QUALITY EVALUATION OF QUAIL MEAT PATTIES UNDER STORAGE

By

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THESIS

Submitted in partial fulfilment of the
requirement for the degree

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DECLARATION

I hereby declare that the thesis entitled **"Quality Evaluation of Quail Meat Patties under Storage"** 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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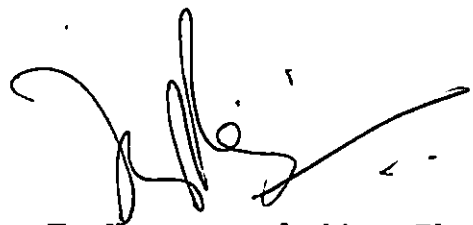
Certified that the thesis entitled **"Quality Evaluation of Quail Meat Patties under Storage"** is a record of research work done independently by **Kum. Kamna Barkataki,** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.



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Dedicated to
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Introduction

INTRODUCTION

India has witnessd a rapid increase in poultry production both in layers as well as in broilers, whereas the consumption of eggs and meat of poultry has not increased to that tune. The per capita availability of poultry meat in India is only 354 g as against 2.5 kg in the developing countries and 15-16 kg for the developed countries (Anon, 1990). One of the reasons for the low consumption may be the lack of range of convenience food items in the market. Therefore, the development of such foods from poultry meat could probably lead to an increased per capita consumption of poultry meat besides extending the availability of meat to a larger section of population who may hesitate to buy the whole chicken for economic reasons.

The demand for good quality ready-to-serve poultry products is fast increasing. Now-a-days many families especially in urban areas, comprise of working husband and wife. Therefore, there is a tremendous scope for the development of ready-to-cook/eat foods. It is very likely that in the near future the demand for chilled ready-to-cook dressed birds could go up tremendously in addition to the requirements for other poultry specialities viz., tandooris, pickles, canned products, meat bonda, sausages etc.

In order to keep up the present tempo of poultry development and to give it a further boost, processing and marketing of chicken meat products have to be strengthened.

Recently attempts are being made to develop ready-to-cook/eat products from poultry meat. Some of the products include poultry pickle, quail egg pickle, chicken sausages, tandoori quail, and the like. The above products have gained commercial recognition and popularity as the housewife, school children, or the office going workers can have a ready-to-cook/eat and nutritious snack at a reasonable cost.

Quail, popularly known as 'Bater' is a table delicacy since olden times. In the recent past many countries have taken up rearing Japanese quail as a commercial meat producer. In India too, the trend has been set to commercially exploit this species. Considering the production potential and large acceptability as a source of meat and egg, quail production is progressing very fast all over the country. The possibility of exploitation of the potentiality of quail and its products is immense and challenging.

In more advanced countries numerous preparations from chicken and quail meat are commercially available and one such product that has gained a fair popularity in the western market is the poultry meat patties. However, with the

difference in the preference between western and Indian consumers the recipe for poultry meat patties developed in western countries may not be readily acceptable to the Indian population. Moreover, the keeping quality of the patties under Indian conditions has to be studied when exploitation is planned.

A good possibility for increasing poultry meat consumption is through the development of new convenience marketable food items, one such possibility is the development of meat patties. 'Patty' literally means 'a little pie' and consists of a small flate cake of minced meat or other food. Technically it may be said that a 'patty' is a small, circular and flate cake prepared from minced meat or any other food along with some binders after baking/grilling.

The present investigation was therefore taken up to examine the feasibility of preparing quail meat patties from the deboned minced meat of quails by using a recipe to suit Indian palate and to evaluate the consumer acceptability, nutritional characteristics, conditions of storage without deterioration of quality and its shelf-life.

Review of Literature

REVIEW OF LITERATURE

This study involves the preparation of a new ready-to-cook product from deboned minced meat of Japanese quails and examination of various characteristics of the product including shelf-life under two storage conditions and periods of storage, chemical composition and organoleptic evaluation. In addition, attempts were also made to study the meat yields, losses and meat to bone ratio of Japanese quails. The research work carried out on the above aspects is rather scanty. The following is a brief review of the more recent and relevant literature on the above aspects.

Processing yields and losses

Even though numerous reports are available on meat yields and losses of chicken, research work on these aspects of quails is very limited.

The net yield of meat from processed poultry is reported to be related to a variety of factors such as body conformation of the bird (Jaap and Penquite, 1938), the previous nutritional status of the bird (Harkin et al., 1960) and sex, age and strain (Fry et al., 1962).

Amon et al. (1970) processed Bobwhite quails in lots of 50 at 10, 12, 14, 16 and 18 weeks of age and reported that the ready-to-cook yield averaged 71 per cent and were similar for birds of all ages and both sexes.

Dawson et al. (1971) reported that the ready-to-cook yields increased from 10 to 18 weeks of age averaging 71 per cent.

Souri et al. (1972) observed that the percentages of yield, blood, feather and inedible offal averaged 76.0, 3.6, 8.4 and 15.5 respectively for Desi chicken (six to 15 months of age).

Pandey et al. (1979) studied the effect of pre-slaughter characteristics of Japanese quails at five weeks of age and observed that the eviscerated per cent averaged 65.97 ± 0.39 for the fasted quails. The authors also reported that the giblet, blood, feather and inedible offal percentages averaged 5.66 ± 0.10, 2.51 ± 0.17, 5.68 ± 0.24 and 19.66 ± 0.39 respectively.

Singh et al. (1980) conducted experiments to study the slaughter characteristics of Japanese quails at different stages of growth and reported that the mean per cent eviscerated yield, giblet and total offal were 65.0 ± 0.83,

6.1 ± 0.13 and 28.6 ± 1.25 respectively for the quails aged eight weeks.

Singh et al. (1981) reported that there was significant ($P<0.05$) increase in total meat yield of the carcass from five to six weeks of age in. both sexes and remained rather constant thereafter. Total edible and inedible components of the carcass were approximately 78 and 22 per cent respectively.

Shrivastava and Panda (1982) reported that the evisceration, giblet and total offal percentages for the quails at five weeks of age ranged from 65.2 to 66.0, 7.2 to 7.5 and 26.1 to 28.1 respectively.

Choudhary and Mahadevan (1983) conducted experiments using Japanese quails and observed that the percentage blood, feather, eviscerated and total offal for females at six weeks of age averaged 4.93 ± 0.14, 10.26 ± 0.26, 61.48 ± 0.36 and 30.92 ± 0.35 respectively.

Narahari et al. (1983) observed significant ($P<0.05$) differences in body weight and ready-to-cook yield based on age and sex of Japanese quails.

The live weight (g), per cent evisceration, giblet, blood, feather and total offals averaged 128.70 ± 2.17,

65.60 ± 0.33, 7.05 ± 0.12, 3.95 ± 0.10, 4.65 ± 0.22 and 27.35 ± 0.30 respectively for Japanese quails of both sex at five weeks of age (Anon., 1985).

Singh and Panda (1985) stated that the percentage evisceration yield averaged 67.66 ± 0.84 for quails at sixth week of age.

Sreenivasaiah et al. (1985) reported that the percentage of dressed weight and giblet for Japanese quails at six weeks of age ranged from 60 to 65 and 5.0 to 6.0 respectively.

Mohan et al. (1986) studying the carcass characteristics and keeping quality trials of male and female Japanese quails at six and eight weeks of age observed that irrespective of age the female quail had shown superiority in slaughter weight and ready-to-cook yield. The edible yield increased with advancement of age. Mean slaughter weight of female Japanese quails at sixth and eighth weeks of age averaged 130.9 ± 1.96 and 157.2 ± 2.61 g respectively and ready-to-cook yield averaged 73.0 ± 0.42 and 73.8 ± 0.45 percentages respectively for sixth and eighth weeks of age.

Panda (1986) noticed that the ready-to-cook percentage in quails aged five to eight weeks varied from 70 to 75.

Tserveni Gousi and Yannakopoulos (1986) experimented with Japanese quails of 42 days age to study the effect of sex on carcass characteristics and observed that the average carcass yield in males was greater than that in females (76.9 compared to 72.7 percentage).

Narayanankutty and Ramakrishnan (1989) studying yield and composition of quail meat found a mean percentage shrinkage of 8.18 and 7.78 at fifth and sixth weeks of age respectively. The per cent blood percentage averaged 4.58 and 4.51 at fifth and sixth weeks of age respectively and the feather percentages averaged 7.04 and 6.78 respectively for the above periods. These workers also reported that the total offal percentages averaged 24.53 and 22.22 at five and six weeks of age respectively and the ready-to-cook yield averaged 75.47 and 77.78 respectively for the above periods. The mean per cent eviscerated yield at five and six weeks of age were 67.99 and 70.48 respectively and the mean giblet percentage were 7.49 and 7.33 respectively for the above periods.

Meat to bone ratio

Amon et al. (1970) reported that the meat to bone ratio for Bobwhite quails of each sex increased with age.

Singh et al. (1981) reported that meat to bone ratio averaged 2.6 ± 0.08 and 3.3 ± 0.12 at five and six weeks of age respectively in Japanese quails and the authors also reported that the ratio in quails increased significantly ($P<0.05$) in both sexes taken together till seven weeks age and remained constant thereafter.

Chidananda et al. (1985) collected data on groups of Japanese quails of 10 males and 10 females killed at five, six, seven, eight, nine and 10 weeks and reported that the meat to bone ratio increased significantly ($P<0.05$) at nine weeks with values at eight weeks not significantly different from at nine weeks and values at seven weeks not significantly different from those at eight weeks of age.

Sreenivasaiah et al. (1985) reported that the meat to bone ratio at six weeks of age in quails averaged 3.97.

Mohan et al. (1986) studying the carcass characteristics of Japanese quails at six and eight weeks of age observed that irrespective of the age the female Japanese quail showed superiority in meat to bone ratio over males. The meat to bone ratio of female Japanese quails at sixth and eighth week of age averaged 3.64 ± 0.05 and 4.48 ± 0.12 respectively.

Narayanankutty and Ramakrishnan (1989) reported that the meat to bone ratio of quails slaughtered at five and six weeks of age averaged 1.90 and 1.98 respectively.

Quail meat products and their shelf-life

There are hardly any reports on the preparation of quail meat patties from deboned minced meat of quails. Perusal of available literature on poultry products technology revealed gaps in our knowledge in respect of many information on new marketable deboned minced poultry meat products which suit to Indian taste.

Various chicken meat products were developed and profitably marketed in the supermarket at Central New York. Baker et al. (1967) developed chicken steaks and marketed profitably. Hasiak and Baker (1968) could store the chicken steak well for seven to ten days under refrigeration storage and for three weeks under frozen storage.

Puttarajappa et al. (1971) in their studies on shelf-life of tandoori chicken at two temperatures (40°F and 12°F) to simulate the marketing conditions indicated that the shelf-life of the product was about 13 days at 40°F and about 44 days at 12°F without appreciable changes in its quality

characteristics from chemical, microbial and sensory point of view.

Narayanankutty et al. (1983) developed chicken steaks using two recipes, from deboned minced meat of spent broiler breeder hens and reported that a highly acceptable product in the form of chicken steak could be prepared. The authors also observed that the optimum condition for its long term storage was -15°C at which temperature the product could be held upto three months without any quality deterioration.

Kondaiah et al. (1988) conducted studies on the utilization of whole meat from spent hens for chicken sausages and found that the product could be stored upto 10 days at 5°C and upto 90 days at -10°C without any quality deterioration.

Anand et al. (1990) in their studies on the microbial profile of chicken sausages observed that raw sausages had a shelf-life of seven days whereas dry and moist cooked sausages had comparatively longer shelf-life of nine to ten days when stored at 5 ± 1°C.

Anjaneyulu et al. (1990) conducted studies on quality of patties from chicken, mutton and combination of meats and reported that yield and composition of chicken and mutton patties were not different significantly and that appearance, flavour and overall acceptability of chicken patties were

significantly ($P<0.05$) better than the patties of combination of meat which were markedly better than mutton patties.

Anand et al. (1991) on studying the microbial quality and shelf-life of chicken patties stored at -18°C observed that the chicken patties had a shelf-life of 150 days.

Rejikumar et al. (1991b) conducted studies on chicken meat balls and reported that a highly acceptable chicken meat product in the form of chicken meat balls could be prepared from deboned minced broiler chicken meat and the optimal condition for its long term storage was determined to be -15°C and that at this temperature the product could be held upto two months without any appreciable quality deterioration. The same authors (1991a) in another work on chicken meat balls also reported that at 5°C the product could be held upto four days without any loss of quality.

Quality characteristics of poultry meat and its products

Proximate composition

Mecchi et al. (1956) reported that the age, sex and species of poultry besides the parts of the carcass from which meat is taken influence the fat content considerably.

It was reported that the carcasses from young birds have a higher proportion of moisture than that from the older ones (Mountney, 1966).

Studies on the formulation and quality evaluation of chicken sausage were conducted by Majhi (1973) demonstrated that the per cent proximate composition of the product namely, moisture, protein, fat and total ash were 65.45, 10.67, 10.67 and 2.97 respectively.

Poultry meat consists of 75 per cent moisture, 18 per cent protein, 3 per cent fat and 0.7 per cent inorganic salts (Varadarajulu, 1973).

Cunningham and Bowers (1977) reported that the fat content of the chicken patties ranged from 11.0 to 13.5 per cent and per cent protein ranged from 18.1 to 20.0 per cent. The authors also reported that percentage moisture and ash averaged 68.90 and 1.34 respectively.

Studies on qualities of patties were also made by Lyon et al. (1978) who reported that the per cent mean protein and fat were 21.71 and 5.61 respectively for chicken patties prepared from hand deboned minced fowl meat.

Narayanankutty et al. (1983) working on chicken steak reported that proximate composition remained unaltered upto

seven days of storage at 5°C and upto 90 days at -15°C. They reported no difference in proximate components due to the difference in temperature or duration of storage. The per cent moisture, protein, fat and ash of chicken steaks stored upto seven days at 5°C varied from 58.27 to 59.18, 19.76 to 20.82, 5.79 to 6.14 and 2.67 to 3.63 respectively. The per cent moisture, protein, fat and total ash of the same stored upto 90 days at -15°C ranged from 58.46 to 59.21, 18.77 to 20.82, 5.79 to 6.33 and 3.25 to 3.58 respectively.

Mahapatra et al. (1984) in their studies on the acceptability and composition of chicken patties observed that the per cent moisture, protein, fat and ash averaged 49.8, 14.8, 18.3 and 3.3 respectively.

Hollender et al. (1987) conducted studies on patties made from restructured spent layer meat and observed that percentage moisture, protein, fat and ash averaged 70.53, 21.75, 9.2 and 0.86 respectively. They also observed that patties made from breast meat contained 22.51 per cent protein and 6.71 per cent fat.

Kondaiah et al. (1988) carried out studies on chicken sausages prepared from spent hens and found 63.10 $\pm$ 0.29, 14.70 $\pm$ 0.18, 14.60 $\pm$ 0.69 and 3.10 $\pm$ 0.13 per cent moisture, protein, fat and ash respectively in the raw sausages.

Lyon et al. (1988) in their studies on chicken patties observed that the percentage moisture, protein and fat averaged 73.08, 18.15 and 6.35 respectively.

Thind et al. (1988) in their studies on chicken patties observed that the percentage moisture and protein averaged 56.4 and 15.1 respectively.

Anjanneyulu et al. (1990) reported that percentage moisture, protein, fat and ash averaged 60.19 $\pm$ 0.36, 13.91 $\pm$ 0.57, 19.02 $\pm$ 0.76 and 2.74 $\pm$ 0.04 respectively in chicken patties.

Rejikumar et al. (1991a) conducted studies on the quality of chicken meat balls under refrigeration storage and reported that the proximate composition of the product remained unaltered when stored at 5°C for upto six days. The percentage moisture of the meat ball ranged from 70.19 to 71.12 for the recipe I and for the recipe II, the values ranged from 68.65 to 69.56. The per cent protein for the recipes I and II ranged from 14.23 to 15.12 and from 13.65 to 14.33 respectively, irrespective of the duration of storage. The fat content of the product ranged from 5.59 to 5.95 for the recipe I and for the recipe II from 5.37 to 5.75 and ash percentage for recipes I and II ranged from 3.76 to 4.20 and

3.43 to 4.46 respectively at 5°C irrespective of the duration of storage.

Rejikumar et al. (1991b) carrying out the storage studies of chicken meat balls under frozen conditions observed that the proximate composition of a product remained unaltered at -15°C upto 60 days. The per cent values for moisture ranged from 71.04 to 72.26 for recipe I and for recipe II from 67.93 to 69.73 percentages, and the protein per cent ranged from 14.00 to 15.21 for recipe I and for recipe II from 12.49 to 14.46 irrespective of days of storage. The per cent fat content of recipes I and II ranged from 5.55 to 5.90 and 5.30 to 5.93 respectively and the total ash ranged from 3.64 to 4.33 and 3.43 to 4.16 percentages respectively.

Rancidity

The 2-thiobarbituric acid number (TBA number) offers an indication of rancidity in meat during storage. It has been observed that there is more rapid rate of oxidation of fatty acids in the dark meat than in white meat. Grinding the meat tended to increase the TBA number (Keskinel et al., 1964). A similar effect was also observed during storage at 5°C by the same authors.

Baker et al. (1967) determined the TBA values of chicken steaks prepared from white and dark meats and stored under different storage conditions over varying periods. The results showed that at refrigeration temperature the values increased as the number of days of storage increased. Freezing for three days at -15°F prior to refrigeration at 35°F had only a slight advantage so far as TBA values were concerned. According to them the best storage for this product appeared to be at -15°F where less TBA values were recorded.

Hasiak and Baker (1968) have published detailed methodology on the preparation of chicken steaks from the breast and thigh meat. Their findings on the TBA values of market test steaks were fairly close to those of Baker et al. (1967). The studies indicated that the product had a shelf-life of 7-10 days under refrigeration storage and minimum of three weeks in frozen state.

The mode of deboning the meat had also an effect on the rancidity. Mechanically deboned meat had a higher TBA number than hand deboned meat (Schnell et al., 1971). Froning (1973) observed the TBA values to increase with the storage time even at fairly low temperature (-29°C). However, Dawson (1975) observed that minimum lipid oxidation can be achieved by low temperature preservation. It was assumed by

Dawson et al. (1975) the TBA values above 2.0 may be associated with development of rancidity in meat sample.

Cunningham and Bowers (1977) reported that TBA values of the chicken patties increased during refrigerated storage.

Lyon et al. (1978) reported that TBA values ranged from 0.31 to 0.85 for the chicken patties stored at -40°C upto eight weeks and showed no significant rancidity development.

Narayanankutty et al. (1983) conducted storage studies on chicken steaks and observed an increase in TBA numbers with increase in the length of storage time under refrigeration condition (5°C) and at -15°C the steaks remained almost unaffected in respect of TBA numbers. The TBA numbers averaged 0.68, 0.70, 0.72, 0.78, 0.82, 0.96 and 1.19 respectively for zero, 15, 30, 45, 60, 75 and 90 days of storage.

Hollender et al. (1987) conducted studies on the quality of patties made from spent layers meat and observed that the TBA values generally increased during storage period (zero to six months). However patties made from breast meat maintained significantly ($P<0.05$) lower values throughout the six months storage period. The authors found that the TBA numbers of chicken patties averaged 0.80, 1.41, 2.10 and 3.21 for zero, one, three and six months of storage respectively.

However, the TBA values for patties prepared from breast meat averaged 0.75, 0.99, 1.23 and 2.17 respectively for zero, one, three and six months storage.

Lyon et al. (1988) prepared chicken patties from white and dark meats precooked and stored for zero one, two or three days at 4°C and then frozen at -34°C until evaluated and observed that the TBA number of samples stored for two and three days increased and the values ranged from 0.22 to 0.58.

Sreenivasaiah et al. (1988) compared selected quality characteristics of raw and precooked meat of spent hen. The results indicated that the TBA values of precooked meat were higher then that for the raw meat and it was suggested that cooked meat will be acceptable upto eight days under refrigeration and upto two months under frozen conditions.

Anand et al. (1991) studying the microbial quality and shelf-life of chicken patties stored at -18°C observed that the thiobarbituric acid increased from 0.28 to 2.17 mg malonaldehyde/kg during storage (zero to 150 days). The TBA values averaged 0.28 $\pm$ 0.07, 0.35 $\pm$ 0.04, 0.38 $\pm$ 0.02, 0.43 $\pm$ 0.01 and 0.42 $\pm$ 0.04 respectively for zero, 15, 30, 45 and 60 days of storage.

Rejikumar et al. (1991a) conducting storage studies on chicken meat balls under refrigeration condition observed that

the TBA values increased significantly ($P<0.05$) with each incremental storage period. The TBA number of the product prepared as per recipe I ranged from 0.54 to 1.84 and that for recipe II ranged from 0.58 to 1.58 at 5°C from zero to six days of storage. They also reported that irrespective of recipes, the TBA numbers were significantly ($P<0.05$) higher for those stored for four and six days at 5°C.

Rejikumar et al. (1991b) in another study on chicken meat balls under frozen condition reported that the TBA numbers increased with increase in length of storage. The TBA numbers of chicken meat balls stored at -15°C were reported to be ranged from 0.54 to 1.21 for recipe I and from 0.58 to 1.18 for recipe II.

Total bacterial count

It has been a recognised fact that the microbial population of poultry meat prior to or during the storage has a profound implication from the public health point of view.

Baker et al. (1967) prepared chicken steaks from the white and dark meat and determined the total bacterial counts of these products under different storage conditions over varying periods. The results showed that at refrigeration temperature, the total bacterial counts increased as the

number of days of storage increased. The authors also reported that the best storage condition for this product appeared to be refrigeration at -15°F where the lowest bacterial counts were recorded.

Hasiak and Baker (1968) also prepared chicken steaks from the breast and thigh meat and their findings with respect to the bacterial count of market test steaks were fairly close to those of Baker et al. (1967).

Ostowar and MacNeil (1971) reported a decrease in total bacterial population per gramme at lower storage temperature even with extended storage.

Mechanically deboned poultry meat is known to have a microbial count ranging from 10×10^5 per gramme of meat (Maxy et al., 1973).

At 0°C or less, most of the organisms in meat failed to grow (Sahoo, 1973). Slow freezing was found to be damaging to microbial population. Pathogenic organisms were reduced in number due to rapid freezing. Repeated freezing and thawing had a drastic killing effect on vegetative forms of microorganisms.

Maxcy et al. (1973) found that micro-organisms in frozen products were similar and remained stable during the

storage upto seven weeks. They also reported that ground poultry product stored at 5°C showed little change in microbial load, increased thereafter which was indicative of organoleptic spoilage in approximately four days.

Froning (1976) reviewing the literature on the microbial content of mechanically deboned meat reported the total counts per gramme to range from 3.25×10^5 to 9.32×10^6 as the days of storage at 3°C increased from zero to 12. On the contrary, storage at -15°C even for 270 days gave a total count of 2.63×10^3 per gramme.

Cunningham and Bowers (1977) studied the microbial count and stability of chicken patties held at refrigeration temperature and observed that initial count per gramme was never greater than 10^4 and total count per gramme ranged from $9x10^3$ to $7x16^6$ after 10 days of storage at 3°C. The authors also reported that the counts averaged $6x10^4$, $8x10^4$ and $8x10^5$ for three, five and seven days of storage respectively.

Narayanankutty et al. (1983) carried out studies on storage of chicken steaks and observed that the microbial population increased in samples stored at 5°C with the increase in the length of storage and at -15°C the opposite effect was observed. The total bacterial count per gramme averaged 8.83×10^4, 9.59×10^4 and 8.10×10^5 for zero, four

and seven days of storage periods respectively at 5°C and at -15°C the counts averaged 8.83×10^4, 8.17×10^4, 7.60×10^4, 6.65×10^4, 6.42×10^4, 6.06×10^4 and 5.47×10^4 respectively for zero 15, 30, 45, 60, 75 and 90 days of storage.

Microbiological studies were conducted during preparation and subsequent storage of chicken sausages by Anand et al. (1990) and observed that the total aerobic counts increased from 4.54 to 7.09 log/g during storage at 5 ± 1°C from zero to eight days. The authors also reported that the total counts averaged 5.45, 5.85 and 6.69 log/g during storage periods of 2, 4 and 6 days respectively.

Anand et al. (1991) carrying out studies on microbial quality of chicken patties stored at -18°C observed a significant increase in bacteria during preparation of patty mix, but the overall count decreased substantially during freezing. The authors also reported that the aerobic counts decreased from 3.71 to 2.62 log/g after 150 days of storage and aerobic plate counts averaged 3.71, 3.78, 3.51, 3.53 and 3.47 respectively for zero, 15, 30, 45 and 60 days of storage.

Rejikumar et al. (1991a) in their work with chicken meat balls observed that the total bacterial count/g of the product increased significantly ($P<0.05$) per each period of storage under refrigeration condition (5°C) and the total

bacterial count (log count/g) of chicken meat balls stored at 5°C averaged 7.52 and 7.59 for the fresh samples prepared by using recipes I and II respectively. On the fourth day the values were 8.15 and 7.98 respectively for recipes I and II and on sixth day of storage the above values increased to 10.12 and 9.89 for recipes I and II respectively. It was concluded that irrespective of recipes, the bacterial load was influenced by duration of storage and the differences in the bacterial count between zero and any other days of storage were significant ($P<0.05$) statistically.

Rejikumar et al. (1991b) conducting storage studies on chicken meat balls observed that the total bacterial count reduced significantly ($P<0.05$) with increase in storage time. The microbial population of fresh chicken meat balls (log count/g) were 7.52 and 7.59 for recipes I and II respectively. The authors also reported that the counts were reduced when observed fortnightly upto 60 days of storage. The counts averaged 6.47, 5.94, 5.54 and 5.37 for 15, 30, 45 and 60 days of storage periods respectively at -15°C for the recipe I and for the recipe II the values averaged 6.23, 6.13, 5.23 and 5.05 respectively for the above periods.

Materials and Methods

MATERIALS AND METHODS

An experiment was designed and conducted in the Department of Poultry Science, College of Veterinary and Animal Sciences, Kerala Agricultural University, Mannuthy to examine the feasibility of preparing quail meat putties from deboned minced meat of Japanese quails and to study the nutritional characteristics, keeping quality and overall acceptability of the product.

Quails aged 25 weeks were used in the study. Data on processing yields, losses and meat to bone ratio were collected from 75 quails. Deboned minced meat from these quails was used for the preparation of quail meat patties.

Processing yields and losses

The quails were slaughtered and processed as per procedure described by Bureau of Indian Standards (ISI, 1973) and processing yields and losses were determined. Feathers were removed manually.

Meat to bone ratio

From eviscerated quails bones were separated from meat

manually and weighed separately. The meat to bone ratio was arrived at using the formula,

$$M:B = \frac{\text{Weight of meat}}{\text{Weight of bone}}$$

Preparation of quail meat patties

Deboned minced meat from the spent quails were used for the preparation of quail meat patties. A recipe was developed for the quail patties (Table 1) to suit Indian palate.

All ingredients including the minced meat were added and mixed thoroughly for two to three minutes manually. The mixed lump was weighed into 70-100 g portion and moulded in glass petridish having 87 mm internal diameters and 17 mm depth, this constituted ready-to-cook quail meat patties. The product thus prepared was stored under refrigeration (5°C) and frozen -15°C) temperatures until further analysis for quality parameters or tested by a panel for organoleptic evaluation after deep fat frying (at 150 to 175°C for ten to fifteen minutes).

The quail meat patties thus prepared as per the recipe and stored were withdrawn from the refrigerator at zero, four and six days of storage and from the freezer at zero, 15, 30,

Table 1. Quail meat patties - Recipe

Ingredients	Quantity
Deboned and minced quail meat	1000 g
Spices mixture*	30 g
Maida	30 g
Red chilli powder	30 g
Chopped and minced onion	60 g
Minced garlic	25 g
Chilled water	40 ml
Table salt	to taste

Spices mixture include - clove, cinnamon, anise, black pepper, capsicum and cardamon

45 and 60 days of storage for further analysis. Representative samples in numbers of five from the product for each storage temperature and withdrawal period were assessed for quality.

The samples were analysed for moisture, protein, fat and total ash by A.O.A.C. (1970) methods.

Rancidity was evaluated by 2-thiobarbituric acid (TBA) test of Tarladgis et al. (1960). The TBA number was expressed as mg malonaldehyde per kg of material.

Total bacterial counts were determined by Plate Count Method as described by Dam et al. (1970) and were expressed as log count per gramme of sample.

Besides evaluating the product for the above parameters, organoleptic evaluations were also conducted after deep fat frying for 10 to 15 minutes at 150 to 175°C. A taste panel consisting of five members was selected for the organoleptic evaluation. A seven point hedonic scale for flavour, tenderness, juiciness and overall acceptability was used. The scorecard used for this purpose is presented in Table 2.

The shelf-life of the product was evaluated in terms of oxidative rancidity, total bacterial count, proximate

Table 2. Scorecard for organoleptic evaluation

Name :

Date :

Product name:

Sample	Flavour	Tenderness	Juiciness	General acceptability

Record the rating number (7-1) below in appropriate column above

Rating scale

7. Like very much
6. Like moderately
5. Like slightly
4. Neither like nor dislike
3. Dislike slightly
2. Dislike moderately
1. Dislike very much

Any additional informations desired to be recorded:

analysis and organoleptic evaluations at each stage of storage period and storage temperature.

The total number of quail meat patties prepared from one kilogramme of meat was calculated and from this the yield per kilogramme of meat was worked out.

Cost structure of the product was calculated based on the prevailing cost of the meat and other ingredients used for the preparation.

Statistical analysis of the data was carried out according to Snedecor and Cochran (1967).

Results

RESULTS

The results obtained in this investigation are briefly described in this section.

Meat yields and losses

The mean live weight at the time of slaughter, mean per cent meat yields and losses and meat to bone ratio obtained during the processing of Japanese quails used for the study are presented in Table 3 and graphically represented in Fig.1 and 2. The mean live weight of quails was 162.37 $\pm$ 1.83 (g) for the quails at the time of slaughter. The mean per cent yields of eviscerated, giblet and ready-to-cook carcass were 62.57 $\pm$ 0.51, 6.63 $\pm$ 0.13 and 69.20 $\pm$ 0.45 respectively. The mean per cent total loss was found to be 30.80 $\pm$ 0.45, the components of which were sub-divided as loss of blood, feathers and inedible offal and the mean per cent contribution of the above were 3.62 $\pm$ 0.13, 3.72 $\pm$ 0.13 and 23.46 $\pm$ 0.48 respectively.

Meat to bone ratio

The mean yields of meat and bone were 54.895 $\pm$ 0.72 (g) and 26.879 $\pm$ 0.40 (g) respectively, resulting in a meat to

Table 3. Meat yields, losses and meat to bone ratio of Japanese quails of twenty-five weeks of age

Mean live weight at the time of slaughter (g)	162.37 ± 1.83
Eviscerated yield (%)	62.57 ± 0.51
Giblet yield (%)	6.63 ± 0.13
Ready-to-cook yield (%)	69.20 ± 0.45
Blood loss (%)	3.62 ± 0.13
Feather loss (%)	3.72 ± 0.13
Inedible offal (%)	23.46 ± 0.48
Total loss (%)	30.80 ± 0.45
Meat to bone ratio	2.04 ± 0.03

Fig.1 THE INEDIBLE LOSS IN JAPANESE QUAIL

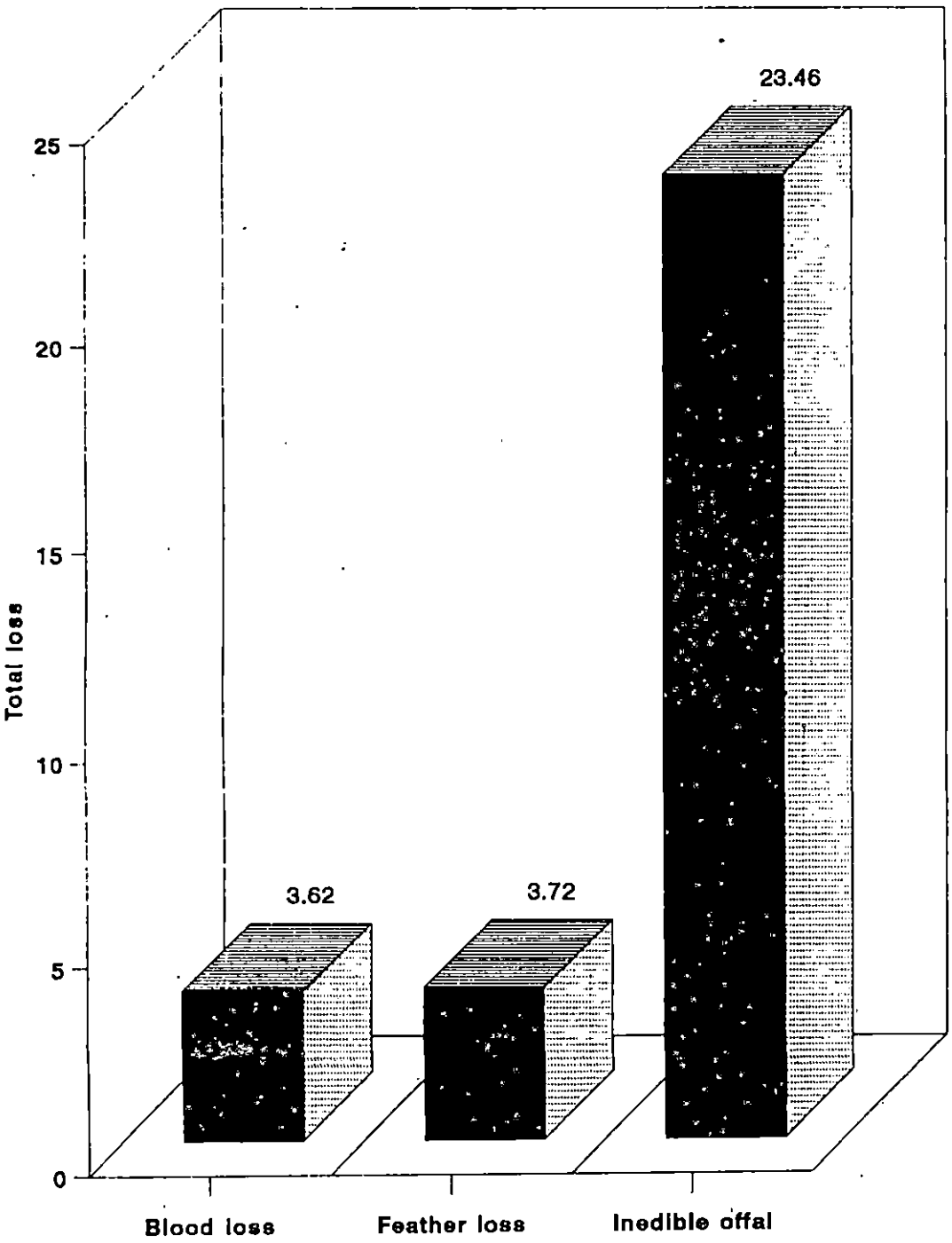
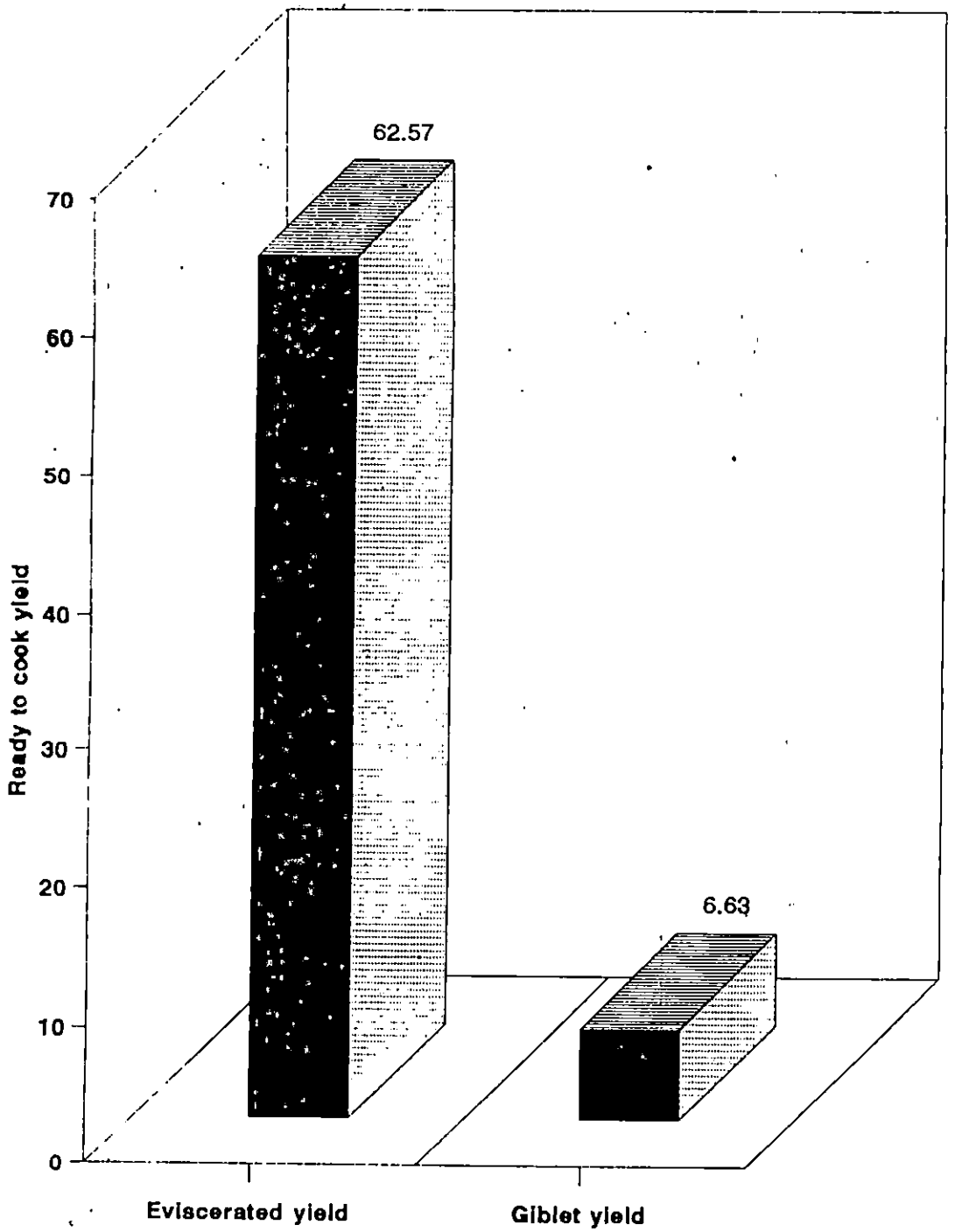


Fig.2 READY-TO-COOK YIELD IN JAPANESE QUAIL



bone ratio of 2.04 ± 0.03 (Table 3). The mean per cent component yields of meat and bone of eviscerated Japanese quails are diagrammatically represented in Fig.3.

Quality characteristics and shelf-life of quail meat patties

Proximate composition

The moisture, protein, fat and total ash contents of quail meat patties prepared using the recipe and stored at 5°C for zero, four and six days and at -15°C for zero, 15, 30, 45 and 60 days are presented in Table 4. The proximate components of ready-to-cook quail meat patties were not significantly affected either by storage time or temperature. Irrespective of the duration of storage, per cent moisture ranged from 71.98 ± 0.64 to 72.43 ± 0.39 at 5°C. At -15°C, the values ranged from 71.58 ± 0.55 to 72.47 ± 0.47.

The mean per cent protein content ranged from 16.46 ± 0.43 to 17.14 ± 0.23 and 16.77 ± 0.40 to 17.25 ± 0.55 respectively at 5°C and -15°C irrespective of days of storage.

Irrespective of duration of storage the mean per cent fat content ranged from 5.87 ± 0.09 to 6.03 ± 0.15 and from 5.77 ± 0.17 to 5.99 ± 0.25 under refrigeration storage (5°C) and frozen storage (-15°C) respectively.

Fig.3 PERCENT MEAN COMPONENT YIELD OF MEAT AND BONE OF EVISCERATED JAPANESE QUAIL

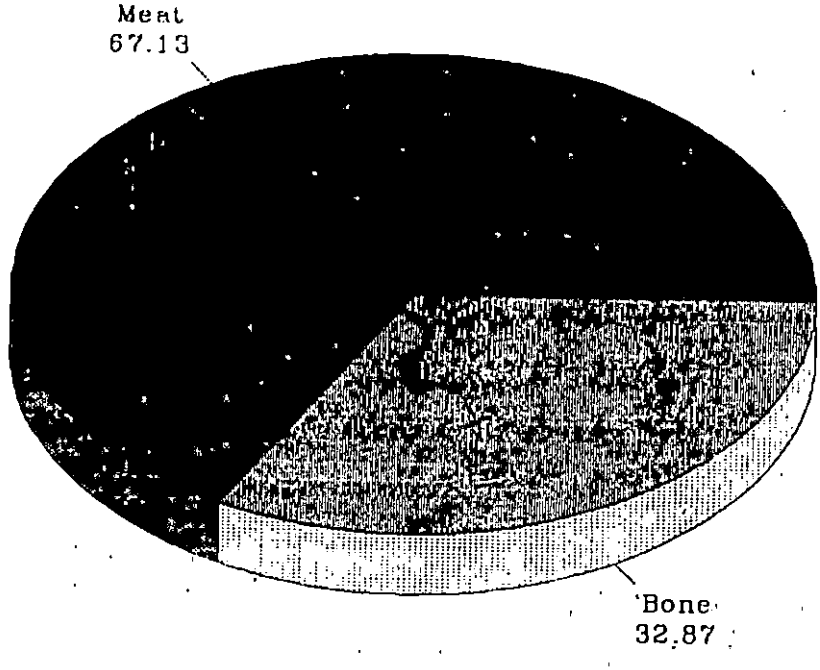


Table 4. Influence of temperature and duration of storage on the proximate composition of ready-to-cook quail meat patties

Storage temperature	Days of storage	Moisture (%)	Protein (%)	Fat (%)	Total ash (%)
5°C	0	72.36 ± 0.41	16.77 ± 0.40	5.99 ± 0.25	4.48 ± 0.05
	4	71.98 ± 0.64	17.14 ± 0.23	5.87 ± 0.09	4.43 ± 0.27
	6	72.43 ± 0.39	16.46 ± 0.43	6.03 ± 0.15	4.60 ± 0.38
-15°C	0	72.36 ± 0.41	16.77 ± 0.40	5.99 ± 0.25	4.48 ± 0.05
	15	72.15 ± 0.73	17.08 ± 0.34	5.88 ± 0.11	4.28 ± 0.38
	30	72.47 ± 0.47	17.03 ± 0.27	5.91 ± 0.34	4.19 ± 0.45
	45	71.74 ± 0.46	17.25 ± 0.31	5.89 ± 0.27	4.64 ± 0.11
	60	71.58 ± 0.55	17.25 ± 0.55	5.77 ± 0.17	4.63 ± 0.16

Irrespective of the days of storage, total ash ranged from 4.43 ± 0.27 to 4.60 ± 0.38 per cent at 5°C and at -15°C the values ranged from 4.19 ± 0.45 to 4.64 ± 0.11.

Rancidity

The oxidative rancidity of fat in terms of mg malonaldehyde per kg of sample prepared as per the recipe and stored at two different storage temperatures viz., 5°C and -15°C for varying periods is presented in Table 5.

The TBA numbers of quail meat patties ranged from 0.20 ± 0.03 to 0.21 ± 0.02 from zero to six days of storage. The TBA numbers of the quail meat patties were not found to be different significantly, irrespective of the days of storage at 5°C.

At -15°C, the TBA numbers of quail meat patties ranged from 0.20 ± 0.03 to 0.37 ± 0.01 during zero to 60 days of storage. The TBA values were significantly higher ($P<0.05$) for patties those stored for 30, 45 and 60 days at -15°C. The values for the product stored at -15°C for 30, 45 and 60 days were 0.280, 0.32 and 0.37 respectively.

Total bacterial count

The total bacterial count of quail meat patties

Table 5. Influence of storage temperature and duration on oxidative rancidity of quail meat patties

Storage temperature	Days of storage	TBA Number (mg malonaldehyde/kg sample)
5°C	0	0.20 ± 0.03^{a}
	4	0.20 ± 0.01^{a}
	6	0.21 ± 0.02^{a}
-15°C	0	0.20 ± 0.03^{a}
	15	0.23 ± 0.02^{a}
	30	0.28 ± 0.03^{b}
	45	0.32 ± 0.01^{b}
	60	0.37 ± 0.01^{b}

Note: Values bearing the same superscripts within the column between zero day and any other days of storage are not significantly different ($P<0.05$)

prepared according to the recipe and stored at different temperatures (5°C and -15°C) and periods is presented in Table 6.

The total bacterial load of the refrigerated products increased with the duration of storage and the increase in counts was significant statistically ($P<0.01$). On the other hand, when the product was deep frozen (-15°C) the counts reduced considerably and the reduction was found to be significant statistically ($P<0.01$).

The total bacterial counts (expressed in colony forming unit/g) of quail meat patties stored at 5°C was 7.80×10^5 for the fresh sample which increased to 1.46×10^6 on fourth day and 5.02×10^7 on sixth day of storage. The bacterial load was influenced by duration of storage at 5°C and the differences in total bacterial count between zero and any other days of storage were significant statistically ($P<0.01$).

At -15°C, the total bacterial count (colony forming units/g) of quail meat patties was 7.80×10^5 for the fresh samples. The counts were found to be reduced when observed fortnightly upto 60 days of storage. On 60th day, the value was 1.91×10^3.

Table 6. Influence of storage temperature and duration on total bacterial count of quail meat patties

Storage temperature	Days of storage	Total count (C.F.U./g of sample)
5°C	0	$7.80 \times 10^5 \pm 7.05 \times 10^4$ a
	4	$1.46 \times 10^6 \pm 3.89 \times 10^4$ b
	6	$5.02 \times 10^7 \pm 2.96 \times 10^6$ b
-15°C	0	$7.80 \times 10^5 \pm 7.05 \times 10^4$ a
	15	$4.70 \times 10^5 \pm 2.64 \times 10^4$ b
	30	$9.26 \times 10^4 \pm 2.59 \times 10^3$ b
	45	$1.40 \times 10^3 \pm 3.54 \times 10^1$ b
	60	$1.91 \times 10^3 \pm 8.43 \times 10^1$ b

Note: Values bearing the same superscripts within the column between zero day and any other days of storage are not significantly different ($P<0.05$)

During the whole storage period at -15°C the bacterial load was found to be different statistically ($P<0.05$) from that obtained for zero day storage.

Organoleptic evaluation of quail meat patties

The organoleptic evaluation of ready-to-eat quail meat patties prepared using the recipe was conducted by a taste panel and the evaluation scores are shown in Table 7.

The scores for flavour, juiciness, tenderness and overall acceptability ranged from 6.0 $\pm$ 0.32 to 6.8 $\pm$ 0.20, 5.4 $\pm$ 0.24 to 6.2 $\pm$ 0.37, 5.4 $\pm$ 0.24 to 6.2 $\pm$ 0.37 and 5.8 $\pm$ 0.20 to 6.2 $\pm$ 0.20 respectively for the quail meat patties stored at 5°C irrespective of the days of storage. The scores for different organoleptic parameters were not found to be significant statistically.

The scores for flavour, juiciness, tenderness and overall acceptability were not found to be significantly different at -15°C irrespective of the days of storage. The scores ranged from 5.2 $\pm$ 0.66 to 6.8 $\pm$ 0.20, 5.2 $\pm$ 0.20 to 6.2 $\pm$ 0.37, 5.4 $\pm$ 0.24 to 6.2 $\pm$ 0.37 and 5.4 $\pm$ 0.20 to 6.2 $\pm$ 0.20 for flavour, juiciness, tenderness and overall acceptability respectively.

Table 7. Organoleptic scores of cooked quail patties as influenced by period of storage and temperature

Storage temperature	Days of storage	Flavour	Juiciness	Tenderness	Overall acceptability
	0	6.8±0.20	6.2±0.37	6.2±0.37	6.2±0.20
5°C	4	6.4±0.39	5.4±0.39	5.8±0.20	6.0±0.00
	6	6.0±0.32	5.4±0.24	5.4±0.24	5.8±0.20
	0	6.8±0.20	6.2±0.37	6.2±0.37	6.2±0.20
	15	5.4±0.39	6.2±0.37	5.8±0.37	5.8±0.20
-15°C	30	6.0±0.45	5.6±0.39	5.8±0.58	5.9±0.24
	45	5.2±0.66	5.8±0.37	5.6±0.24	5.4±0.37
	60	5.6±0.51	5.2±0.20	5.4±0.24	5.4±0.20

Yield per gramme of meat

The number of quail meat patties prepared from one kilogramme of deboned quail meat was worked out. From each kilogramme of deboned minced meat, 12 quail meat patties of 100 g each could be prepared.

Cost structure of ready-to-cook quail meat patties

The cost structure for the preparation of ready-to-cook quail meat patties was calculated and presented in Table 9. The calculation was based on the costs of deboned quail meat and total additives. Accordingly, the cost worked out to Rs.7.84 per each quail meat patty.

Table 8. Calculation of cost structure of quail meat patties prepared as per the recipe

Ingredients	Weight (g)	Cost (Rs.)
Deboned quail meat	1000	90.00
Total additives	200	4.08
Total	1200	94.08
One quail patty	100	7.84

Discussion

DISCUSSION

The results of the study conducted with Japanese quails to determine the feasibility of using deboned quail meat for the preparation of quail meat patties are discussed below.

Meat yields and losses

The mean per cent eviscerated, giblet, and ready-to-cook yield of Japanese quails used for the study were 62.57 ± 0.51, 6.63 ± 0.13 and 69.20 ± 0.45 respectively (Table 3).

Body conformation of bird (Jaap and Penquite, 1938); the previous nutritional status of the bird (Harkin et al., 1960) and sex, age, strain (Fry et al., 1962) are known to influence yield percentage.

Amon et al. (1970) reported that the ready-to-cook yield averaged 71 per cent for Bob White quails at 18 weeks of age. The authors also reported that the yield was similar for birds of both sexes. It was reported that the ready-to-cook yield increased from 10 to 18 weeks of age averaging 71 per cent (Dawson et al., 1971). Pandey et al. (1979) studied the effect of pre-slaughter characteristics of Japanese quails at

five weeks of age and reported that the eviscerated and giblet percentages averaged 65.97 ± 0.39 and 5.66 ± 0.10 respectively. Experiments were conducted to study the slaughter characteristics of Japanese quails at different stages of growth and reported that the mean per cent eviscerated yield and giblet were 65.0 ± 0.83 and 6.1 ± 0.13 respectively for the quails aged eight weeks (Singh et al., 1980). Shrivastava and Panda (1982) reported that the eviscerated and giblet yield ranged from 65.2 to 66.0 and 7.2 to 7.5 percentages respectively for the quails of five weeks of age. Choudhary and Mahadevan (1983) reported that the eviscerated yield averaged 61.48 ± 0.36 per cent in Japanese quails at six weeks of age. The per cent evisceration and giblet averaged 65.60 ± 0.33 and 7.05 ± 0.12 respectively for the Japanese quails of both sex at five weeks of age (Anon, 1985). Singh and Panda (1985) observed that the percentage evisceration yield averaged 67.66 ± 0.84 for the quails at six weeks of age. It was reported that the percentage dressed and giblet weight ranged from 60 to 65 and 5 to 6 respectively for the Japanese quails at six weeks (Sreenivasaiah et al., 1985). Panda (1986) observed that the ready-to-cook percentage in quails aged five to eight weeks varied from 70-75. The findings of the present study is fairly in agreement with that of the above authors.

The mean per cent losses of blood, feathers, inedible offal and total loss were also determined during the processing of Japanese quails (Table 3). The mean per cent losses due to the blood (3.62 ± 0.13), feathers (3.72 ± 0.13), inedible offal (23.46 ± 0.48) and total loss (30.80 ± 0.45) obtained in this study are within the range reported in the literature. Pandey et al. (1979) reported that the mean per cent loss due to blood, feather and inedible offal were 2.51 ± 0.17, 5.68 ± 0.24 and 19.66 ± 0.39 respectively in Japanese quails at five weeks of age. Choudhary and Mahadevan (1983) reported the per cent loss of blood amounted to 4.93 ± 0.14 in Japanese quails at six weeks of age. It was reported that the per cent blood and feather averaged 3.95 ± 0.10 and 4.65 ± 0.22 respectively for the Japanese quails for both sexes at five weeks of age (Anon, 1985). The values obtained in the present study for blood, feather and inedible offal are fairly in agreement with those reported by the above authors. Singh et al. (1980) reported that the mean per cent total offal was 28.6 ± 1.25. Shrivastava and Panda (1982) observed that the total offal percentage ranged from 26.1 to 28.1 in Japanese quails at five weeks of age. Choudhary and Mahadevan (1983) reported that the total offal for female Japanese quails at six weeks of age amounted to 30.92 ± 0.35 which is in close agreement with that obtained in the present study indicating that Japanese quails can be effectively utilised at this age

in order to reduce the economic loss in terms of processing loss.

Meat to bone ratio

The meat to bone ratio obtained in this study averaged 2.04 ± 0.03 (Table 3). Singh et al. (1981) reported that the meat to bone averaged 2.6 ± 0.8 in quails at five weeks of age. The value obtained in the present study for the meat to bone ratio is in close agreement with that reported by Narayanankutty and Ramakrishnan (1989) for the Japanese quails slaughtered at five and six weeks of age.

Quality characteristics and shelf-life of quail meat patties

Proximate composition

The proximate components of quail meat patties prepared as per the recipe revealed that the mean per cent moisture, protein, fat and total ash ranged from, 71.58 ± 0.55 to 72.47 ± 0.47, 16.46 ± 0.43 to 17.25 ± 0.31, 5.87 ± 0.09 to 6.03 ± 0.15 and 4.19 ± 0.45 to 4.64 ± 0.11 respectively (Table 4). These values are almost in agreement with those reported by Varadarajulu (1973) for poultry meat, Cunningham and Bowers (1977) for chicken patties, Hollender et al. (1978) for chicken patties, Narayanankutty et al. (1983) for chicken

steak, Lyon et al. (1988), Thind et al. (1988) for chicken patties and Rejikumar et al. (1991 a,b) for chicken meat balls.

The data showed that the proximate composition of quail meat patties prepared using the recipe was not altered either by the two different storage temperatures employed in the study or by the duration of storage under the above temperature regimen. Rejikumar et al. (1991 a,b) in their study with chicken meat balls observed that no appreciable changes occurred in the proximate composition of the product stored at 5°C for six days and at -15°C for 60 days.

Rancidity

The thiobarbituric acid (TBA) numbers of quail meat patties ranged from 0.20 ± 0.03 to 0.21 ± 0.02 at 5°C and 0.20 ± 0.03 to 0.37 ± 0.01 at -15°C. At 5°C the TBA numbers remained unaltered at zero and fourth day of storage but slightly increased at sixth day of storage. The statistical analyses revealed that the TBA number of quail meat patties was not influenced by the duration of storage at 5°C upto 6 days. An increase in TBA numbers was observed with increase in duration of storage at -15°C. The statistical analysis revealed that the TBA number of the product was influenced by the storage periods under frozen storage.The effect of storage

of quail meat patties on the fatty oxidation under deep freezing condition seemed to be in appreciable on 15th day of storage. Thereafter, there was a slight but significant ($P<0.05$) increase in the oxidation of fat even at -15°C. The present findings however, indicated that even at fairly low temperature (-15°C) the fat in the meat product was not totally resistant to oxidative rancidity as evidenced by increased TBA number.

Keskinel et al. (1964) observed a similar effect of storage on the fatty oxidation in minced meat. Even at fairly low temperature (-29°C) of storage, Froning (1973) found increased oxidation of fat as the storage period was increased. Dawson (1975) achieved a control in the lipid oxidation in minced meat by employing low temperature storage. It was assumed by Dawson et al. (1975) that the TBA values above 2.00 may be associated with the development of rancidity in meat sample. Lyon et al. (1978) reported that the TBA values ranged from 0.31 to 0.85 for the chicken patties stored at -40°C. Narayanankutty et al. (1983) observed that in chicken steak the TBA numbers increased with increase in the length of storage at 5°C and at -15°C the chicken steaks remained unaffected with regard to TBA number. Hollender et al. (1987) reported that the TBA values of chicken patties generally increased during storage period. Anand et al.

(1991) conducted studies on chicken patties stored at -18°C and observed that the TBA values averaged 0.28 ± 0.07, 0.35 ± 0.04, 0.38 ± 0.02, 0.43 ± 0.01 and 0.42 ± 0.04 respectively for zero, 15, 30, 45 and 60 days of storage. Rejikumar et al. (1991 a,b) reported that the TBA values, increased with each incremental storage period under refrigeration and frozen storage in chicken meat balls.

In the context of the above, it appears that although the TBA number recorded a slight but significant ($P<0.05$) increase at storage temperature of -15°C, there might not be any deterioration in the quality of quail meat patties upto 60 days so far as the organoleptic or nutritional aspects are concerned.

The findings in the present study which indicate an increase in the TBA number during storage agrees with those reported by Keskinel et al. (1964), Froning (1973), Lyon et al. (1978), Narayanankutty et al. (1983), Hollender et al. (1987), Anand et al. (1991) and Rejikumar et al. (1991 a,b).

Total bacterial count

Storage of quail meat patties at 5°C influenced the total bacterial counts which differed from storage of the same at -15°C. The counts increased at refrigeration temperature (5°C) with length of storage. At -15°C the opposite effect was

evident. The increase in total bacterial count under refrigeration condition (5°C) was also reported by Baker et al. (1967), Narayanankutty et al. (1983) and Rejikumar et al. (1991 a,b). Similarly, it has been reported by many research workers (Baker et al. (1967), Hasiak and Baker (1968), Ostowar and MacNeil (1971), Maxcy (1973), Sahoo (1973), Froning (1976), Narayanankutty et al. (1983), Anand et al. (1991) and Rejikumar et al. (1991 a,b)) that the storage at -15°C or lower temperatures helped to reduce the bacterial count in the product and thus aid to maintain its quality for longer periods.

Maxcy et al. (1973) reported that the normal range of total bacterial counts of fresh deboned meat ranged from 10×10^4 to 10×10^5 per gramme of meat. A value of 7.80×10^5 C.F.U./g of sample obtained in the present study (Table 6) for total bacterial counts of freshly prepared quail meat patties is in close agreement with that reported by earlier workers.

The trend of the observation of this study is in close agreement with those reported by Baker et al. (1967), Ostowar and Macneil (1971), Sahoo (1973), Froning (1976), Cunningham and Bowers (1977), Narayanankutty et al. (1983), Anand et al. (1990) and Rejikumar et al. (1991 a,b).

Organoleptic evaluation of cooked quail meat patties

The taste panel preferences of the quail meat patties prepared as per the recipe were evaluated in terms of flavour, juiciness, tenderness and overall acceptability (Table 7).

The present study revealed that the overall acceptability of the product was not found to be different statistically at different storage temperatures for varying periods. The judges opined that quail meat patties prepared as per the recipe were quite acceptable with regard to flavour juiciness, tenderness and overall preference.

The present study revealed that a highly acceptable and nutritious quail meat product viz., quail meat patties could be prepared from deboned minced meat of spent Japanese quails and stored upto six days at 5°C and upto 60 days at -15°C without any quality deterioration.

Hasiak and Baker (1968) could store the chicken steak well for seven to ten days under refrigeration storage and for three weeks under frozen storage. Narayanankutty et al. (1983) developed chicken steaks using two recipes from the deboned minced meat of spent broiler breeder hens and reported that the optimum condition for its long term storage was -15°C at which temperature the product could be held upto three months without any quality deterioration. Kondaiah et al.

(1988) could store chicken sausage developed from spent hens at -10°C without any quality deterioration, Anand et al. (1991) studied the shelf-life of chicken patties and reported that the product could be stored upto 150 days at -180°C. Rejikumar et al. (1991 a,b) conducted studies on chicken meat balls developed from deboned minced broiler chicken meat and reported that the product could be held upto four days at 5°C and upto two months at -15°C without causing any quality deterioration. The findings of the present study is in close agreement with those reported by above workers with regard to the shelf-life of the product.

Cost of ready-to-cook quail meat patties

The cost structure of Rs.7.84 per quail meat patties eventhough may appear on the higher side when considered in the light of its nutritive value and the convenience of using quail meat in an acceptable form is justifiable. Further, with improved innovation in the technology of quail management for producing cheaper quails and use of large scale operations in the preparation of quail meat patties the cost is likely to go lower.

Summary

SUMMARY

An experiment was designed and conducted to evaluate the feasibility of preparing quail meat patties from deboned minced meat of Japanese quails by using a recipe, to suit Indian palate and to study the nutritional characteristics, keeping quality conditions of storage without deterioration of quality and overall acceptability of the product.

Japanese quails of 25 weeks age were used in the study. Data on processing yields, losses and meat to bone ratio were collected from all the quails. Deboned minced meat from these quails was used for the preparation of the quail meat patties. The product prepared as per the recipe was stored under refrigeration (5°C) and frozen (-15°C) temperatures until further analysed for quality parameters or tested by a panel for organoleptic evaluation. The quail meat patties were withdrawn from the refrigerator at zero, four and six and from the freezer at zero, 15, 30, 45 and 60 days of storage. The shelf-life of the product in terms of the quality parameters viz., proximate composition, oxidative rancidity, total bacterial count and organoleptic evaluation was studied at each stage of storage period and temperature. The total number of quail meat patties prepared from one kilogramme

deboned minced quail meat and its cost structure were also calculated.

The following observations were made in this investigation.

1. It was observed that the eviscerated, giblet and ready-to-cook yields averaged 62.57± 0.51, 6.63 ± 0.13 and 69.20 ± 0.45 per cent respectively. the loss due to blood, feather and inedible offal averaged 3.62 ± 0.13, 3.72 ± 0.13 and 23.46 ± 0.48 per cent respectively. The total loss was found to average 30.80 ± 0.45 percentage.

2. The meat to bone ratio in Japanese quails averaged 2.04 ± 0.03.

3. The proximate components of the product were not influenced by the different storage temperatures and periods employed in the study. The proximate composition remained unaltered at refrigeration and deep freezing temperatures and periods of storage. The chemical composition of the product was found to agree with the reported values for the poultry meat and meat products.

4. At refrigeration temperature (5°C) the quail meat patties remained almost unaffected in respect to TBA values but at deep freezing temperature (-15°C) the TBA values were

found to be increased significantly with each incremental storage period.

5. The total bacterial count per gramme of the product increased significantly for each period of storage under refrigeration temperature and under frozen condition the opposite effect was found.

6. The organoleptic evaluation of cooked quail meat patties prepared as per the recipe and stored at two different temperatures for different storage periods revealed that the product was quite acceptable. The organoleptic evaluation revealed that the product could be stored upto six days at 5°C and upto 60 days at -15°C without any loss in quality.

7. It was found that from each one kg deboned minced quail meat, 12 quail meat patties of 100 g each could be made as per the recipe.

8. The cost structure revealed that cost of each quail meat patty prepared as per the recipe was Rs.7.84.

On the basis of the above findings it was concluded that a highly acceptable quail meat product in the form of quail meat patties could be prepared from deboned minced quail meat. At 5°C, the product could be stored upto six days

without any loss of quality. The optimal condition for its long term storage was determined to be -15°C. At this temperature the quail meat patties could be held upto two months without any qualitative changes or deterioration.

Plate 1. Moulding patties in glass petri dishes

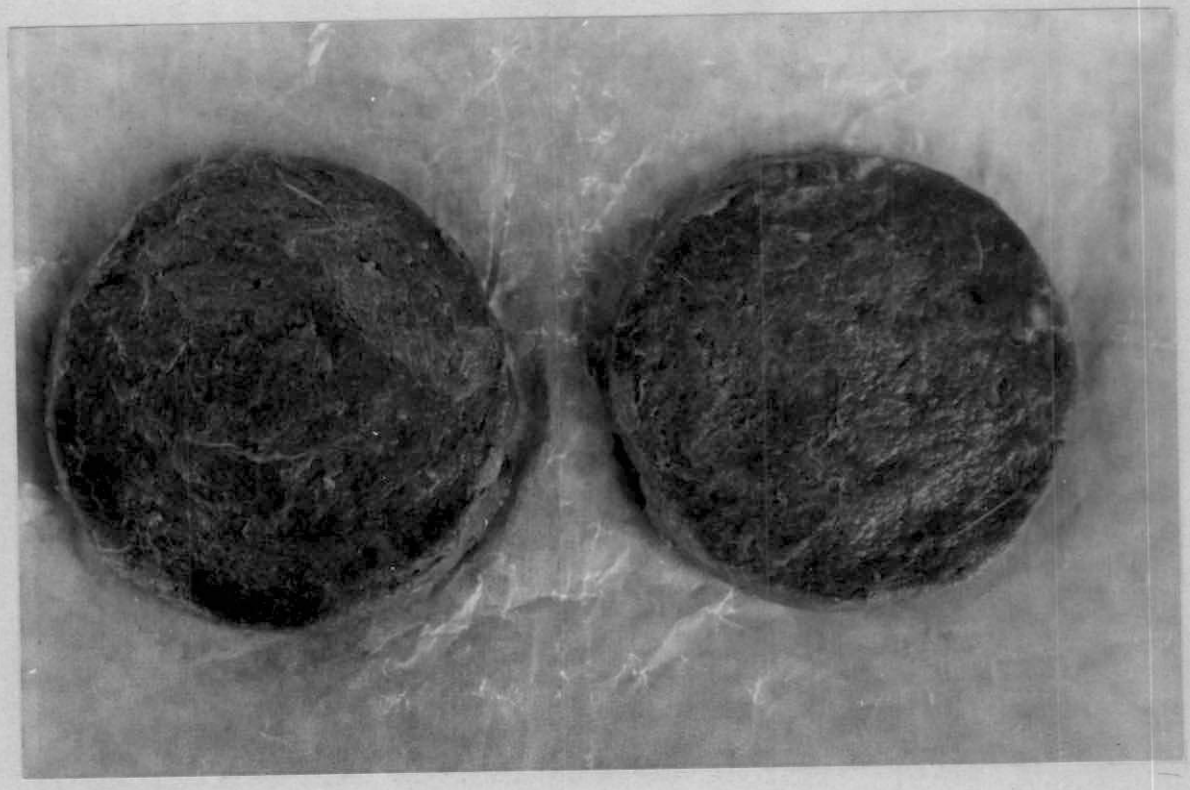


Plate 2. Ready-to-cook patties

Plate 3. Ready-to-eat patties

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ABSTRACT

A study was conducted to examine the feasibility of formulation of quail meat patties from deboned minced meat of Japanese quails and to evaluate its shelf-life.

The ready-to-cook yield, total loss and meat to bone ratio averaged 69.11 $\pm$ 0.45, 30.80 $\pm$ 0.45 and 2.04 $\pm$ 0.03 per cent respectively for quails (25 weeks of age) used for the study.

The quail meat patties prepared as per the recipe was kept at 5°C for six days and at -15°C upto 60 days. Representative samples were analysed qualitatively and evaluated organoleptically by a taste panel on zero, four and six days under refrigeration (5°C) and zero, 15, 30, 45 and 60 days of storage under frozen condition (-15°C). It was found that irrespective of different temperatures and duration of storage the proximate components viz., moisture, protein, fat and total ash of the product remained unaltered. The thiobarbituric acid (TBA) number remained unaffected at 5°C irrespective of different days of storage. At -15°C the TBA number increased as the storage period increased. The total bacterial count increased at 5°C and decreased significantly $P<0.01$) at -15°C with increase in the duration of storage. The

quail meat patties prepared as per the recipe was found to be well acceptable organoleptically. It was observed that 12 quail meat patties could be made from each kg of deboned minced quail meat. The cost of a quail meat patty weighing 100 g was found to be Rs.7.84.

From the above findings it was concluded that a highly acceptable, nutritious, ready-to-cook quail meat product could be prepared from deboned minced quail meat. Under refrigeration (5°C) and frozen (-15°C) conditions the product could be stored upto six and 60 days respectively without any quality deterioration or consumer acceptance of the product.