *et al.* (1992) for which suspension was made by blending 10 g of sample with 50 ml distilled water. The pH of suspension was measured with the help of digital pH meter equipped with a combined glass electrode.

Emulsion stability: Emulsion stability of meat emulsion was determined as per the procedure of Townsend *et al.* (1968). Polyethylene bags (12 x 10 cm) containing 25 g samples were sealed, and immersed in thermostatically controlled water bath at 80°C for 20 min. The bags were removed from the water bath, cut open and cooked fluids (fat, water and solids) were drained out and weighed. The weight of product after cooking was measured and expressed in percentage emulsion stability.

Cooking yield: The weight of each meatball was recorded before and after frying. The yield was calculated and expressed as percentage (Murphy *et al.* 1975).

$$\text{Cooking yield (\%)} = \frac{\text{Weight of cooked meatballs}}{\text{Weight of uncooked meatballs}} \times 100$$

Determination of moisture-retention: Moisture retention value represents the amount of moisture retained in the cooked product per 100g of sample. It was determined according to equation by El-Magoli *et al*. (1996).

Sensory evaluation: The quality of quail meatball for various sensory attributes viz., appearance, flavour, juiciness, texture and overall acceptability was evaluated by five semi trained academic staff members as a sensory panel members by using 8 point descriptive scale (Keeton 1983). Before evaluation, the panelists were told the nature of experiment without giving any identity.

Statistical analysis: The data obtained during the experiment was analyzed by Analysis of Variance following the procedure described by Snedecor and Cochran (1989).

***Economics of quail meatballs*:** Economics were calculated as per the prevalent rates of ingredients from local market.

RESULTS AND DISCUSSION

The processing parameters to obtain acceptable quality quail meatballs using different levels of extenders viz., soya flour and rice flour were optimized. The results pertaining to physico-chemical properties presented in table 2 and with respect to sensory evaluation of meat ball presented in table 3.

Effect of incorporation of various levels of extenders on the quality of quail meatballs

Soya flour

Physico-chemical properties: The study showed that pH of quail meat balls increased significantly ($p<0.05$) with addition of soya flour. However, pH differences among quail meat ball groups containing various levels of soya flour were non-significant. An increase in pH due to addition of soya flour into chicken patties formulation was reported previously by Raut (2007). In contrast, Das *et al.* (2006) observed non-significant variation in pH between control and goat meat patties with soya paste.

The emulsion stability of quail meat ball increased significantly ($p<0.05$) with addition of soya flour as compared to control. However, the difference in emulsion stability of quail meatballs incorporated with various levels of soya flour were statistically non-significant ($p<0.05$). The highest emulsion stability was observed for quail meatballs incorporated with 7.5 percent soya flour while significantly ($p<0.05$) lowest emulsion stability was recorded for control. The present findings are in close agreement with Chandralekha (2012) who also reported higher emulsion

stability in chicken meatballs incorporated with soya flours. Contrarily, Dushayntan *et al.* (2008) reported gradual decrease in emulsion stability up to 3 percent soya flour incorporation in buffalo meat nuggets. Incorporation of soya flour at various levels resulted in significant ($p<0.05$) improvement in cooking yield over control sample. This increase in cooking yield in quail meatballs may be the result of an increased number of charged polar amino and carboxylic groups due to peptide cleavage which leads to a stranger protein water interaction (Pinna Rammos and Xiong 2003). Among the treatments, cooking yield was maximum in the quail meatballs added with 7.5 percent soya flour but at par with 2.5 percent and 5 percent soya flour. Similarly, increase in cooking yield was observed by Kilio *et al.* (2010) for low fat cooked koffte (Turkish meatballs) with addition of texturized soya protein. On the contrary, Dusyantan *et al.* (2008) reported significant decrease in cooking yield of buffalo meat nuggets with addition of various levels of soya flour. Incorporation of soya flour significantly ($p<0.05$) contributed to retain the moisture content of quail meatballs.

The moisture content of quail meatballs incorporated with various levels (2.5, 5 and 7.5 percent) differ significantly ($p<0.05$). Incorporation of soya flour up to 5 percent resulted in gradual increase in moisture content as compared to control. The highest moisture content was recorded in quail meatballs incorporated with 7.5 % soya flour but differences between 5 percent and 7.5 percent soya flour added quail meatballs were marginal. The present findings are in agreements with Pandey *(*1996) to reveal that egg patties prepared with higher level of texture soya flour had low moisture content. On contrary to the present findings, Das *et al*. (2006) reported decrease in moisture content of goat meat patties incorporated with full fat soya paste.

The moisture retention in soya flour extended quail meatballs was higher than that of control. The increase was quite linear up to 2.5 percent soya flour added quail meatballs but thereafter significant increase in moisture retention was noticed among the treatment and moisture retention did not differ significantly. The highest moisture retention was recorded in 7.5 percent soya flour added quail meatballs, which might be due to non meat proteins. Chin *et al.* (1998) reported that addition of soybeans to meat product helps to retain added water as well as prevent loss of moisture of the product during cooking. Similar findings were reported by Singh and Chauhan (1986). On the contrary, Kenwai *et al.* (2009) reported reduction in moisture content of product by using soya flour as meat extender at 10 percent level.

The protein content of soya flour extended quail meatballs increased significantly ($p<0.05$) with gradual replacement of meat by soya flour as compared to control. The highest protein content was recorded in quail meatballs incorporated with 7.5 percent soya flour. The increase in protein content of quail meatballs extended with soya flour may be due to increased protein content of soyabean (Raut 2007). The present findings were in close agreement with that of Pandey *et al.* (1996) who reported that egg patties containing 25 percent textured soya protein had higher protein content as compared to 10 percent soya flour extended patties.

The highest fat content of quail meatballs was recorded in 7.5 percent soya flour extended quail meatballs. The present findings are in agreement with Das *et al. (*2006) who reported significant increase in fat content of goat meat patties incorporated with full fat soya paste while Pandey *et al.* (1996) did not show any defined change in fat content of egg patties incorporated with textured soya protein. In contrast to present findings, Kenawi *et al.* (2009) reported significant decrease in fat content of buffalo meat patties incorporated with 10 percent low fat soya flour.

Sensory attributes: Incorporation of soya flour significantly ($p<0.05$) affected the sensory attributes of quail meatballs. Results revealed significant ($p<0.05$) variations in appearance score of quail meatballs incorporated with different levels of soya flour. The maximum scores were recorded for control (without extenders), while lowest score was observed for quail meatballs incorporated with 7.5 percent soya flour. However, non significant variation were observed between quail meatballs incorporated with 2.5 percent and 5 percent soya flour with further addition of soya flour i.e. 7.5 percent, the appearance scores declined significantly ($p<0.05$) indicating that the higher level of soya flour was not beneficial. Contrary results were reported by Dushyanthan *et al.* (2008) for appearance scores of buffalo meat nugget added with 3 % soya flour, this variation may be attributed to type of meat. However, Chowdhury (1994) reported that the score with regards to appearance were unaffected due to incorporation of different levels of texturized soya flour in chicken patties. The quail meat ball without soya flour (Control) recorded significantly ($p<0.05$) highest scores for flavour. Addition of soya flour significantly ($P<0.05$) declined the flavor scores of quail meat ball which might be due to the presence of lipoxygenase enzyme in raw soybean (Raut 2007). The flavour scores for quail meatballs incorporated with 2.5 percent and 5 percent soya flour did not differ significantly, but subsequent increase in soya flour to 7.5 percent declined the score

significantly ($p<0.05$) which might be due to lack of meaty flavour. The scores for sensory attributes viz., juiciness, texture and overall palatability declined gradually with incorporation of soya flour up to 2.5 percent. Incorporation of further higher levels of soya flour however, resulted in lowering the scores significantly ($p<0.05$). It indicated that higher level of soya flour i.e. more than 2.5 percent was not suitable since product became tough and more chewable. On the contrast, Raut (2007) reported improvement in juiciness in soya flour added chicken patties. Present findings is in agreement with the results of Dushyanthan *et al.* (2008) for buffalo meat nuggets however, Das *et al.* (2006) observed no significant difference in juiciness, texture and overall palatability scores between control and goat meat patties incorporated with soya paste.

Rice flour

Physico-chemical properties: The pH of quail meatballs increased gradually with increase in levels of rice flour up to 5 percent. With further increase in rice flour to 7.5 percent, the pH increased significantly ($p<0.05$) as compared to control. However, the difference in pH of control and quail meatballs incorporated with rice flour up to 5 percent was non-significant indicating that pH of quail meatballs not differed with incorporation of rice flour. Similar increase in pH of low fat chicken sausage was noticed by Ali *et al.* (2011). The present findings are in concurrence with Raut (2007) who also recorded significant increase in pH of chicken patties with increase in level of rice flour. Significant ($p<0.05$) increase in cooking yield and emulsion stability of quail meatballs were recorded with the incorporation of rice flour as extender.

Table 2: Effect of addition of different levels of extenders on physico-chemical characteristics of quail meatballs (Mean±S.E.)

Levels of Soya flour	pH	Emulsion stability (%)	Cooking yield (%)	Moisture retention (%)	Moisture (%)	Protein (%)	Fat (%)
0%	$6.13^{b}\pm0.05$	$91.62^{b}\pm0.09$	$89.42^{c}\pm2.82$	$58.27^{b}\pm0.15$	$57.12^{b}\pm0.15$	$21.71^{d}\pm0.2$	$12.40^{b}\pm0.10$
	$6.22^{a}\pm0.02$	$95.07^{a}\pm0.12$	$89.42^{c}\pm2.82$	$58.35^{b}\pm0.12$	$57.58^{ab}\pm0.07$	$22.39^{c}\pm0.07$	$12.50^{b}\pm0.06$
	$6.24^{a}\pm0.01$	$95.10^{a}\pm0.03$	$93.12^{a}\pm2.09$	$58.62^{ab}\pm0.04$	$57.70^{a}\pm0.24$	$24.15^{b}\pm0.17$	$12.81^{ab}\pm0.23$
	$6.29^{a}\pm0.01$	$95.11^{a}\pm0.09$	$93.13^{a}\pm4.00$	$58.69^{a}\pm0.04$	$58.05^{a}\pm0.05$	$24.83^{a}\pm0.18$	$13.03^{a}\pm0.07$
Rice flour							
0%	$6.20^{a}\pm0.04$	$91.08^{b}\pm0.68$	$91.99^{b}\pm2.78$	56.78 ± 0.07	58.48 ± 0.18	21.78 ± 0.17	12.37 ± 0.01
2.5%	$6.24^{ab}\pm0.03$	$92.60^{a}\pm0.46$	$94.71^{a}\pm0.76$	57.05 ± 0.31	58.36 ± 0.22	21.76 ± 0.17	12.36 ± 0.02
5.0%	$6.25^{ab}\pm0.02$	$92.94^{a}\pm0.27$	$94.86^{a}\pm0.31$	57.09 ± 0.02	57.75 ± 0.07	21.75 ± 0.18	12.34 ± 0.02
7.5%	$6.36^{b}\pm0.02$	$94.90^{a}\pm0.04$	$94.98^{a}\pm0.65$	57.12 ± 0.01	57.37 ± 0.03	21.70 ± 0.02	12.32 ± 0.01

Means with common superscripts did not differ significantly ($p<0.05$)

Addition of rice flour at 2.5 percent level increased the emulsion stability and cooking yield significantly ($p<0.05$) as compare to control. Further addition of rice flour from 2.5 to 7.5 percent revealed marginal increase in the emulsion stability and cooking yield, indicating that higher level of rice flour was not beneficial. The higher cooking yield of rice flour incorporated quail meatballs might be due the addition of carbohydrate source i.e. rice flour as a binder which helps to keep whole meat tissue and meat juices at together while cooking and during storage (Keer 1950). The present findings are in agreement with the findings of Raut (2007) for chicken patties and Ali *et al.* (2011) for low fat chicken sausage incorporated with rice flour as extender. Moisture retention was gradually increased with incorporation of rice flour in quail meatballs as compared to control. The highest moisture retention was recorded for quail meatballs incorporated with 7.5 percent rice flour. The present findings are in agreement with Ikhlas (2011). It was revealed that moisture, protein and fat content of quail meatballs declined gradually with incorporation of rice flour at various levels. There was no significant difference among quail meatballs incorporated with rice flour indicating that any differences in physical properties and sensory ratings observed for quail meatballs would not be biased by different moisture content of quail meatball incorporated with various levels of rice flour. The similar observations were made by Raut (2007) and Ali (2011).

Sensory attributes: The proportion of rice flour used in the present experiment had appreciable effect on sensory quality of quail meatballs. It was observed that the scores of all the sensory attributes declined significantly ($p<0.05$) with incorporation of rice flour at various levels (2.5, 5 and 7.5 per cent). However, non significant variation were observed between control (without rice flour) and quail meatballs incorporated with 2.5 percent rice flour. Both the treatments

were significantly superior over quail meatballs incorporated with higher levels of rice flour (7.5 percent). This indicated that higher levels of rice flour (5 and 7.5 percent) did not have any beneficial effect on sensory quality of quail meatballs. Quail meatballs prepared with addition of higher levels of rice flour (5 and 7.5 percent) scored significantly lower values for various sensory attributes which might be due to loss of meaty flavor which was liked by the sensory panelist. Similar observations were observed by Kumar and Sharma (2005) who reported that flavour score declined significantly ($p<0.05$) using extenders (Sorghum flour). In contrast to our findings, Ali *et al.* (2011) reported significant increase in sensory attributes of low fat pork sausages with addition of 10 percent rice flour.

Table 3: Effect of addition of different levels of extenders on sensory characteristics of quail meatballs (Mean±S.E.)

Levels of	Appearance	Flavour	Juiciness	Texture	Overall palatability
Soya flour					
0%	$7.33^{a} \pm 0.24$	$7.44^{a} \pm 0.18$	$7.44^{a} \pm 0.18$	$7.44^{a} \pm 0.18$	$7.55^{a} \pm 0.18$
2.5%	$6.67^{b} \pm 0.24$	$6.78^{b} \pm 0.22$	$6.89^{a} \pm 0.11$	$6.89^{a} \pm 0.17$	$7.33^{a} \pm 0.17$
5.0%	$6.67^{b} \pm 0.17$	$6.22^{b} \pm 0.15$	$6.22^{b} \pm 0.22$	$6.00^{b} \pm 0.24$	$6.22^{b} \pm 0.29$
7.5%	$5.67^{c} \pm 0.17$	$5.00^{c} \pm 0.29$	$5.00^{c} \pm 0.29$	$4.89^{c} \pm 0.20$	$4.89^{c} \pm 0.26$
Rice flour					
0%	$7.33^{a} \pm 0.24$	$7.33^{a} \pm 0.24$	$7.33^{a} \pm 0.24$	$7.33^{a} \pm 0.24$	$7.33^{a} \pm 0.24$
	$6.67^{ab} \pm 0.24$	$6.89^{a} \pm 0.20$	$6.89^{a} \pm 0.11$	$6.67^{b} \pm 0.17$	$6.89^{a} \pm 0.17$
	$6.22^{bc} \pm 0.22$	$6.11^{b} \pm 0.11$	$6.11^{b} \pm 0.17$	$6.33^{b} \pm 0.17$	$6.22^{b} \pm 0.15$
	$5.78^{c} \pm 0.32$	$5.00^{c} \pm 0.24$	$4.89^{c} \pm 0.35$	$4.78^{c} \pm 0.32$	$4.89^{c} \pm 0.26$

Means with common superscripts did not differ significantly ($P<0.05$)

Cost structure of quail meatball: The cost of production for preparation of single meatball (10 g) was calculated considering the prevailing market price and based on the selling rate, net profit of each meatball was worked out. Result showed that the cost of production of control meatballs comes to Rs. 3.78 which was higher than that of soya and rice extended meatballs. Depending upon the selling rate of single meatballs, the net profit obtained from quail meatballs for control, soya extended and rice meatballs was Rs. 1.22, 1.31 and 1.32 respectively and the profit per kilogram of meatballs was Rs. 122, 131 and 132, respectively. Similarly, Raut (2007) reported that, the cost structure of chicken patties is reduced by incorporation of soya, rice flour and lentil flour in it. It is clear from the above observations that quail meatballs with different levels of soy and rice flour helps to reduce the cost of meatballs. The higher net profit in soya extended quail meatballs may be attributed to replacement of lean meat with soya and rice flour.

CONCLUSIONS

From the study, it is concluded that a value added, nutritionally balanced, highly acceptable and cost effective rice and soya flour extended meatball could be prepared without adversely affecting its quality. Extenders viz., soya flour and rice flour can be added upto 2.5% for development of acceptable quality meat ball, whereas addition of higher level extenders (7.5%) affect all sensory attributes adversely.

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