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ASSESSMENT OF THE SHELF LIFE OF QUAIL EGG PICKLE

By

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THESIS

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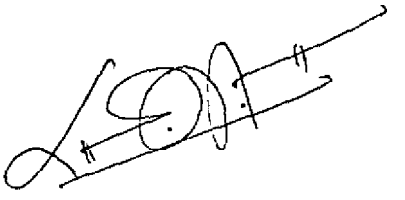
2001

DECLARATION

I hereby declare that the thesis entitled *"ASSESSMENT OF THE SHELF LIFE OF QUAIL EGG PICKLE"* is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.



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DEEPA MENON

CERTIFICATE

Certified that the thesis entitled " *ASSESSMENT OF THE SHELF LIFE OF QUAIL EGG PICKLE* " is a record of research work done independently by Deepa Menon, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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Deepa Menon

Dedicated to Amma & Roshan

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Introduction

INTRODUCTION

Poultry industry in India has shown spectacular progress during the last three decades. Although the recent periods have witnessed a phenomenal increase in egg production in the country, the consumption of eggs has not increased much. One of the reasons for the low consumption rate may be the lack of a range of convenient food items. Therefore, the development of such food from egg would probably lead to an increase in per capita consumption. With the introduction of fast food culture in India, the demand for good quality ready-to-serve poultry products is increasing. In order to keep up with the current tempo of poultry development, and to give it a full boost, processing and marketing of poultry products have to be strengthened.

The Japanese Quail, (*Coturnix coturnix japonica*), popularly known as bater is a table delicacy since olden times. In the recent past many countries like the U S, France, China, Japan, South-East Asian countries and India have taken up the rearing of Japanese quails for commercial egg and meat production. Quail farming is on the increase in India, since its introduction in 1974. The popularity of quail can be attributed to its prolific egg laying and meat yielding potential. They have the capacity to yield 300 or more eggs per annum.

Quail egg is roughly one-fifth the size of a chicken egg and weighs around 10g. Nutritionally, the quality of these eggs is at par with that of chicken eggs, rather they contain less cholesterol (Kundu and Singh, 1991). The proportion of yolk to albumen, at 39 : 61, is higher when compared to chicken eggs.

Quail eggs are small in size, tinted and thin shelled which limits their efficient transport and disposal in the raw state. Therefore, there is an immense need to find an alternative method to promote the sale of quail eggs, which will generate additional income to farmers. There are a variety of egg products like brined eggs, pickled eggs, Italian pastas, scotch eggs etc. In the recent past, there has been a considerable increase in the demand for good quality ready-to-cook/eat meat products especially poultry products in the urban areas of our country. In order to keep up with the current growth in quail farming, production, processing and marketing of quail egg products will have to be strengthened.

Pickling is one such method for the effective utilization of this valuable food item. Pickling is the process of preserving perishable foods in vinegar and or oil with added spices, salt and condiments in the form of a ready-to-eat food item.

Pickling of quail eggs is a simple process and unlike other eggs, quail eggs are smaller in size, which makes it suitable for pickling. Generally pickles of any kind are favourite side dish in Indian meals. The recipe, preparation, and standardisation of quail egg pickle, evaluation of its quality and shelf life at room temperature are essential for, proper consumer acceptance and effective marketing. Information on eating qualities, keeping and microbiological properties of quail egg pickle are rather scanty, which necessitates further research.

Therefore, the present investigation was taken up to examine the feasibility of preparing quail egg pickle suitable for the Indian palate and to evaluate the consumer acceptability, nutritional characteristics, shelf life and economy of production.

Review of literature

REVIEW OF LITERATURE

This study involves preparation of quail egg pickle and evaluation of its quality parameters during storage at a mean room temperature of 34.6° C. The quality characteristics include pH, proximate composition, 2-thiobarbituric acid reactive substances (TBARS) number, total viable count, yeast and mould count and organoleptic evaluation. Efficacy of potassium sorbate as a preservative in quail egg pickle was also studied. A brief review of relevant literature on the mentioned aspects is given below.

2.1 Cooking yield

Singh and Panda (1988b) studied the keeping quality of pickled quail eggs under different packaging and storage conditions and found that quail eggs lost 7.36 per cent weight during cooking.

Sapcota and Siddiqui (1989) reported that the cooking yield of quail eggs was 86.16 per cent, after 48 hours of ageing at room temperature, in a study conducted on the quality of hard cooked quail eggs.

Pandey *et al.* (1993a) found that the peeling yield varied from 87.50 to 88.90 per cent, in a study conducted on the peeling characteristics and quality of hard cooked eggs.

While determining the peelability and quality characteristics of eggs, it was observed that the cooking yield of hard cooked quail eggs was 89.22 per cent (Pandey *et al.*, 1994a).

A cooking yield of 82 per cent was reported in a study on the effect of storage and subsequent hard cooking on the quality of quail eggs (Pandey *et al.*, 1994b).

2.2 pH

Hale *et al.* (1981) observed that the pH of the preservative solution with 0.85 per cent citric acid was 4.0 and that with 0.20 per cent citric acid was 5.50, while studying the quality of hard cooked eggs pickled in solutions containing 0.10 per cent sodium benzoate. The authors also reported that the pH of the pickle increased considerably during storage.

Essary and Georgiades (1982) found that the pH of pickling solution increased during the third week of storage. The albumen pH was found to decrease considerably during the period.

It was observed that the mean pH of pickle solution increased from 3.25 at zero day to 4.61 at 24 weeks of storage at ambient temperature, while investigating the shelf life of quail eggs pickled in three different solutions (Arafa, 1983).

Shrivastav *et al.* (1983) found that the pH of quail egg pickle packed in polyethylene pouches increased from 4.30 to 4.60 during six months of storage at room temperature.

Sheldon and Kimsey (1985) observed that pH of eggs declined during cooking associated with the migration of ions from yolk to albumen.

James (1987) reported that organic acids in food were oxidized by organisms to carbonates, causing the medium to turn more alkaline during storage.

Singh and Panda (1988a) reported that the pH of pickled quail eggs stored in HDPE pouches for six months at room temperature increased gradually.

Cherian *et al.* (1989) found that cooking of eggs resulted in an increase in the pH of yolk while the albumen pH decreased slightly.

Singh *et al.* (1989a) reported that the pH values of albumen and yolk of pickled quail eggs were found to be 8.92 and 6.23 respectively after 24 hours of storage at room temperature. The pH of pickle solution increased with a corresponding drop in the pH of egg components. The authors also stated that the eggs in pickling solution containing 0.10 per cent citric acid and 0.20 per cent sodium benzoate had comparatively lower pH than those kept in plain brine solution.

In a study on the shelf life of oil based quail egg pickle with 0.20 per cent sodium benzoate and 0.40 percent citric acid, it was observed that the pickle reached an equilibrium pH of 4.70 after four days of storage at refrigeration conditions (Singh *et al.*, 1989b).

Panda *et al.* (1990) studied the changes in quail egg pickle packed in polyethylene pouches and stored at a mean room temperature of 31°C and found that pH of the pickle solution increased with a corresponding but gradual fall in the pH of egg components after pickling.

Sapcota and Siddiqui (1991) reported that the albumen pH of hard cooked eggs remained almost unaffected while that of yolk showed a significant ($P \leq 0.01$) and definite shift towards increased alkalinity during storage under ambient conditions.

While studying the quality of quail egg pickle, it was found that pickled egg albumen and yolk reached near equilibrium acidity within two to four days of storage (Singh and Panda, 1991b).

Pandey *et al.* (1993b) showed that albumen pH declined while yolk pH increased after cooking in the range of 8.80 to 8.59 and 6.16 to 6.45, respectively.

Pandey *et al.* (1994b) observed a change in pH of albumen from 8.06 to 7.70 and from 5.85 to 6.32 in the yolk after cooking, while investigating the properties of hard cooked eggs. The pH of egg components increased during storage for a period of seven days at room temperature.

The mean pH of both vinegar and oil based quail egg pickles were found to increase progressively from 4.17 to 4.25 during storage for 84 days at a mean room temperature of 26°C, in a study conducted on the suitability of various recipes in pickling of quail eggs. (Singh, 1994).

Pandey *et al.* (1995) reported an increase in mean pH of pickle solution from 2.13 on zero day to 6.67 on 14th day of storage, while conducting a study on the quality characteristics and shelf stability of eggs preserved in 0.50, 0.75 and 1 per cent citric acid solutions.

Singh and Anand (1995) evaluated the quality of pickled quail eggs in solutions containing 0.40 per cent citric acid and 0.20 per cent sodium benzoate, packed in HDPE pouches (330G) and stored for a period of eight weeks at room temperature. The authors found that pH of both yolk and albumen declined for a period of two weeks and thereafter remained constant.

While studying the shelf life of chicken meat pickle, it was observed that the pH of pickling solution increased from 3.59 on the day of preparation to 4.24 after 80 days of storage at room temperature (Reddy and Rao, 1997).

Efiuvwevwere and Efi (1999) studied the anti microbial effects of potassium sorbate on quality changes in palm oil and demonstrated that bi-phasic mycelia growth was markedly inhibited in samples. The changes in pH were minimal suggesting less microbial activity.

Berry (2001) investigated the effect of organic acidulants on the pH of processed foods and opined that acetic acid imparted sour taste and adjusted the pH.

2.3 Proximate composition

2.3.1 Moisture

Arafa (1983) reported that a significant reduction in the moisture content of pickled eggs could be seen during storage at room temperature for 24 weeks. The author also reported that cooking reduced the moisture content of eggs.

Studying the quality characteristics of quail egg pickle, Shrivastav *et al.* (1983) observed that the total moisture content of pickled whole egg decreased consequent to storage at room temperature, for six months.

Singh and Panda (1988a) found that quail eggs lost about two per cent moisture during pickling, decreasing from 79.12 to 77.73 per cent from one to six months of storage at ambient temperature.

It was reported that hard cooking of eggs resulted in considerable movement of moisture from albumen to yolk (Cherian *et al.,* 1989).

Evaluating the physical composition of quail egg, Panda (1989) observed that the mean moisture content was 73.80 in peeled eggs.

Singh *et al.* (1989a) observed that quail eggs pickled in 50 per cent vinegar solution lost about 8.80 to 12.20 per cent weight, within 48 hours of storage.

Panda *et al.* (1990) found that pickling of eggs resulted in a loss of 8.59 to 9.30 per cent moisture and subsequent storage also resulted in slight reduction of moisture.

The moisture content of pickled quail egg components was found to decrease gradually during storage for a period of one month at room temperature and packed in glass jars. (Raikhy and Bawa, 1991).

It was observed that the moisture content was reduced by about one per cent after cooking, in a study conducted on the

proximate composition of hard cooked quail eggs (Pandey *et al*., 1993b).

Pandey *et al.* (1994b) found that the moisture content in cooked quail egg components decreased gradually during storage at room temperature.

The moisture content of pickled quail eggs packed in glass jars were reported to decrease initially from zero to two weeks of storage at room temperature (Singh, 1994).

Reddy and Rao (1996) found that the moisture content of bottled chicken meat pickle decreased from 64.46 to 50.41 per cent during zero to 80 days of storage at room temperature.

Murugan (1998) reported that the moisture content of tenderized chicken meat pickle decreased from 64.59 ± 0.49 to 54.31 ± 0.50 per cent during storage at room temperature for a period of 64 days.

Singh *et al.* (2000) reported that the weight of eggs pickled in oil free organic acid solutions declined progressively during four months of storage due to the loss of moisture and solids.

2.3.2 Protein

Pandey *et al.* (1983) reported that the protein content of pickled quail egg increased during storage at room temperature.

Singh and Panda (1988b) reported a significant increase in the protein content of pickled quail eggs, within 48 hours of ageing period, from an initial value of 11.16 per cent. The total protein varied from 13.79 to 18.06 per cent during storage in HDPE pouches (330G), for a period of six months.

It was observed that quail egg pickle packed with or without pickle solution did not show appreciable variation with respect to total protein content during storage at room temperature for six months (Shrivastav *et al.*, 1989).

A significant ($P \leq 0.01$) increase in the protein content of pickled quail eggs was noticed within five days of ageing. The protein content increased from 14.45 to 15.67 per cent in albumen and from 16.8 to 17.46 per cent in the yolk (Panda *et al.*, 1990).

Raikhy and Bawa (1991) reported a reduction in protein content in the range of 0.25 to 0.74 per cent in the yolk and 0.81 to 1.54 per cent in the albumen of pickled quail eggs packed in glass jars, during storage at ambient temperature.

Singh (1994) observed that the protein content of the pickle showed a slight decrease from 13.21 to 13.09 per cent from zero to

80 days of storage at room temperature, in a study conducted on the suitability of various recipes in pickling quail eggs.

Reddy and Rao (1997) reported that the content of protein in chicken pickle increased from 22.38 to 27.29 per cent, during storage at room temperature for 80 days.

Murugan (1998) reported that the protein content of chicken meat pickle stored at room temperature for 64 days increased from 21.80 ± 0.45 to 26.65 ± 0.34 per cent.

2.3.3 Fat

Singh and Panda (1984) found that pickling increased the total fat content of quail meat and the values were 4.73, 4.68, 4.96 and 4.92 per cent at zero, 30, 90 and 150 days of storage respectively.

Singh (1994) observed that the total fat content in quail egg pickle stored at room temperature increased from an initial value of 12.66 to 15.66 after 12 weeks of storage.

It was observed that the fat content of chicken meat pickle decreased gradually by about two per cent after six months of storage at ambient temperature (Puttarajappa *et al.*, 1996).

Reddy and Rao (1996) reported that the mean fat content of

pickled chicken meat increased from 11.59 to 14.09 per cent during 80 days of storage at room temperature.

In a study conducted on the shelf life of chicken meat pickle it was found that the fat content increased significantly from 11.71 to 14.58 per cent during storage in bottles for a period of 64 days at room temperature (Murugan, 1998).

2.3.4 Total ash

Pandey *et al.* (1983) observed that there was no appreciable change in total ash content of whole egg during pickling and subsequent storage.

Anon (1985) reported that the ash content of quail eggs were 0.79, 1.80 and 1.03 per cent respectively in albumen, yolk, and whole egg.

Quail eggs were reported to contain 0.95, 1.55 and 0.66 per cent total ash in whole egg (excluding shell), albumen and yolk respectively (Sapcota and Siddiqui, 1989).

It was observed that the total ash content in quail egg pickle increased from an initial value of 5.40 at zero day to 6.83 per cent after 12 weeks of storage at room temperature (Singh, 1994).

Murugan (1998) found that the total ash content of chicken meat pickle increased significantly from 1.21 to 3.66 per cent from zero to 64 days of storage at ambient temperature.

2.4 2-Thiobarbituric acid reactive substance (TBARS) number

The estimation of 2-thiobarbituric acid reactive substance number is an indication of oxidative rancidity in food items. Malondialdehyde forms a 1 : 2 adduct with thiobarbituric acid and this is being measured by spectrophotometry.

Dawson (1975) reported that food items with TBARS values above two mg malonaldehyde / kg may be considered to have developed rancidity and hence unacceptable.

Arafa (1983) found that TBARS value of pickled quail eggs increased from 0.23 to 3.97 mg malonaldehyde /kg after 16 weeks of storage at room temperature.

It was observed in an investigation on storage stability of eggs that the denaturation of lipo proteins occurred due to the thermal and pickling treatments, which exposed the yolk lipids to oxidation (Pike and Peng 1985).

Dziezak (1986) studied the effect of antioxidants on foods and reported that the sequestering effect of organic acids was capable of inhibiting lipid oxidation.

Singh and Panda (1988b) found that the TBARS value of quail egg remained less than 0.50 mg malonaldehyde / kg during storage at ambient temperature for four weeks.

Singh *et al.* (1989b) found that raw egg yolk had a mean TBARS value of 0.08, which increased to 0.13 mg malonaldehyde per kg following cooking. The TBARS value of quail egg pickle containing 0.40 per cent citric acid and 0.20 per cent sodium benzoate varied from 0.16 to 0.60 mg malonaldehyde/kg, respectively after eight weeks of refrigerated storage.

Serdaroglu *et al.* (1992) investigated the use of sorbic acid to inhibit bacterial growth on turkey meat. At the end of 10 days of storage at 4°C, TBARS values were analysed and the results indicated that with the use of 0.50 per cent sorbic acid solution, there was only a slight increase.

The TBARS values of pickled quail eggs in HDPE pouches increased from 0.12 on the day of production to 1.03 mg malonaldehyde / kg at six weeks of storage at ambient temperature (Singh and Anand, 1995).

Pandey *et al.* (1995) found that TBARS number of hard cooked eggs preserved in citric acid solutions registered a significant ($P \leq 0.01$) increase from 0.17 to 0.70 mg malonaldehyde / kg during 40 days of refrigerated storage.

Reddy and Rao (1997) observed that the TBARS value of chicken meat pickle increased progressively during storage at ambient temperature from 0.24 to 2.12 mg malonaldehyde /kg showing oxidation.

It was reported that the TBARS number of tenderized chicken meat pickle stored in bottles at room temperature increased significantly ($P \leq 0.01$) from 0.26 to 0.89 mg malonaldehyde / kg during storage at room temperature for 64 days (Murugan, 1998).

Shukla and Srivastava (1999) reported that the TBARS value of chicken meat pickle gradually increased from 0.31 to 1.06 mg malonaldehyde/kg from zero to 90 days of storage at room temperature.

Kumar *et al.* (2000) investigated the application of hurdle technology and reported that chicken meat treated with infusion solutions containing 500-ppm sorbic acid, considerably inhibited the development of oxidative rancidity during storage for a period of 12 days at ambient temperature.

2.5. Microbial profile

2.5.1 Total viable count of mesophilic bacteria

Fischer *et al.*(1985) observed that acidity of the pickling medium had a pronounced effect on the microbial quality of pickled eggs.

Frazier and West Hoff (1988)opined that sorbic acid and its salts, when added in food were inhibitory to yeast and mould, but were less effective against bacteria. It ionized to yield chloride ions, which are harmful to microorganisms.

Price and Schweigert (1987) observed that acetic acid possessed only weak bacteriostatic properties and hence at least 3.60 per cent solutions are required to preserve pickles, effectively at room temperature.

It was reported that the permissible mesophilic count of poultry products is in the limit of not more than 10^5 /g (Hern and Kovacs, 1988).

Singh *et al.* (1989a) found that the halophilic bacterial count increased from log 1.98 to log 6.00 and log 4.90 CFU /g, respectively in salt- benzoate solutions, at the end of six and eight weeks of refrigerated storage.

Sapcota and Siddiqui (1991) reported that the total plate count of hard cooked eggs was 8.50×10^5 and 1.65×10^9 CFU /g, respectively after six and twelve days of storage at room temperature. The authors also suggested that a count of less than or greater than 10^7 might be regarded as the dividing line between microbiologically fit or unfit condition for hard cooked eggs.

Serdaroglu *et al.* (1992) investigated the use of sorbic acid to inhibit bacterial growth on shrink packed turkey meat. At the end of 10 days of storage at 4°C, results indicated that 0.50 per cent sorbic acid solution significantly retarded bacterial growth.

It was reported that heat treatments given during the preparation of convenient egg products was not enough to completely eliminate all bacterial organisms (Anand *et al.*, 1994).

Pal and Agnihotri (1994) observed a total viable count in the range of three log cycles, in quail egg pickle at 90-day storage period.

Pandey *et al.* (1994a) showed that the total plate count of hard cooked eggs varied from log 2.49 to log 2.45 CFU /g during 21 days of refrigerated storage.

Anand *et al.* (1995) observed that the aerobic plate count of liquid egg stored in LDPE (250G) pouches increased from log 1.89 to log 5.54 CFU/g during 14 days of storage at ambient temperature.

Pandey *et al.* (1995) reported that the total plate count of hard cooked eggs preserved in citric acid solutions, increased from log 2.55 to log 2.72 CFU / g during 40 days of storage.

It was observed that the halophilic bacterial count in pickle increased with storage time, regardless of treatments, but pickling

solutions containing sodium benzoate had comparatively lower counts (Singh and Anand, 1995).

Reddy and Rao (1997) found that the total mesophilic count of bottled chicken meat pickle stored at room temperature increased from log 2.74 to log 3.50 CFU / g after a period of 80 days.

It was reported that the total bacterial count in chicken meat pickle increased from log 2.60 ±0.04 to log 4.43± 0.04 CFU /g during 64 days of storage at ambient temperature (Murugan, 1998).

2.5.2 Yeast and mould count

Price and Schweigert (1987) found that potassium sorbate inhibited yeast and mould growth when added in food products. The authors also added that it is generally considered as a safe preservative for meat and egg products especially in acidic medium.

Singh *et al.* (1989a) found that the yeast and mould counts increased from nil at zero day. to log 1.50 /g after eight weeks of refrigerated storage.

Pal (1990) reported a significant increase in yeast and mould count in meat pickle during storage.

It was reported that the yeast and mould counts of hard cooked eggs increased from 180 to 430 CFU /g after twelve days of storage at ambient temperature (Sapcota and Siddiqui, 1991).

Anand *et al.* (1994) reported that the yeast and mould counts were found to be log 0.53 CFU ± 0.21 / g in liquid egg mix.

It was observed that the yeast and mould counts in hard cooked eggs increased from log 1.77 to log 1.97 CFU / g from the day of production to 21 days of storage under refrigeration conditions (Pandey *et al.*, 1994a).

Anand *et al.* (1995) observed that the yeast and mould counts of unpasteurised liquid egg stored in LDPE (250G) pouches were between log 1.41 and 2.02 CFU / g during six days of storage at ambient temperature.

In a study conducted on the quality characteristics and shelf life of hard cooked eggs preserved in citric acid solutions, it was reported that the yeast and mould counts increased from zero to log 1.63 CFU / g in egg contents during 40 days of refrigerated storage (Pandey *et al.* , 1995).

It was observed that fungal counts gradually increased with storage time regardless of treatments. Pickling solutions containing sodium benzoate had comparatively lower counts. Yeast and mould could be detected in the order log 1.3 and 3.6 CFU /g at eight weeks of storage at ambient temperature (Singh and Anand, 1995).

Tzatzarakis *et al.* (2000) studied the growth and fungal spore germination inhibition effect of common food additives like sorbic acid, potassium sorbate, propionic acid, acetic acid, formic acid etc, and reported that the inhibitory efficacy of these chemicals decreased in the same order.

2.5 Organoleptic evaluation

The modern day concept of quality control involves application of sensory evaluation to determine the storage stability, packaging material suitability and quality assurance.

Ball and Saffores (1973) observed that there was a significant reduction in the mean panel scores for flavour during storage of egg pickle at ambient temperature.

Stadelman and Rhorer (1984) reported that fresh hard cooked egg flavour was best preserved by a solution containing citric acid, sorbic acid and sodium chloride.

Lawrie (1985) rated tenderness as an important attribute affecting overall acceptability of poultry products.

It was reported that hard cooked eggs preserved in organic acid solutions in room temperature underwent both physical and sensory modifications during storage (Sheldon, 1986).

Alteration of flavour in egg pickles during storage might have resulted from auto oxidation of yolk lipids due to thermal and acid treatments (Pike, 1987).

Singh and Panda (1988a) studied the organoleptic qualities of pickled quail eggs, stored at ambient temperature in flexible pouches for six months and reported a gradual decline in mean panel scores for colour, flavour, texture and overall acceptability with the progress in storage time.

It was observed that there was considerable increase in the yolk blackening with increase in pH of the pickling solution (Lee and Park, 1989).

Singh *et al.* (1989b) noticed that the sensory attributes, particularly flavour and overall acceptability of pickled quail egg, kept at ambient temperature declined gradually with storage time, from 6.4 at zero day to 3.4 after four weeks, regardless of the treatments.

A gradual decline in the mean panel scores for colour, flavour, texture and over all acceptability of pickled eggs could be noticed during storage (Panda *et al.*, 1990).

Parrish *et al.* (1991) observed that the scores for tenderness, flavour and juiciness influenced overall acceptability of food.

Raikhy and Bawa (1991) found that three per cent citric acid solution provided quail egg pickle of excellent organoleptic quality. The flavour and overall acceptability were found to be the lowest for eggs pickled in six per cent citric acid solution.

Singh and Panda (1991a) observed that there was a gradual decline in mean panel scores for colour, flavour, texture and over all acceptability of oil based quail eggs pickle, during storage at ambient temperature for nine months.

Pandey *et al.* (1993b) reported that the albumen texture improved initially, while egg yolk colour became darker during storage. The flavour scores were found to decrease gradually from 7.2 to 6.9 during 14 days of storage at a mean room temperature of 26.1° C.

Pandey *et al.* (1994a) noticed that the sensory scores of hard cooked eggs started decreasing from five days of storage at ambient temperature.

Pandey *et al.* (1994b) observed that the sensory profiles of hard cooked eggs decreased during storage at room temperature.

It was observed that the organoleptic scores of quail egg pickle varied significantly for various recipes, during 80 days of

storage at room temperature. The mean scores were 6.25, on the day of preparation and 5.95, after 12 weeks (Singh, 1994).

A semi-trained type of taste panel consists of persons normally familiar with the quality of different classes of foods (Pal *et al.*, 1995).

Pandey *et al.* (1995) observed that the mean panel score for flavour of hard cooked eggs preserved in citric acid solution was significantly altered progressively during 40 days of refrigerated storage from 7.8 to 4.5.

The mean panel scores for colour, flavour, texture and overall acceptance of brined quail eggs gradually declined from 6.15 at zero to 5.56 at eight weeks of storage in treatments containing potassium sorbate (Singh and Anand, 1995).

Reddy and Rao (1997) reported that the scores for colour, flavour, overall acceptance and tenderness of poultry pickle gradually increased while that for juiciness decreased during storage at room temperature for 80 days.

Flavour is a complex sensation comprising mainly of taste and odour. Juiciness comprises of two organoleptic components namely wetness and the sustained stimulatory effect on salivation (Sharma *et al.*, 1997).

Singh *et al.* (1997) observed that the overall acceptability scores of quail eggs progressively reduced from 6.60 to 4.60 after four weeks of storage at an ambient temperature of 31°C.

It was reported that the mean overall sensory score of chicken meat pickle were not statistically different during storage at room temperature for 64 days (Murugan, 1998).

Shukla and Srivastava (1999) evaluated the sensory quality traits of chicken meat pickle and found that the mean scores for flavour decreased from 6.14 to 5.47, after 90 days. The panel scores for texture and overall acceptability showed a significant ($P < 0.01$) decrease, as the storage period advanced. In pickled products, flavour scores greatly influenced overall acceptability.

While investigating the influence of pickled storage on sensory qualities of chicken eggs it could be seen that there was a significant reduction in mean panel scores during storage (Singh *et al.*, 2000).

Berry (2001) reported that the sour taste imparted by acetic acid to a food could be attributed to the hydrogen [H^+] or hydronium [H_3O^+] ions.

2.7 Shelf life

Arafa (1983) studied the quality characteristics of pickled

eggs packed in flexible pouches and found that the pickle could be stored without spoilage at room temperature for 24 weeks.

It was reported that hard cooked eggs could be preserved in a solution of citric acid, sorbic acid, sodium chloride and polyphosphate for over six weeks (Stadelman and Rhorer, 1984).

Singh and Panda (1988a) used HDPE pouches to store quail eggs pickled in a solution containing five per cent vinegar and eight per cent sodium chloride and observed a shelf life of four months at room temperature.

It was reported that pickled quail eggs with potassium sorbate as preservative could be safely stored at ambient temperature in glass jars, for a period of eight weeks (Singh *et al.* , 1989b).

Panda *et al.* (1990) observed that pickled quail eggs with sodium benzoate as preservative could be stored safely for 60 days at ambient temperature.

Raikhy and Bawa (1991) conducted a study with hard cooked eggs preserved in citric acid solutions in jars kept at room temperature and found that five and six per cent solutions provided better shelf life.

Pandey *et al.* (1995) reported a shelf life of 40 days for citric acid based quail egg pickle containing 0.20 per cent sodium benzoate and stored in HDPE pouches (330G) in refrigerator.

Singh and Anand (1995) found that quail eggs pickled in salt-acid-benzoate solutions had a shelf life of seven weeks at refrigeration temperature.

It was observed that the shelf life of vinegar based chicken pickle was 80 days, during storage at ambient temperature (Reddy and Rao, 1996).

Shukla and Srivastava (1999) observed that poultry pickle could be stored at ambient temperature for a period of 90 days without significant loss in quality.

Singh *et al.* (2000) reported that chicken eggs pickled in organic acids with potassium sorbate could be safely stored for four months at ambient temperature.

Materials and methods

MATERIALS AND METHODS

An experiment was designed and carried out to evaluate the feasibility of storing quail egg pickle packed in HDPE pouches at room temperature. The nutritional and keeping quality parameters, consumer acceptability and economy of production were also determined.

3.1 Design of experiment

The experiment was of completely randomized design consisting of a treatment and a control with five replicates each and six different durations of storage. Each packet contained 10 eggs, thus involving a total of 600 eggs in 60 packets.

3.2 Preparation of eggs

Fresh quail eggs that were held at room temperature were procured from local market. The procured eggs were held at an ambient temperature of 32.4° C for 24 hours before cooking in water. The mean weight of eggs was determined after dividing them randomly into batches of ten.

Quail eggs of uniform size and intact shell were washed in tap water and then put in boiling water containing two per cent sodium chloride. The eggs were boiled for 10 minutes. The eggs

were then cooled in tap water, peeled and washed. Six hundred eggs of good quality with intact white were selected for pickling.

3.3 Cooking yield

The hard-boiled and peeled eggs for pickling were divided randomly into batches of ten each. The weight of each batch i.e. 60 batches was recorded separately. Yield of peeled eggs was calculated as percentage of the weight of raw eggs. (Pandey *et al.*, 1994b).

$$\text{Per cent cooking yield} = \frac{\text{weight after peeling}}{\text{Initial weight}} \times 100$$

3.4 Preparation of pickle

The ingredients required for preparation were weighed to 0.05 g accuracy and all the ingredients (Table1), except ginger and garlic were ground to a fine powder and thoroughly mixed.

Minced garlic and ginger were sauted in gingelly oil till golden brown in colour. All the remaining ingredients were added to this and simmered. Peeled and washed hard-boiled quail eggs were added to this and simmered further for five minutes. After cooling synthetic vinegar was also added to the pickle. The pickle thus prepared was halved. To one half, an aqueous solution of potassium sorbate @ 0.26 per cent, was added and this was the treatment group. The other half was considered as the control.

3.5 Packing and storage

The pickle was packed in HDPE pouches (300G) under ordinary packing 3 : 2 proportion (egg : pickle solution) and stored at a mean ambient temperature of 34.6 ^{0} C. Each of the pouches contained 10 eggs along with sufficient quantity of pickle solution. A total of 60 packets were prepared and double sealed using a semiautomatic sealing machine.

Samples were drawn at monthly interval for analysis i.e. on zero, 30, 60, 90 and 120 days of storage. The flow chart is given in Fig. 1.

3.6 Assessment of quality

The parameters studied to assess the pickled egg quality were pH, proximate principles, 2-thiobarbituric acid reactive substances (TBARS) number, total viable count of mesophilic bacteria, yeast and mould count and organoleptic evaluation. The assessment was done at monthly intervals.

The samples from both treatment and control were analysed for proximate principles viz. moisture , protein, fat and total ash (A O A C, 1990).

The development of rancidity was evaluated by detecting the presence of TBARS (Witte *et al.*, 1970) and expressed in mg malonaldehyde / kg of pickle.

The pH of pickle solution and eggs was determined in Cyberscan -2500 pH meter using glass and surface electrodes.

The total viable count of mesophilic bacteria was estimated by pour plate technique, using Standard Plate Count Agar, (A O A C, 1990) and expressed in log CFU /g of pickle sample. The culture plates were incubated for 48 hours at 37 °C.

Yeast and mould count was determined using Potato Dextrose Agar (A O A C, 1990) and expressed in log CFU / g of pickle sample. The plates were incubated at 37 °C for seven days.

Organoleptic evaluation of both control and treatment groups of quail egg pickle stored at room temperature was conducted by a six-member, semi trained taste panel, in terms of flavour, juiciness, tenderness and overall acceptance on a seven point hedonic scale. The scorecard used is given in Table 2.

The cost of production of quail egg pickle was calculated based on the prevailing cost of quail egg and other ingredients used for preparation.

Statistical analysis of the data was carried out according to Snedecor and Cochran (1980). Duncan' s (1985) F- Test and multiple range tests were also carried out.

Table 1 : Formulary for Quail Egg Pickle

Sl.No	Ingredients	Quantity
1	Peeled hard boiled quail eggs	100nos(915g)
2	Gingelly oil	100 ml
3	Red chilli powder	30g
4	Coriander powder	20g
5	Table salt	30g
6	Ginger (minced)	20g
7	Garlic (minced)	20g
8	Turmeric powder	10g
9	Asafoetida	10g
10	Cumin seeds	5g
11	Spices mixture*	30g
12	Synthetic vinegar	200 ml

**Spices mixture contains Blackpepper-10g, Cardamom-2g, Clove-1g, Aniseed-12g, Cinnamon-5g.*

Table 2 : Score card for evaluating cooked poultry products

Score card for evaluating quail egg pickle

Name :

Date :

Product name:

Sample No.	Tenderness	Juiciness	Flavour	Overall Acceptability
1				
2				

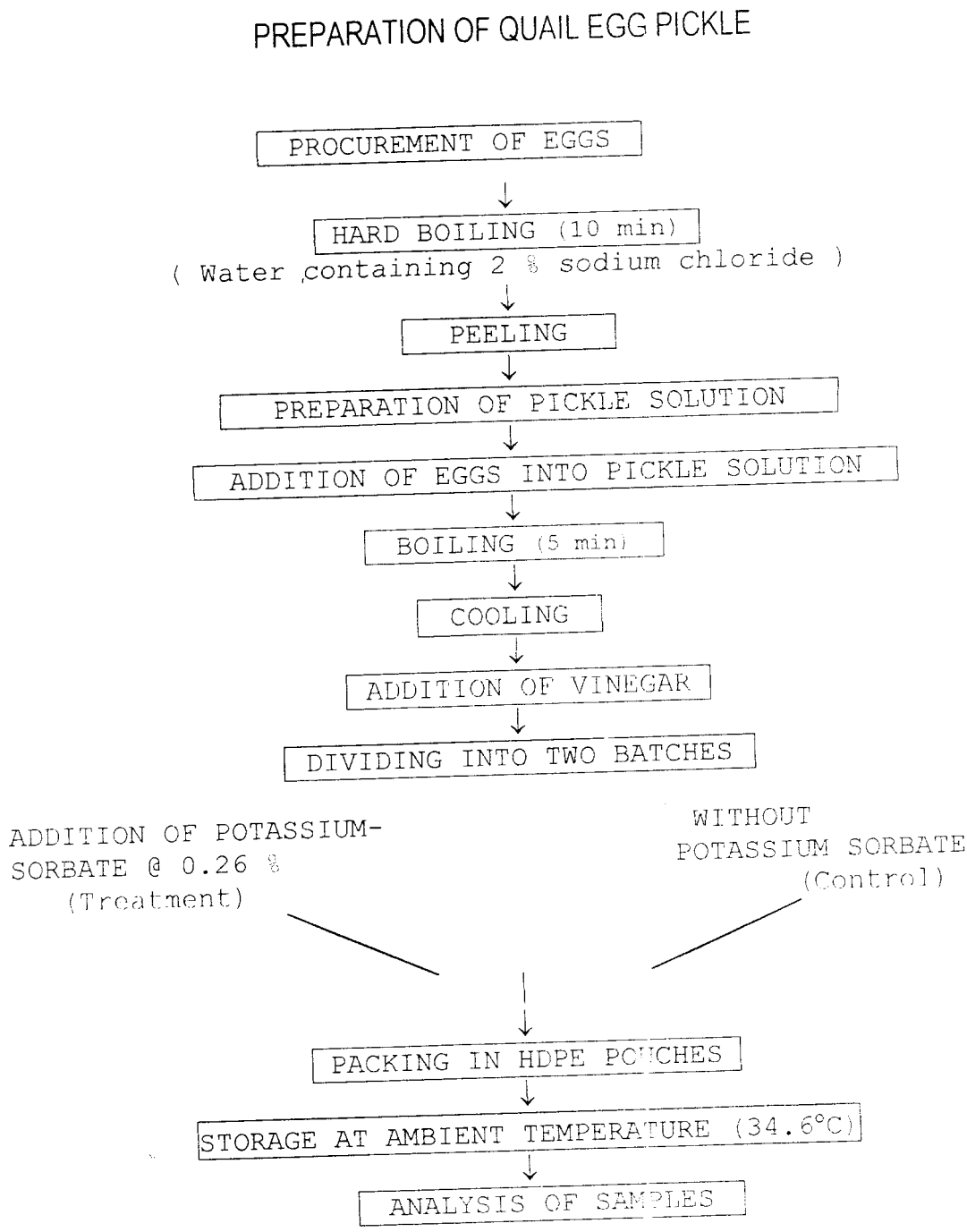
Remarks:

Signature

Rating Guide

Score	Quality
7	Excellent
6	Very good
5	Good
4	Fair
3	Satisfactory
2	Poor
1	Very poor

Fig. 1: Flow diagram for preparation of quail egg pickle



Results

RESULTS

The effect of storage of the control and treatment group (containing potassium sorbate) of quail egg pickle at a mean room temperature of 34.6°C for a period of 120 days, on the various physicochemical, microbiological and organoleptic properties as well as the cost of production of the product were studied and the results are furnished hereunder.

4.1 Cooking yield

The mean weight of raw quail eggs used for pickling was 10.94 ± 0.02 g and that of cooked and peeled eggs was 9.15 ± 0.06 g. Therefore, the mean cooking yield was found to be 83.63 ± 0.02 per cent.

4.2 pH

The pH of quail egg pickle stored at room temperature was determined for the control and treatment groups and the results are presented in Table 3 and Fig 2. The mean pH values were 3.60 ± 0.01, 4.53 ± 0.01 , 4.65 ± 0.01 and 4.76 ± 0.01 for the control groups at zero, 30, 60 and 90 days of storage, respectively. For the treatment group, the corresponding values were 3.59 ± 0.01, 4.52 ± 0.01, 4.64 ± 0.01 and 4.73 ± 0.01, respectively.

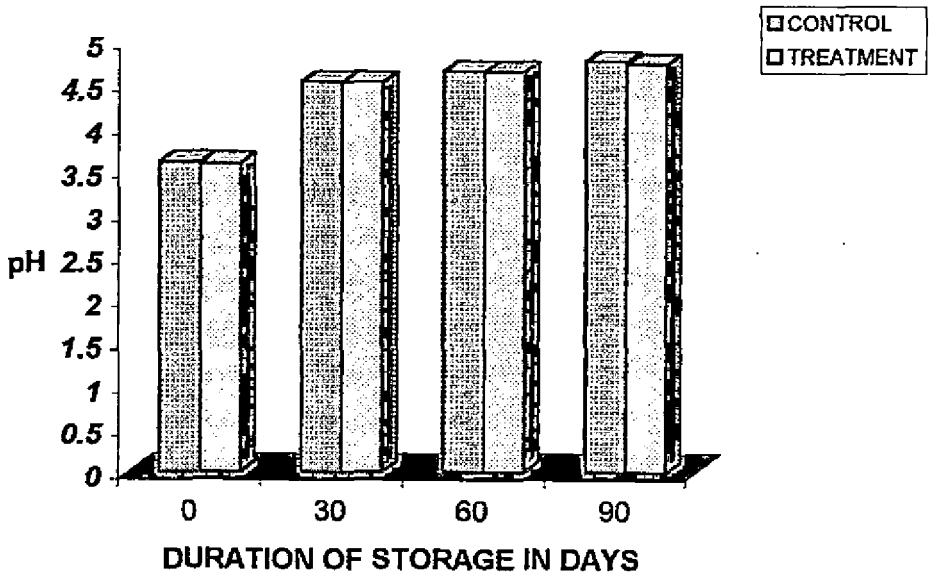
Within the same period of storage, the pH values for the control and treatment groups of pickle, were not statistically different. A statistically significant ($P \leq 0.01$) increase could

Table 3 : Influence of storage on the pH of quail egg pickle

Days of Storage	Mean pH of quail egg pickle	
	Control	Treatment
0	3.60 ± 0.01 ^{d}	3.59 ± 0.01 ^{d}
30	4.53 ± 0.01 ^{c}	4.52 ± 0.01 ^{c}
60	4.65 ± 0.01 ^{b}	4.64 ± 0.01 ^{b}
90	4.76 ± 0.01 ^{a}	4.73 ± 0.01 ^{a}
MEAN	4.38 ± 0.07	4.37 ± 0.07

Means in a column carrying same lower case superscript are not different significantly ($P \leq 0.01$)

Fig.2. Change in pH of quail egg pickle during storage at room temperature



be noticed between the pH on the day of preparation and those at 30, 60 and 90 days of storage in both the groups. The mean pH of the control and treatment groups was found to be 4.38 ± 0.07 and 4.37 ± 0.07, respectively, throughout the storage period from zero to 90 days. The pH of quail egg pickle was found to increase significantly ($P \leq 0.01$) during storage for 90 days, irrespective of the treatment.

4.3 Proximate composition

The proximate principles were determined viz. moisture, protein, fat and total ash and the results are summarized in Table 4. The proximate principles in both control and treatment groups did not differ significantly within the same period of storage. A statistically significant ($P \leq 0.01$) reduction in the moisture content and a significant ($P \leq 0.01$) increase in protein, fat and total ash contents could be noticed among the various periods of storage. The mean proximate composition of the pickle is shown in Fig. 3.

4.3.1 Moisture

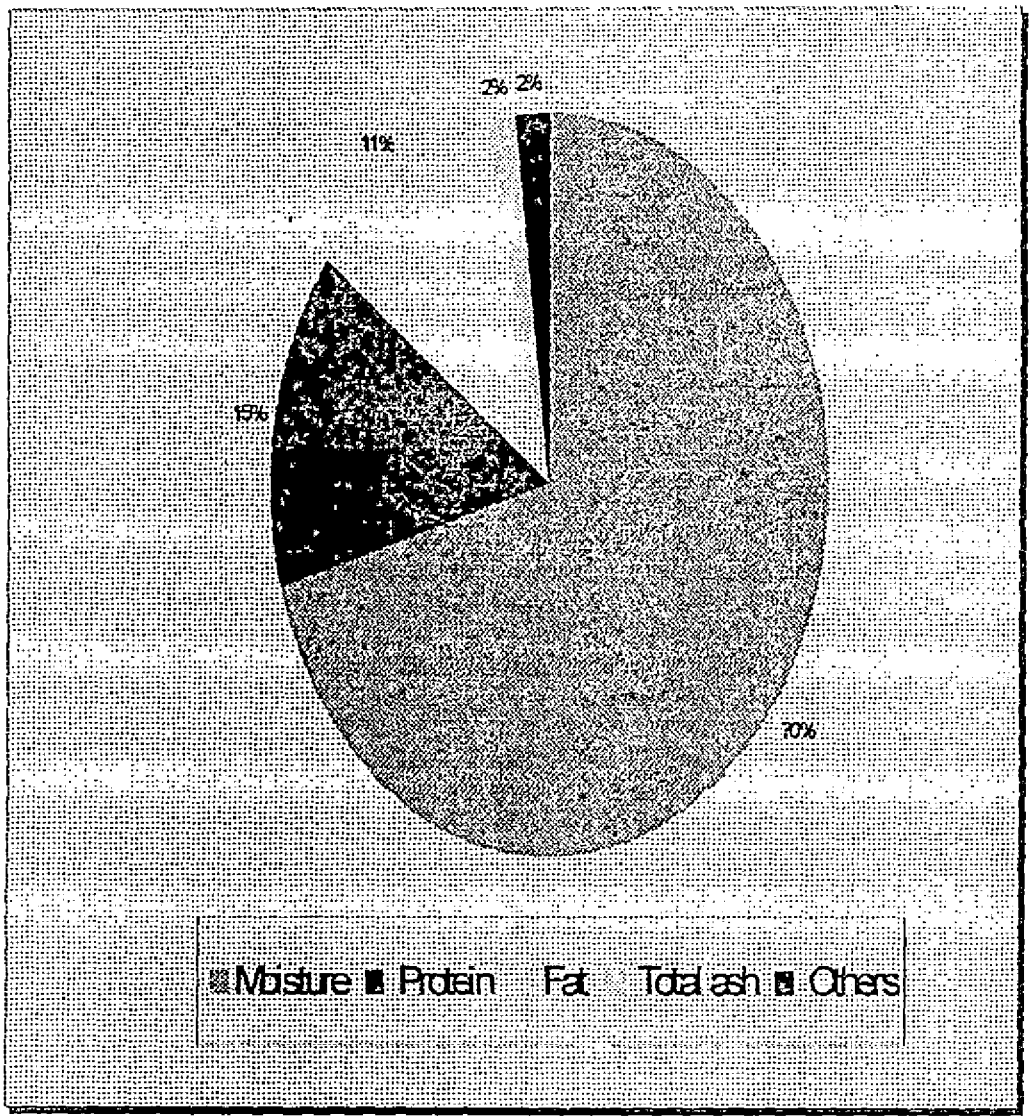
The mean moisture content on the day of production was 73.17 ± 0.21 and 73.18 ± 0.32 per cent, respectively for control and treatment groups. On the 90^{th} day of storage, the mean moisture content averaged 67.48 ± 0.26 and 67.53 ± 0.30 per cent, respectively.

Table 4 : Proximate composition of quail egg pickle during storage at room temperature

Days Of Storage	Moisture (%)		Protein(%)		Fat (%)		Total Ash(%)	
	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment
0	73.17 ± a 0.21	73.18 ± a 0.32	13.04 ± d 0.08	13.05 ± d 0.06	10.71 ± d 0.02	10.72 ± d 0.02	1.18 ± c 0.03	1.17 ± c 0.02
30	71.47 ± b 0.23	71.52 ± b 0.32	14.15 ± c 0.17	14.35 ± c 0.14	10.99 ± c 0.01	10.95 ± c 0.02	1.57 ± b 0.02	1.58 ± b 0.01
60	69.53 ± c 0.34	69.58 ± c 0.36	15.80 ± b 0.17	15.87 ± b 0.10	11.09 ± b 0.16	11.11 ± b 0.12	1.83 ± b 0.01	1.82 ± b 0.03
90	67.48 ± d 0.21	67.53 ± d 0.16	16.77 ± a 0.17	16.87 ± a 0.08	11.36 ± a 0.01	11.34 ± a 0.01	2.09 ± a 0.04	2.07 ± a 0.03
MEAN	70.42 ± 0.33	70.45 ± 0.35	14.94 ± 0.22	15.03 ± 0.22	11.04 ± 0.03	11.02 ± 0.02	1.67 ± 0.02	1.66 ± 0.02

Means in a column with same lower case superscript are not significantly ($P \leq 0.01$) different.

Fig. 3. Mean proximate composition of quail egg pickle



Statistical analyses revealed a significant ($P \leq 0.01$) reduction in the moisture content of both control and treatment groups, throughout the period of storage of 90 days. The mean moisture content of the pickle during the storage period was 70.42 ± 0.33 and 70.45 ± 0.35 per cent, respectively for the two groups and within the same period of storage, there was no significant difference between the control and treatment containing potassium sorbate.

The influence of duration of storage on the moisture content of quail egg pickle is shown in Fig 4.

4.3.2 Protein

The results are represented graphically in Fig. 5. The protein content of quail egg pickle increased from 13.04 ± 0.08 to 16.77 ± 0.17 per cent for the control group and from 13.05 ± 0.06 to 16.87 ± 0.08 per cent for the treatment group after 90 days of storage. The mean protein contents at 30 and 60 days of storage were 14.15 ± 0.17 and 15.80 ± 0.17 per cent, respectively for the control group. In the case of the treatment group, the mean protein contents for the same durations of storage were 14.35 ± 0.14 and 15.87 ± 0.10 per cent, respectively.

There was no significant difference between the control and treatment groups, within all the four periods of storage. There was a gradual but, statistically significant ($P \leq 0.01$) increase in the protein content of the pickle between the days of

Fig.4:Influence of storage at room temperature on the moisture content of quail egg pickle

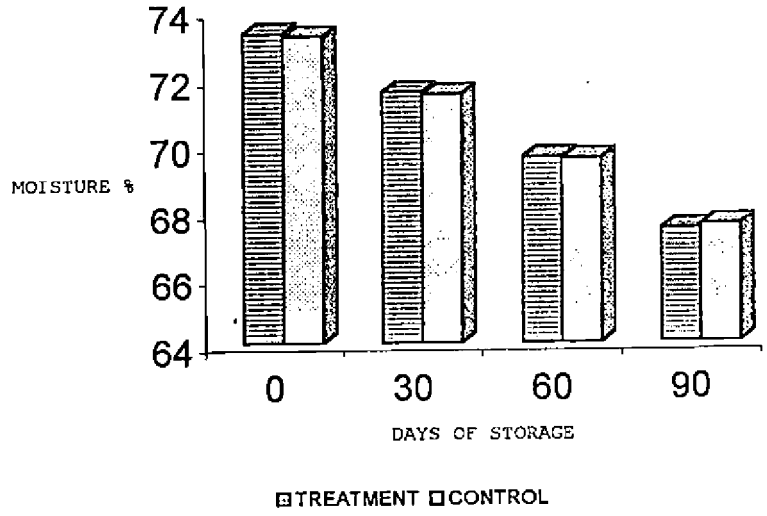
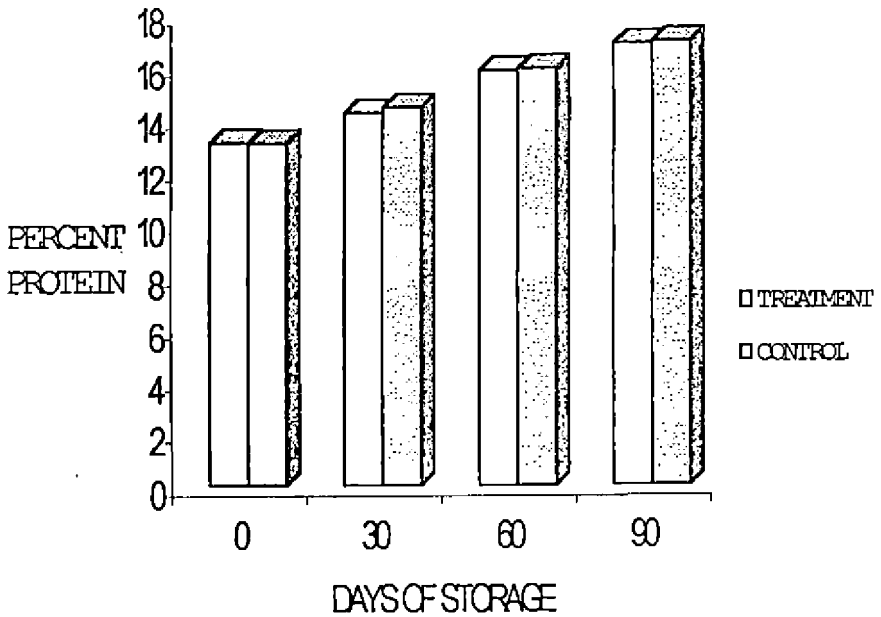


Fig. 5: Influence of storage on the protein content of quail egg pickle



production and all other periods of storage, i.e. at 30, 60 and 90 days for both groups. The mean protein content of the control group was 14.94 ± 0.22 per cent whereas, for the treatment group it was 15.03 ± 0.22 per cent.

4.3.3 Fat

The mean fat content of quail egg pickle at zero, 30, 60 and 90 days of storage were 10.71 ± 0.02, 10.99 ± 0.01, 11.09 ± 0.16 and 11.36 ± 0.01 per cent, respectively for the control group, whereas, in the treatment group, the corresponding values were 10.72 ± 0.02, 10.95 ± 0.02, 11.11 ± 0.12 and 11.34 ± 0.01 per cent, respectively.

The fat content of quail egg pickle was found to increase significantly ($P \leq 0.01$) for both the groups, between zero and the rest of the periods, viz., 30, 60 and 90 days of storage. But within the same period, there was no statistically significant difference between the control group and the treatment containing potassium sorbate. The mean fat contents of quail egg pickle throughout the storage period were 11.04 ± 0.03 and 11.02 ± 0.02 per cent, respectively for the control and treatment groups.

4.3.4 Total ash

The total ash content of quail egg pickle was found to be 1.18 ± 0.03, 1.57 ± 0.02, 1.83 ± 0.01 and 2.09 ±

0.04 per cent, respectively for the control group at zero, 30, 60 and 90 days of storage and for the treatment group, the corresponding mean total ash content were 1.17 ± 0.02, 1.58 ± 0.01, 1.82 ± 0.03 and 2.07 ± 0.03 per cent, respectively.

Analysis of the data revealed that the total ash content at zero day was significantly ($P \leq 0.01$) higher than all other periods of storage in both the groups. There was no significant increase in the ash contents between 30 and 60 days of storage for both the groups. The total ash content of the pickle at 90 days was significantly higher than all other storage periods.

Within the same period of storage, no significant difference could be noted, between the control and treatment groups. The total ash contents of the pickle, throughout the period of storage were 1.67 ± 0.02 and 1.66 ± 0.02 per cent, respectively for the control and treatment groups.

4.4. 2-Thiobarbituric acid reactive substance (TBARS) number

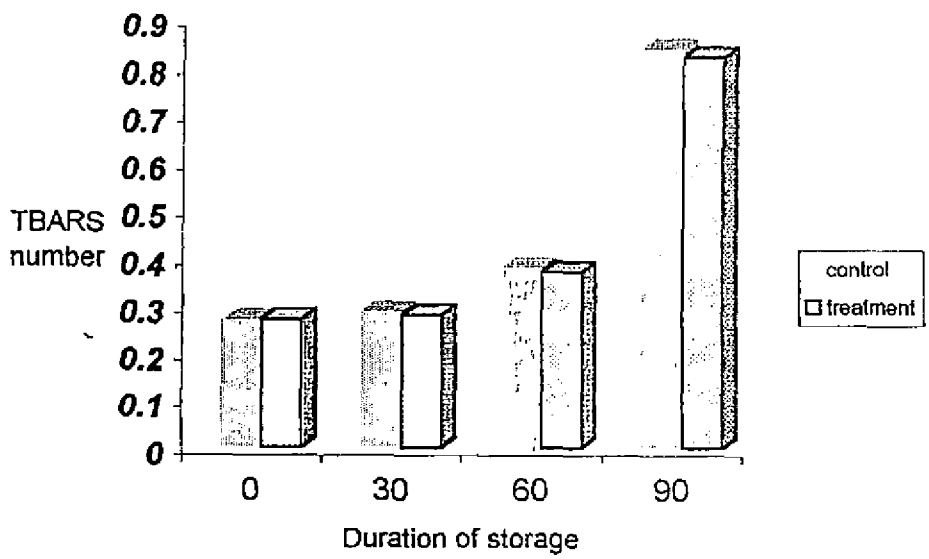
The presence of TBARS in the quail egg pickle, which is an indication of oxidative rancidity, measured in terms of mg malonaldehyde / kg of the sample for both the control and treatment groups is presented in Table 5 and Fig.6. The mean TBARS values at zero, 30, 60 and 90 days of storage, for the control group were 0.27 ± 0.01, 0.29 ± 0.01, 0.38 ± 0.01 and 0.84 ± 0.01, respectively and 0.27 ± 0.01, 0.28 ± 0.01, 0.37 ± 0.01and 0.82 ±

Table 5: Influence of storage on the TBARS value of quail egg pickle

Days of storage	Mean TBARS number in mg malonaldehyde / g	
	Control	Treatment
0	0.27 ± 0.01 ^{d}	0.27 ± 0.01 ^{c}
30	0.29 ± 0.01 ^{c}	0.28 ± 0.01 ^{c}
60	0.38 ± 0.01 ^{bC}	0.37 ± 0.01 ^{bD}
90	0.84 ± 0.01 ^{aA}	0.82 ± 0.01 ^{aB}

Means in a column with same lower case superscript are not significantly ($P \leq 0.01$) different.
Means in a row with no or same upper case superscript are not significantly ($P \leq 0.05$) different.

Fig. 6. The trend of increase in TBARS number of quail egg pickle



0.01, respectively for the treatment group, during the same periods of storage.

There was a statistically significant ($P \leq 0.01$) increase in the TBARS number in both the groups, with an increase in the storage period. On the 90th day of storage, there was a three-fold increase in the TBARS number in both the groups, when compared to that on the day of production.

Throughout the period of storage, there were comparatively lower TBARS values in the treatment group containing potassium sorbate. In the treatment group, there was no significant increase in rancidity up to 30 days of storage but the control group showed a significant ($P \leq 0.01$) increase in rancidity from zero to 30 days of storage. There were significantly ($P \leq 0.05$) higher TBARS numbers in the control group at 60 and 90 days of storage, when compared to the treatment group.

4.5. Microbial profile

4.5.1 Total viable count of mesophilic bacteria

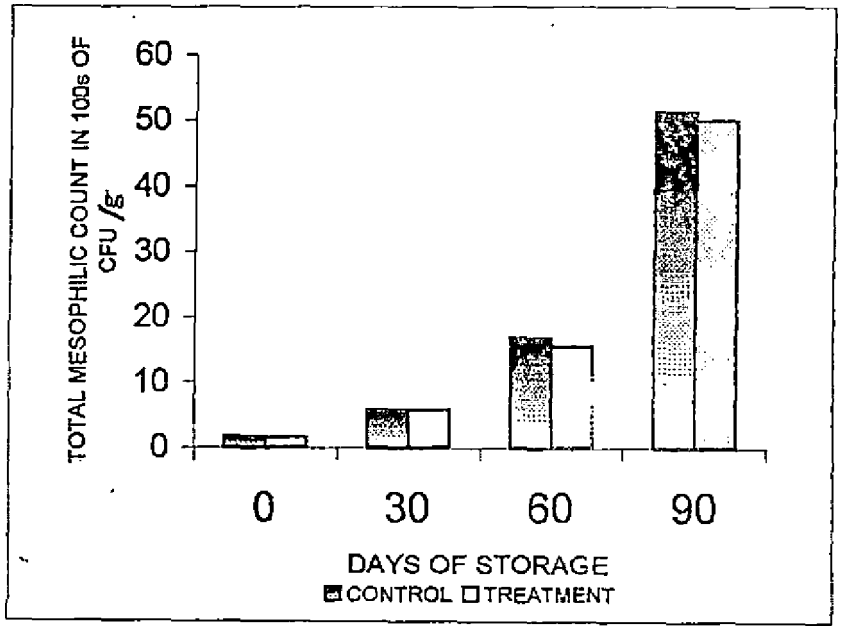
The mesophilic bacterial count in quail egg pickle, determined for both control and treatment is expressed as logCFU/g of pickle in Table 6. The mean mesophilic counts on zero, 30, 60 and 90 days of storage were 2.21 ± 0.30, 2.77 ± 0.02, 3.23 ± 0.02 and 3.71 ± 0.02, respectively for the control group, whereas,

Table 6: Mean mesophilic bacterial count in quail egg pickle during storage

Days of storage	Mean bacterial count in log CFU/g	
	Control	Treatment
0	2.21 ± 0.30 ^{d}	2.19 ± 0.30 ^{d}
30	2.77 ± 0.02 ^{c}	2.76 ± 0.02 ^{c}
60	3.23 ± 0.02 ^{b}	3.19 ± 0.02 ^{b}
90	3.71 ± 0.02 ^{a}	3.70 ± 0.02 ^{a}

Means in a column carrying same lower case superscript are not significantly ($P \leq 0.01$) different

Fig. 8. Change in mesophilic bacterial count in quail egg pickle during storage



whereas, those for the treatment group were 2.19 ± 0.30, 2.76 ± 0.02, 3.19 ± 0.02 and 3.70 ± 0.02, respectively.

The mesophilic bacterial counts in the quail egg pickle were found to increase significantly ($P \leq 0.01$) in both groups during storage at room temperature. However, statistically significant differences were not detected between the control and treatment groups, within the same period of storage. The treatment group had comparatively lower mesophilic bacterial counts, throughout the duration of storage from zero to 90 days.

Irrespective of groups, the total viable count was influenced by the duration of storage and the differences between the zero days and all other periods of storage were statistically ($P \leq 0.01$) significant. The results are graphically represented in Fig. 8.

4.5.1 Yeast and mould count

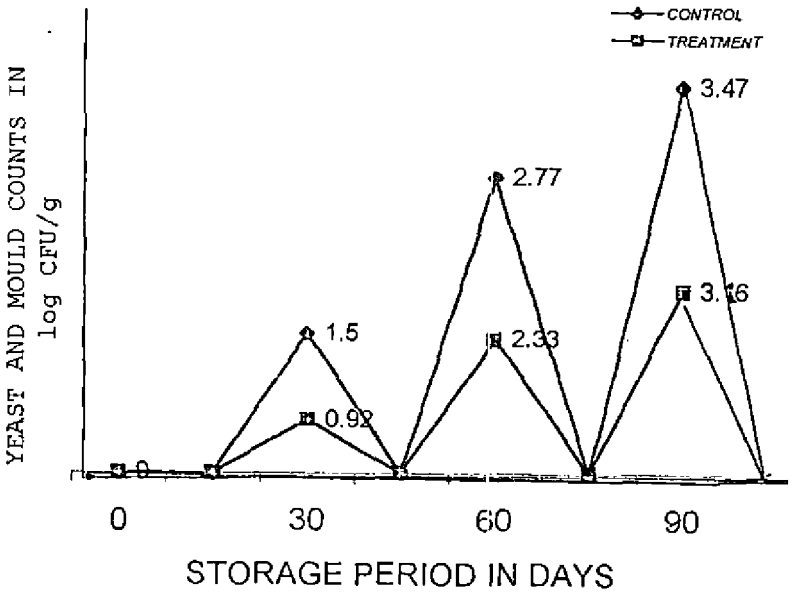
The yeast and mould counts estimated are expressed in log CFU /g of pickle in Table 7 and Fig. 9. There were no yeast and mould colonies in both groups of the freshly prepared pickle. The mean counts on 30 days of storage were log 1.50 ± 0.14 and log 0.92 ± 0.24 CFU /g, respectively, for the control and treatment groups. On 60 days of storage, the mean counts increased to log 2.77 ± 0.03 and log 2.33 ± 0.21 CFU /g, respectively for the two

Table 7: Yeast and mould counts in quail egg pickle as influenced by duration of storage

Days of storage	Mean yeast and mould counts in log CFU/g	
	Control	Treatment
0	ND	ND
30	1.50 ± 0.14 ^{cE}	0.92 ± 0.24 ^{cF}
60	2.77 ± 0.03 ^{bC}	2.33 ± 0.21 ^{bD}
90	3.47 ± 0.03 ^{aA}	3.16 ± 0.03 ^{aB}

Means in a column with same lower case superscript are not significantly ($P \leq 0.01$) different.
Means in a row with same upper case superscript are not significantly ($P \leq 0.05$) different.
ND = No colonies detected

Fig. 9. Trend of increase in yeast and mould count of quail egg pickle during storage.



groups. On 90 days of storage, the counts further increased to log 3.47 ± 0.03 and log 3.16 ± 0.03 CFU /g for the control and treatment group containing potassium sorbate, respectively.

The results, when subjected to statistical analysis revealed that there was a significant ($P \leq 0.01$) increase in the yeast and mould counts in both the groups of pickle during all the three periods of storage viz., 30, 60 and 90 days of storage. Addition of potassium sorbate resulted in a significant ($P \leq 0.05$) reduction in the yeast and mould counts in the treatment group, when compared to the control.

4.6 Organoleptic Evaluation

The results of organoleptic evaluation of both control and treatment groups of quail egg pickle, stored at room temperature as conducted by a six-member, semi trained taste panel, in terms of flavour, juiciness, tenderness and overall acceptance on a seven point hedonic scale are given in Table 8.

4.6.1 Flavour

In both control and treatment groups, there was an increase in the mean panel scores for flavour from zero to thirty days and a gradual decline thereafter. In the control group, there was no significant difference between the mean scores on zero and the next two periods of storage namely 30 and 60 days. So also there

Table 8 : Mean organoleptic scores for the quail egg pickle during storage

Days of storage	Flavour		Juiciness		Tenderness		Over all acceptance	
	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment
0	5.50 a ± 0.22	5.67 a b ± 0.21	6.17 a ± 0.07	6.17 a ± 0.17	5.83 a ± 0.17	5.83 a ± 0.17	5.67 a ± 0.33	5.50 a ± 0.22
30	5.72 a ± 0.31	6.00 a ± 0.26	5.33 b ± 0.21	5.39 b ± 0.20	5.47 a b ± 0.18	5.67 a ± 0.21	5.42 a ± 0.33	5.36 a ± 0.16
60	5.14 a b ± 0.18	5.33 b c ± 0.21	5.17 b ± 0.17	5.17 b ± 0.17	5.17 b ± 0.17	5.33 a ± 0.21	5.17 a ± 0.17	5.33 a ± 0.21
90	4.83 b ± 0.17	5.00 c ± 0.01	4.33 c ± 0.21	4.33 c ± 0.21	4.17 c ± 0.18	4.17 b ± 0.17	4.00 b ± 0.01	4.17 b ± 0.17

Means in a column with same lower case superscript are not significantly ($P \leq 0.01$) different.

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was no significant difference between the 60 and 90-day storage periods. The mean scores gradually declined from 5.72 ± 0.31 to 4.83 ± 0.17 from 30 to 90 days of storage.

In the case of treatment group, the mean panel scores for flavour decreased from 6.00 on 30-day storage period to 5.00 on 90 days of storage. There was a significant ($p \leq 0.01$) reduction in the scores from 30 days of storage onwards. The 90-day mean score was significantly lower than those on 30 and 60 days. The mean scores declined from 5.67 ± 0.21 to 5.00 ± 0.01 for the treatment group, during 90 days of storage. Throughout the period of storage, within the same period of storage, there was no significant difference between the control and treatment groups.

4.6.2 Juiciness

The mean scores for juiciness, for the control group were 6.17 ± 0.07, 5.33 ± 0.21, 5.17 ± 0.17 and 4.33 ± 0.21, respectively at zero, 30, 60 and 90 days of storage. The mean scores for the treatment group also decreased gradually from 6.17 ± 0.17 at zero day to 5.39 ± 0.20, 5.17 ± 0.17 and 4.33 ± 0.21 at 30, 60 and 90 days of storage, respectively.

There was a significant reduction in the mean panel scores ($p \leq 0.01$) between the zero and all the other periods of storage

for both the control and treatment groups. There was no significant reduction in the mean scores obtained, between the 30 and 60-days in both the groups. The 90-day mean scores were significantly ($P \leq 0.01$) lower than all the other periods of storage in both groups. Throughout the period of storage, within the same period, there was no significant difference between the control and treatment .

4.6.3 Tenderness

The mean panel scores for tenderness of pickled quail eggs declined gradually as the storage period progressed. The mean scores on zero, 30, 60 and 90 days of storage for the control group were 5.83 ± 0.17, 5.47 ± 0.18, 5.17 ± 0.17 and 4.17 ± 0.18, respectively. The mean scores for the treatment group were 5.83 ± 0.17, 5.67 ± 0.21, 5.33 ± 0.21 and 4.17 ± 0.17, respectively during the same storage periods.

There was a significant ($P \leq 0.01$) reduction in the scores after 60-days storage periods for the control group. So also the scores on 90 days of storage was significantly ($P \leq 0.01$) lower than those of all other periods of storage.

In the treatment group, only the 90-day mean score was significantly ($p \leq 0.01$) lowered during storage. Throughout the period of storage, there was no significant difference between the

control and treatment within the same period of storage, though the treatment group showed numerically higher scores at 30 and 60 days of storage.

4.6.4 Overall acceptance

The mean panel scores for overall acceptance of the pickle were 5.67 ± 0.33, 5.42 ± 0.33, 5.17 ± 0.17 and 4.00 ± 0.01 for the control group at zero, 30, 60 and 90 days of storage. The corresponding scores for the treatment group were 5.50 ± 0.22, 5.36 ± 0.16, 5.33 ± 0.21 and 4.17 ± 0.17, respectively. The mean panel scores were affected by the duration of storage and were found to decrease, with an increase in storage period, irrespective of the treatment.

A statistically significant reduction ($P \leq 0.01$) could be noticed in the 90-day mean panel score for both the treatment and control groups. Throughout the period of storage, within the same period of storage there was no significant difference between the control and treatment.

4.6 Cost of production

The cost of production of quail egg pickle packed in HDPE pouches, determined for both the control and treatment group containing potassium sorbate is presented in Table 9. The items included in calculating the cost of production were price of quail

eggs, various ingredients used, potassium sorbate and HDPE pouches. The cost of production is summarized as Rs. 74.39 / kg and Rs. 74.72 / kg, respectively, for the control and treatment groups in order to produce ten packets each.

Table 9: Cost of production of quail egg pickle.

Items	Control		Treatment	
	Quantity	Cost (Rs)	Quantity	Cost (Rs)
Quail Eggs	100 Nos (915 g)	80.00	100 Nos (915 g)	80.00
Ingredients	475 g	20.40	475 g	20.40
Potassium Sorbate			0.5 g	0.50
HDPE Pouches	(30 g)	3.00	(30 g)	3.00
Total	1390 g	103.40	1390.5g	103.90
Cost / kg	1000	74.39	1000	74.72

4.7 Shelf life

The quail egg pickle was found to be unacceptable at 120 days of storage as evidenced by very high levels of bacterial and fungal population and hence the experiment was concluded at this period.

Discussion

DISCUSSION

Findings of the study conducted at the Department of Poultry Science, on the assessment of shelf life of quail egg pickle, stored at a mean room temperature of 34.6°C, and its characteristics during various periods of storage are discussed below.

5.1 Cooking yield

The mean weight of raw eggs was found to be 10.94 ± 0.02 g and that of peeled eggs was found to be 9.15 ± 0.06 g. The cooking yield of quail eggs calculated for the present study was 83.63 ± 0.02 per cent. These findings are in agreement with the observations of Pandey *et al.* (1994b), who reported a cooking yield of 82 per cent. The findings of various studies revealed that the cooking yield of eggs varied from 82 to 92 per cent(Sapcota and Siddiqui ,1989., Pandey *et al* .,1993a .,Singh and Panda, 1988)

5.2 pH

The mean pH of quail egg pickle was found to increase significantly ($P \leq 0.01$) from 3.60 ± 0.01 to 4.76 ± 0.01 for the control and 3.59 ± 0.01 to 4.73 ± 0.01 for the treatment groups (Table 3). However, throughout the storage period the pH values were below five, which is considered to be critical for storage

stability of poultry pickle (Dziezak, 1986., Pal, 1990 ., Pal and Agnihotri, 1994).

The results of this study are in agreement with the findings of Singh *et al.* (1989b) and Panda *et al.* (1990). Singh (1994) found a similar trend of increase in pH of quail egg pickle from 4.17 to 4.25 during storage at ambient temperature for 84 days.

The pH of quail egg pickle increased during storage, irrespective of the treatment and this might be attributed to the increase in microbial growth and consequent to the oxidation of primary acids.

5.3 Proximate composition

The major proximate principles of the quail egg pickle were determined viz., moisture, protein, fat and total ash and the values were similar to those obtained for quail egg pickle and similar products (Table 4).

5.3.1 Moisture

The moisture content of quail egg pickle was found to decrease significantly ($P \leq 0.01$) during storage, from 73.17 ± 0.21 to 67.48 ± 0.21 per cent and 73.18 ± 0.32 to 67.53 ± 0.16 per cent for the control and treatment groups, respectively from zero to 90 days of storage. There was no significant difference between

the control and the treatment group containing potassium sorbate, within the same period of storage. A similar reduction in the moisture content of pickle was noticed in a study conducted by Singh and Panda (1988a) wherein, there was a decline from 79.12 to 77.73 per cent during storage at ambient temperature.

The gradual reduction in moisture content of quail egg pickle during storage may be attributed to the movement of moisture from the egg to the pickle solution, consequent to dehydration of egg albumen by acidic brine medium (Panda *et al.*, 1990). These finding are also in agreement with the observations of Panda *et al.* (1990), Raikhy and Bawa (1991) and Reddy and Rao (1996). Murugan (1998) reported that the moisture content of chicken meat pickle decreased from 64.59 to 54.31 per cent during storage at room temperature for a period of 64 days, the trend of which is almost similar to the current findings.

5.3.2 Protein

The mean protein content of quail egg pickle stored at room temperature increased significantly ($P \leq 0.01$) from 13.04 to 16.77 per cent and 13.05 to 16.87 per cent for the control and treatment groups, from the day of production to 90 days of storage, respectively. There was no significant difference between the control and the treatment groups, within the same period of storage.

Singh and Panda (1988b) also reported a significant ($P \leq 0.01$) increase in protein content of quail egg pickle during storage at ambient temperature, declining from 13.79 to 18.06 per cent, owing to a gradual reduction in the moisture content. The present findings are also in agreement with those of Panda *et al.* (1990), who reported an increase of 12 per cent in the protein content of quail egg pickle during storage.

The increase in total protein content might be attributed to the decrease in the moisture content of pickle during storage (Reddy and Rao, 1997., Murugan 1998).

5.3.3 Fat

The mean fat content of quail egg pickle was found to increase gradually and significantly ($P \leq 0.01$) during storage, irrespective of the treatment. There was no significant difference between the control and treatment groups, within the same periods of storage.

Similar results were also reported by Singh and Panda (1984) wherein, the fat content of chicken meat pickle was found to increase from 4.73 to 4.92 per cent. Singh (1994) also reported that the mean fat content of quail egg pickle increased significantly from 12.66 to 15.66 per cent during storage. Reddy and Rao (1996) and Murugan (1998) also noticed a trend similar to the findings of the current study. This may be attributed to the decrease in moisture content during storage.

5.3.4 Total ash

The total ash content of quail egg pickle increased significantly ($P \leq 0.01$) proportionate to the reduction in moisture content during storage at ambient temperature and there was no significant difference between the control and treatment groups , within the same period of storage.

A similar trend of increase in the total ash content was also reported by Singh (1994) in quail egg pickle stored at ambient temperature for 84 days. The results are also in agreement with the findings of Murugan (1998). The increase in total ash content of pickle might be due to the diffusion of salt into eggs and also associated with the reduction in moisture content.

5.4 2- Thiobarbituric acid reactive substance(TBARS) number

Dawson (1975) observed that animal food items with levels above two mg malonaldehyde/ kg might be considered to have developed rancidity. TBARS number is considered to be a reliable and convenient method to detect lipid oxidation.

The oxidative rancidity of pickle estimated in terms of mg malonaldehyde / kg was found to increase significantly ($P \leq 0.01$) from 0.27 ± 0.01 to 0.84 ± 0.01 and 0.27 ± 0.01 to 0.82 ± 0.01 mg malonaldehyde /kg in the case of control and treatment groups, respectively from the day of production to 90 days of storage at room temperature (Table 5).

An increasing trend of TBARS number with storage was also reported by Arafa, (1983) and Singh *et al.* (1989b). The findings of current study are also in agreement with that of Singh and Anand (1995), who reported a significant ($P \leq 0.01$) increase in TBARS values from 0.12 to 1.03 mg malonaldehyde / kg of quail egg pickle. Pandey *et al.*, (1995) also reported a similar increase in TBARS from 0.17 to 0.70 mg malonaldehyde / kg in quail eggs pickled in citric acid .

This gradual rise in the TBARS values might be because of the sequestering effect of acetic acid in inhibiting lipid oxidation (Dziezak, 1986). It appears that the denaturation of lipoproteins (Pike and Peng, 1985) due to thermal and pickling treatments might have exposed yolk lipids to oxidation, resulting in an increase in TBARS values during storage (Singh *et al.*, 1989). This together with the gaseous exchange through the highly oxygen permeable HDPE pouches might have resulted in increased TBARS values during storage (Prize and Schweigert, 1987).

There was no significant difference between the TBARS values for the control and the treatment group containing potassium sorbate between the day of production and 30 day storage periods. The treatment group had significantly ($P \leq 0.05$) lower TBARS numbers at 60 and 90 days of storage.

The addition of potassium sorbate in the treatment group did not make any significant reduction in the TBARS values up to 60 days, though numerically lower values were recorded throughout the storage period for the treatment group. There were significantly ($P \leq 0.05$) lower TBARS values for the treatment group at 60 and 90 days of storage, and this might be attributed to the inhibitory effect of potassium sorbate on oxidative rancidity (Serdaroglu *et al.*, 1992). Kumar *et al.* (2000) reported that potassium sorbate was effective in controlling TBARS number in poultry meat pickles and the current findings confirmed the same.

5.5 Microbial profile

5.5.1 Total viable count of mesophilic bacteria

The acceptable level of bacterial count in poultry products is considered to be $\leq 10^5$ CFU / g (Hern and Covacs, 1988) and hence poultry products with bacterial counts above this should be considered to be unfit for consumption.

The total viable count in quail egg pickle was found to increase significantly ($P \leq 0.01$) from zero to 90 days of storage in both groups, irrespective of the treatment. The mesophilic counts increased significantly from log 2.21 to log 3.71 CFU /g and log 2.19 to log 3.70 CFU / g of pickle during storage at a mean ambient temperature of 34.6°C, for the control and treatment groups, respectively (Table 6).

The results of this study are in accordance with the findings reported by Singh *et al.,* (1989a) who found that the total mesophilic count in quail egg pickle increased from log 1.98 to log 6.00 and log 4.90 CFU / g after six and eight weeks of storage. Pandey *et al.* (1995) also found a similar mesophilic count in quail egg pickle during storage. Reddy and Rao (1997) and Murugan (1998) also reported a similar trend during storage of chicken meat pickle at room temperature for 64 days.

Though the bacterial population was found to show an increasing trend in both the groups throughout the storage period, the group with potassium sorbate had numerically lower counts. Serdaroglu et al. (1992), Singh and Anand (1995) reported that potassium sorbate had a slight inhibitory action on bacterial growth.

The quail egg pickle was found to be acceptable throughout the storage period of 90 days as the counts remained in the range of three log cycles, which is similar to the observations of Pal and Agnihotri (1994). The storage stability of the product might be due to the inhibitory action of pickle additives.

5.5.2 Yeast and mould count

There was no yeast and mould count in freshly prepared pickle. Dry and moist cooking was found to reduce the total

aerobic counts as well as the yeast and mould counts (Anand *et al.*, 1990).

With a raise in the duration of storage, a significant ($P \leq 0.01$) increase in the fungal counts could be noticed in both the groups. The fungal count in the treatment group increased from log 1.50 to log 3.47 CFU / g from 30 to 90 days of storage, whereas, the corresponding values were log 0.92 and log 3.16 CFU / g for the treatment group containing potassium sorbate (Table 7). Pal (1990) also reported a significant ($P \leq 0.01$) increase in the mean fungal counts of meat pickle during storage. Similar increase in the yeast and mould counts of quail egg pickle was also reported by Pandey *et al.* (1995) and Singh and Anand (1995).

However, the treatment group revealed significantly ($P \leq 0.01$) lower counts, throughout the storage period from 30 to 90 days. Price and Schweigert (1987) reported that potassium sorbate inhibited yeast and mould growth especially in acidic mediums. Comparatively lower fungal counts in the treatment group might be attributed to the inhibitory effect of potassium sorbate on fungal growth (Singh and Anand, 1995). The addition of potassium sorbate as preservative had an inhibitory effect on the yeast and mould growth (Tzatzarakis *et al.*, 2000).

The product was acceptable up to 90 days of storage and this may be attributed to the inhibitory effects of pickle additives especially spices, oil, salt and volatile oils.

5.6 Organoleptic evaluation

The modern day concept of quality control involves application of sensory evaluation to determine the storage stability, packaging material suitability and quality assurance. The variables studied include flavour, juiciness, tenderness and overall acceptance and the mean panel scores for both groups were found to be decrease significantly ($P \leq 0.01$)after 60 days of storage (Table 10). The mean panel scores were found to decline gradually and this is in agreement with the findings of Sheldon (1986), Singh and Panda (1988a), Singh *et al.* (1989b) and Singh and Panda (1991a).

5.6.1 Flavour

The mean panel scores were 5.50 ± 0.22, 5.72 ± 0.31, 5.14 ± 0.18 and 4.83 ± 0.17, respectively for the control group at zero, 30, 60 and 90 days of storage. The mean values for the treatment group were 5.67 ± 0.21, 6.00 ± 0.26, 5.33 ± 0.21 and 5.00 ± 0.01, respectively for the same storage periods. The mean panel scores for flavour increased during the first 30 days of storage for both the groups and thereafter, recorded a gradual decline. A gradual decline in flavour scores for pickle during storage was also

reported by Singh *et al.* (1989b) and Panda *et al.* (1990). Singh (1994) also reported a similar increase in the flavour scores up to six weeks of storage, from 4.67 to 5.00.

The gradual increase in the scores for flavour might be attributed to the better penetration of pickle ingredients into the egg leading to a better odour and taste on 30 days storage period. In pickled products, flavour greatly influences overall acceptability (Shukla and Srivastava, 1999).

On subsequent storage, production of microbial metabolites and fermentation products of yeast in particular would have resulted in the lowering of flavour scores. A significant reduction ($P \leq 0.01$) in mean panel scores for flavour could be noticed in both the groups and this might be attributed to the leaching of egg solids to solution (Ball and Saffores, 1973). Alteration of flavour in egg pickles during storage might have also resulted from auto oxidation of yolk lipids due to thermal and acid treatments (Pike, 1987).

5.6.2 Juiciness

The mean panel scores for juiciness of the quail egg pickle were found to decrease throughout storage and the values declined from 6.17 ± 0.07 to 4.33 ± 0.21 for both the groups from the day of preparation to 90 days of storage. Within the same period of storage, there was no significant difference between the control and treatment groups, with respect to the mean panel scores for

juiciness. A similar reduction in juiciness of pickled quail eggs was also reported by Parrish *et al.* (1991) and Singh (1994). These results are also in accordance with the findings of Reddy and Rao (1997), who reported a reduction in the juiciness of chicken pickle from 6.55 at zero days to 5.76 after 80 days of storage at room temperature.

There was a statistically significant ($P \leq 0.01$) reduction in the juiciness of eggs in both the groups, and this might be associated with the loss of moisture from eggs to pickle solution during storage. Parrish *et al.* (1991) also reported that the degree of shrinkage on cooking was directly related to loss of juiciness.

5.6.3 Tenderness

Tenderness is associated with the ease of chewing and this was found to be significantly ($P \leq 0.05$) altered from 30 days of storage for the control group. However, there was no significant difference in the tenderness of pickle between the 30 and 60 days of storage. There was significant($P \leq 0.01$) reduction in the mean scores for the treatment group only on the 90th day of storage. Similar results were reported by Singh and Panda (1988a) Panda *et al.*, (1990) and Singh (1994). The findings of Singh and Anand (1995) further confirmed the trend.

Loss of tenderness of eggs was due to the dehydration of egg components, consequent to pickling. The treatment group had a better mean score for tenderness throughout the duration of

storage and this might be attributed to the superior storage stability of the treatment group, when compared to the control.

5.6.4 Overall acceptance

This refers to the sensory perception of the product in total. Though it is not a sensory attribute as such, it is of utmost practical importance as a cumulative perception of the product. Lawrie (1985) rated tenderness as an important attribute affecting overall acceptability. Parrish *et al.* (1991) observed that the scores for tenderness, flavour and juiciness influenced overall acceptability.

The mean panel scores for this variable were found to decline gradually throughout the storage period of 90 days, but there was no significant difference between the control and treatment groups within the same period of storage. These findings are in agreement with the results reported by Singh and Panda (1988a). The findings of Panda *et al.* (1990) and Singh and Panda (1991a) further confirmed the same. The gradual reduction in overall acceptance of the product might be attributed to a reduction in the scores for juiciness, tenderness and flavour associated with increasing microbial population during storage.

4.8 Cost of production

The study conducted at the Department of Poultry Science on the feasibility of production of quail egg pickle with and without

potassium sorbate, and packed in HDPE pouches. The cost of production was Rs. 74. 39 and Rs. 74. 72 for the control and the treatment groups, respectively and it was found to be quite economical..

5. 8 Shelf life

It was inferred that vinegar, oil based quail egg pickle packed in HDPE pouches could be stored at a mean room temperature of 34. 6°C for 90 days. Singh *et al.* (1989b) reported that quail egg pickles with potassium sorbate could be safely stored for eight weeks at room temperature. Panda *et al. (1990)* found that quail eggs could be stored at room temperature for a period of 60 days. The present findings are also in agreement with those of Pandey *et al.* (1995) and Singh and Anand (1995).

Reddy and Rao (1996) and Murugan (1998) also reported a shelf life of 80 and 64 days, respectively for chicken pickle stored at room temperature.

The current study revealed that nutritious and tasty quail egg pickle could be prepared and stored at ambient temperature for 90 days in HDPE pouches. The product was found to be microbiologically safe, acceptable from the sensory quality point of view as well as economical.

Plate : 1 Quail egg pickle packed in HDPE pouches

Plate :2 Ready-to-eat quail egg pickle

Summary

SUMMARY

An experiment was designed and conducted at the Department of Poultry Science, College of Veterinary and Animal Sciences, Mannuthy to assess the shelf life of vinegar, oil based quail egg pickle with potassium sorbate, packed in HDPE pouches and stored at a mean room temperature of 34.6°C. The various quality characteristics of the product were evaluated at 30-day intervals.

Hard-boiled and peeled quail eggs of uniform size and quality were pickled as per a recipe developed to suit the Indian palate. The pickle was divided into two portions and to one was added potassium sorbate @ 0.26 per cent and packed in HDPE pouches.

Representative samples were drawn from both the control and treatment groups at zero, 30, 60, 90 and 120 days of storage. The shelf life of the product was determined in terms of quality parameters namely pH, proximate composition, oxidative rancidity (TBARS number), total viable count of mesophilic bacteria, yeast and mould count and organoleptic evaluation.

Findings of the study are summarized below

1. The mean weight of raw quail eggs used for pickling was 10.94 ± 0.02 g and that of cooked and peeled eggs was 9.15 ± 0.06 g. Therefore the cooking yield was found to be 83.63 ± 0.02 per cent.

2. The mean pH of quail egg pickle was found to increase significantly ($P \leq 0.01$) from 3.60 ± 0.01 to 4.76 ± 0.01 for the control group and 3.59 ± 0.01 to 4.73 ± 0.01 for the treatment groups respectively. The pH values were affected by storage at room temperature for 90 days, irrespective of the groups and there was no significant difference between the control and the treatment containing potassium sorbate.

3. The chemical composition of the product was in agreement with the values reported for quail egg pickle and similar products.

4. There was a significant ($P \leq 0.01$) reduction from the moisture content in the fresh quail egg pickle and those on 30, 60 and 90th days of storage, in both control and treatment groups, whereas, a significant ($P \leq 0.01$) increase was observed in the protein, fat and total ash content of pickle, irrespective of the treatment. There was no significant difference between the control and treatment groups within the same period of storage.

5. It was observed that the TBARS values in quail egg pickle increased significantly ($P \leq 0.01$) with the progress in storage, in both the control and treatment groups. The treatment group showed a significantly ($P \leq 0.05$) lower TBARS number at 60 and 90 days of storage when compared to the control group.

6. The total viable count of mesophilic bacteria in the pickle was found to increase significantly ($P \leq 0.01$) during storage, irrespective of the treatment and there was no significant difference between the control and treatment throughout the storage period, though the treatment group showed numerically lower count during storage.

7. The yeast and mould count of quail egg pickle increased significantly ($P \leq 0.01$), irrespective of the treatment with a progress in the duration of storage. No yeast and mould colonies could be detected in the fresh pickle. There were significantly ($P \leq 0.05$) lower counts in the treatment group at 30, 60 and 90 days of storage when compared to the control. Addition of potassium sorbate seemed to be effective in controlling the yeast and mould growth in pickles.

8. The organoleptic evaluation of both treatment and control groups of the pickle, conducted by a six-member semi trained taste panel on a seven point hedonic scale revealed that the product was fairly acceptable throughout the storage period of 90 days.

9. Cost structure for one kilogram of the product was worked out and the cost of production of the control and treatment groups was found to be Rs. 74.39 and Rs. 74.72, respectively.

10. On the 120th day of storage it was observed that both the groups were unfit for consumption based on the mesophilic and yeast and mould counts .The experiment was concluded at this stage.

The treatment group with potassium sorbate had significantly ($P \leq 0.05$) lower fungal counts and TBARS number during storage. There were numerically lower total viable counts and pH values as well for the treatment group, throughout the various periods of storage.

On the basis of the above findings it was inferred that wholesome and tasty quail egg pickle could be prepared with vinegar, gingelly oil, condiments and stored safely up to 90 days at ambient temperature after packing in HDPE pouches. Addition of potassium sorbate ensured better quality of the product during storage.

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ASSESSMENT OF THE SHELF LIFE OF QUAIL EGG PICKLE

By

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ABSTRACT OF A THESIS

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ABSTRACT

An investigation was carried out at the Department of Poultry Science, College of Veterinary and Animal Sciences, Mannuthy to assess the shelf life of vinegar, oil based quail egg pickle with and without potassium sorbate. The quality characteristics of the product packed in HDPE pouches as influenced by the period of ambient storage was evaluated at monthly intervals.

The mean weight of raw quail eggs used for pickling was 10.94 ± 0.02 g and that of cooked and peeled eggs was 9.15 ± 0.06g. Therefore the cooking yield was found to be 83.63 ± 0.02 per cent.

The product was stored for a period of 120 days and it was found that it was acceptable up to 90 days. The control and treatment groups were evaluated in terms of qualitative parameters namely pH, proximate composition, oxidative rancidity (TBARS number), total viable count of mesophilic bacteria, yeast and mould count and organoleptic qualities.

It was observed that during the period of study, from the day of production to 90 days of storage, the pH of quail egg pickle increased significantly ($P \leq 0.01$) from 3.60 ± 0.01 to 4.76 ± 0.01 for the control group and 3.59 ± 0.01 to 4.73 ± 0.01 for the treatment group, respectively. Though there was no significant difference between the two groups, within the same period of

storage, the proximate composition of the pickle was significantly ($P \leq 0.01$) affected irrespective of the treatments. There was a gradual but significant ($P \leq 0.01$) increase in 2-thiobarbituric acid reactive substance (TBARS) number in both the groups, during storage. The treatment group showed statistically lower TBARS numbers at 60 and 90 days of storage, when compared to the control.

The total viable count in both the groups increased significantly ($P \leq 0.01$) during storage but were well within the acceptable limit up to 90 days. There was no significant difference between the control and treatment groups, even though the treatment group had comparatively lower values throughout the storage period. The freshly prepared pickle did not have any yeast or mould population. There was a gradual and significant ($P \leq 0.01$) increase in the yeast and mould count with the progress in storage period, however, significantly ($P \leq 0.05$) lower counts were detected in the treatment group at 30, 60 and 90 days of storage.

In the case of organoleptic evaluation, the mean panel scores for flavour were 5.50, 5.72, 5.14 and 4.83 respectively for the control group on zero, 30, 60 and 90 days of storage. The corresponding values for the treatment group were 5.67, 6.00, 5.33 and 5.00, respectively. On working out the cost of production of pickle, it was found to be quite economical. The cost of

kilogram of quail egg pickle was Rs.74.39 and Rs.74.72, respectively for the control and treatment groups.

Henceforth it was concluded that nutritious, tasty and ready to eat quail egg pickle could be prepared with vinegar, gingelly oil and potassium sorbate, packed in HDPE pouches and stored safely for a period of 90 days at ambient temperature.