FORMULATION AND QUALITY EVALUATION OF CHICKEN MEAT BALLS

By

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THESIS

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Faculty of Veterinary and Animal Sciences
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Department of Poultry Science
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DECLARATION

I hereby declare that this thesis entitled "FORMULATION AND QUALITY EVALUATION OF CHICKEN MEAT BALLS" 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.

Mannuthy
30-8-1991

T.P. REJIKUMAR

CERTIFICATE

Certified that this thesis, entitled "FORMULATION AND QUALITY EVALUATION OF CHICKEN MEAT BALLS" is a record of research work done independently by Sri. T.P. Rejikumar under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

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Dedicated to

My Parents and (late) Pāppa

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INTRODUCTION

Poultry production in India has taken the shape of an industry in a very short span of time. Till the late 70's production of eggs was the major activity, rearing chicken exclusively for meat was almost non-existent. Spent hens and cockerels constituted the source of chicken meat. With the introduction of chicken broilers, chicken developed exclusively for meat, the quantum jump made by this sector of poultry production has been phenomenal. The broiler production which was only four million in 1971 rose to 168 million in 1988 and is expected to reach a level of 1200 million by the turn of this century (Anon., 1990). This spectacular development is essentially due to two factors viz., the shorter time to harvest a crop and the comparatively lower cost of broiler meat compared to other meat sources like mutton, chevon, pork and fish.

If the tempo of development is to be sustained it becomes necessary that attention is given to value added products so that the producer is able to get remunerative price for the product-broiler chicken. The possibilities for this are vast because of changes in the socio-economic conditions of the society, especially in urban areas, where both the husband and wife are employed. Therefore, any method that will help to reduce the drudgery in kitchen will be welcomed by house-wives. It is at this point further-processed produce like ready-to-cook or ready-

to eat or fast-foods have relevance. Poultry produce, particularly from broilers, fit in well with the demand of the new generation for quality and hygienic chicken delicacies in a handy and convenient pack. Further-processed poultry produces are reputed for their uniformity, high quality and hence have gained wide consumer acceptance.

Although, the recent periods have witnessed a phenomenal increase in poultry production in India, the consumption of egg or poultry meat has not very greatly increased or atleast to the expectation of planners. The per capita availability of poultry meat in India is only 354 g as compared to 2.5 kg for the developing countries and 15.6 kg for the developed countries (Anon., 1990). One of the reasons for the low consumption may be the lack of a range of convenience food items. Therefore, the development of such foods from poultry meat would probably lead to an increase in the 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.

In developed countries numerous preparations from chicken meat are commercially available. However, those recipes which are popular in western countries may not be readily acceptable in our country. A few products like chicken kabab, chicken tandoori are already popular in India. In order to have a range of

products such that the consumer can pick and choose according to his requirement, it is necessary that newer products are developed and their commercial suitability is studied.

The present study, therefore, is an attempt in this direction. The investigation is aimed to examine the feasibility of preparing a ready-to-cook poultry meat product namely, chicken meat balls, from deboned meat of broiler chicken by using two recipes to suit the Indian palate and to evaluate the consumer acceptability, nutritional characteristics and 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 broilers and examination of various characteristics of the product including shelf-life under two different 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 the broilers. The following is a brief review of the more recent and relevant literature on the above aspects.

Meat yield and losses

The net yield of meat from processed poultry is reported to be related to a variety of factors such as the 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). The meat yield and processing loss of chicken have been reported by many workers (Table 1). It is evident from these data that the dressing yields expressed as per cent of live weight ranged from 61.12 to 77.10. The higher values (above 70 per cent) are usually reported with commercial broilers.

Table 1. Summary of the mean per cent yield and losses of blood, feathers and inedible offals in different breeds and age group of chicken

Breed/strain/age group	Yield (%)	Dressing losses (%)			Reference
		Blood	Feather	Inedible offal	
Broilers	66 to 76	3.5 to 4.5	4.5 to 7.5	-	Jull (1951)
Arbor Acre broilers					
Male	71.08	4.44	4.33	20.16	Mathur and Ahmed (1968)
Female	71.13	4.23	5.86	18.78	
White Rocks (13 weeks of age)	64.18 to 64.69	-	-	-	Prabhakaran and Ranganathan (1971)
Desi (6 to 15 months of age)					
Male	76.10	3.50	8.30	15.40	Souri et al. (1972)
Female	75.00	3.60	8.60	16.20	
Mixed	76.00	3.60	8.40	15.50	
Broilers (8 weeks of age)					
Male	72.04	-	-	-	Hayse and Marion (1973)
Female	70.08				
Broilers:					
8 weeks of age	77.10	-	-	-	Singh and Essary (1975)
10 weeks of age	76.30	-	-	-	
Hubbard broilers of 10 weeks of age	69.80 to 70.80	-	-	-	Tan et al. (1975)

Loss of blood from poultry consequent to dressing ranges from 3.5 to 4.5 per cent approximately and that of feathers from 4.5 to 7.5 per cent. The inedible offals constitute 18 to 20 per cent approximately.

Simpson and Goodwin (1979) reported that the weight of broilers averaged 1010 and 1130 g for females and males respectively.

Narayanankutty et al. (1982) conducted studies on the processing yields and losses in spent hens of White Rock and White Cornish breeds aged between 18 and 24 months and reported that the per cent ready-to-cook yield ranged from 71.13±1.20 to 76.92±0.18.

A quality comparison of meat from different types of chicken was carried out and data on meat yield and yield of different cut-up parts of spent hens, cocks, broilers and White Leghorn male chicks grown upto 12 and 14 weeks of age were reported (Kutty et al., 1983b). In the above study it was observed that the per cent ready-to-cook yield of broilers averaged 67.0 and eviscerated yield averaged 62.0 per cent.

Shyam Sunder et al. (1988) studied the conformation, carcass characteristics and yield of purebred broilers and obtained live

weight (g), shrinkage, eviscerated yield, total yield, blood, feathers, offal and total loss (per cent) ranging from 1065 to 1225, 3.61 to 6.99, 65.74 to 67.94, 70.80 to 73.64, 3.94 to 4.88, 6.82 to 8.58, 13.51 to 16.78 and 16.80 to 29.20 respectively.

Meat to bone ratio

Hayse and Marion (1973) determined the meat to bone ratio for whole broiler carcass as 2.43 for males and 2.71 for females.

Wahid et al. (1974) reported that the meat to bone ratio was highest in White Cornish pure bred females and White Cornish x New Hampshire crossbred (WC x NH) females and lowest in White Rock purebred males and New Hampshire purebred males. They also observed that in different crosses, the females had an average meat to bone ratio of 2.55 and the males a mean of 2.35.

The meat to bone ratios in the same breed of broilers varied from 2.50 to 2.98 in one experiment and from 2.41 to 2.95 in another experiment conducted by Rao (1975).

Narayanankutty et al. (1982) in their studies with spent hens of White Rock and White Cornish breeds aged between 18 and 24 months reported that the meat to bone ratio ranged from 2.35 ± 0.04 to 2.49 ± 0.03.

In a study conducted by Kutty et al. (1983b)on the quality comparison of meat from different types of chicken it was reported that the meat to bone ratio of spent hens, cocks, broilers and White Leghorn male chicks grown upto 12 and 14 weeks of age averaged 1.83,1.90, 1.53, 1.50 and 1.65 respectively.

Comparing the meat to bone ratio of spent hens v/s spent ducks, Kutty et al. (1983a)reported that ratio averaged 1.83 and 1.79 respectively.

Chicken meat products and their shelf-life

There is hardly any report on the preparation of chicken meat balls from deboned minced meat of broilers. Perusal of the literature on poultry product technology reveals gaps in our knowledge in respect of many new marketable deboned minced chicken meat products which suit Indian palate. Various chicken products were developed and marketed profitably in super markets 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. Studies on the preparation of poultry pickle and its shelf-life were carried out by Chatterjee et al. (1969). They could handle, transport and store the pickle for a few months in ambient temperature without any appreciable loss of quality.

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

Narayanankutty et al. (1983) developed chicken steak using two recipes, from deboned minced meat of broilers and reported that highly acceptable product in the form of chicken steak could be prepared. The workers 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 sausage production and reported that the sausages 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.

Quality Characteristics of Chicken Meat and its Products

Proximate composition

Harshaw (1942) found that the edible portions of the fowl contained 19.9 per cent protein. The age, sex and species of poultry besides the parts of the carcass from which meat is taken are reported to influence the fat content considerably (Mecchi et al., 1956).

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

Chatterjee et al. (1969) reported that poultry pickle contained 53.20 per cent moisture, 24.35 per cent protein and 4.14 per cent fat.

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

Moisture, protein, fat and ash contents of deboned chicken meat stored at 5°C for zero, four and seven days and at -15°C for zero to 90 days at 15 days interval were determined (Narayanankutty, 1979). It was observed that there was no change in the proximate composition of chicken meat stored at 5°C for seven days and at -15°C for 90 days. Irrespective of storage temperature and duration, moisture ranged from 71 to 74, protein from 16.61 to 17.17, fat from 4.25 to 5.01 and total ash from 0.95 to 1.14 per cent.

Chiang and Brekke (1982) in their studies on the formulation and storage stability of fabricated breakfast strip utilizing fowl meat found that raw breakfast strip contained 60.02, 20.28, 16.37 and 3.25 per cent of moisture, protein, fat and total ash respectively.

Narayanankutty et al. (1983) conducted studies on chicken steak and reported that the 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 recipes, 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.

Marion and Peterson (1987) reported that the moisture, crude protein, ether extract and ash per cent varied from 64.50 to 66.44, 17.18 to 18.69, 13.18 to 15.42 and 2.08 to 3.10 respectively in broiler meat.

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

Rancidity

The 2-thiobarbituric acid number (TBA number) in meat samples 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 the 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.

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. 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 seven to ten days under refrigeration storage and at least three weeks in the 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) that the TBA values above two may be associated with the development of rancidity in meat samples.

Chiang and Brekke (1982) in their studies with spent fowl observed TBA numbers of 0.5 at 3.7°C upto three days of storage and a value of 1.2 at the same temperature upto 42 days of storage. Authors also reported a TBA number of 0.62 under frozen storage initially and the same was increased during first three weeks (1.00) and decreased slightly thereafter (0.90).

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.

Whang and Peng (1987) in their studies with turkey meat observed that ground thigh of turkey developed significantly higher TBA values than its skin and breast during storage at 4°C for upto eight days. During frozen storage (-20°C) for upto 30 days, TBA values remained low and constant (less than 1.0).

Lyon et al. (1988) prepared chicken patties from white and dark meat, precooked and stored for zero, one, two or three days at 4°C and then frozen at -34°C until evaluated. They 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 spent hen breast meat. The results indicated that TBA values of precooked meat were higher than that for the raw meat. It was suggested that cooked meat will be acceptable upto eight days under refrigeration and upto two months under frozen conditions.

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. Freezing for three days at -15°F prior to refrigeration at 35°F had only a slight advantage in storage as far as bacterial counts were concerned. 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 10×10^4 to 10×10^5 per gramme (Maxcy 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 immediate freezing. Repeated freezing and thawing had a drastic killing effect on vegetative forms of micro-organisms.

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

Varadarajulu et al. (1974) observed that the total aerobic micro-organisms ranged from 3.2×10^3 to $9.6 \times 10^3/cm^2$ on poultry carcasses after evisceration and washing.

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 twelve. 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 were never greater than 10^4 and total count per gramme ranged from 9×10^3 to 7×10^6 after 10 days of storage at 3°C.

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.

In muscles stored at 6°C, total colony forming units were found to increase from 10^4 to 10^7 after four days of storage (Sklan and Tenne, 1984). During storage at 0°C, colony forming units approached 10^7 after 16 days of storage at which time 88 per cent of the sample were organoleptically rejected.

It was reported that the total aerobic count (log/g) were 5.0 ± 0.08, 5.1 ± 0.19, 5.6 ± 0.08, 5.3 ± 0.17, 6.4 ± 0.14 and 6.6 ± 0.20 during zero, three, five, seven, 10 and 12 days of storage respectively for chicken sausages prepared from spent hens, and stored at 5 ± 1°C (Kondaiah et al., 1988).

Microbiological studies were carried out 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 reported total counts of 5.45, 5.85 and 6.69 log/g during storage periods of two, four and six days respectively.

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 chicken meat balls from deboned minced meat of broiler chicken and to study the nutritional characteristics, keeping quality and overall acceptability of the product.

Commercial broilers of eight weeks of age were used in the study. Data on meat yield, losses and meat to bone ratio were collected from 19 broilers. Deboned minced meat from these broilers was used for the preparation of chicken meat balls.

Meat yield and losses

The broilers were slaughtered and dressed as per procedure described by Indian Standard Institute (ISI, 1973). After recording the live weight, the birds were bled by severing the jugular vein at the occipito-atlantus joint to effect complete bleeding. After killing, one minute time was allowed for bleeding. The birds were weighed again and the difference between the two weights was considered as the weight of blood. Scalding was done at 60°C for about one minute. A mechanical poultry feather-picker was used for defeathering and the left-

over feathers were removed manually. The pin feathers were removed using a pinning knife. After pinning, the body hairs were removed by singeing. The weight of feathers was arrived at as difference between the weight of bird after bleeding and weight of defeathered bird. The head and shanks were removed and the birds were then eviscerated manually. Eviscerated and giblet weights were recorded and using these data the per cent yields and losses were calculated as follows:

$$\text{Blood loss, (\%)} = \frac{\text{Weight of bird Before slaughter} - \text{Weight of bird after slaughter}}{\text{Live weight}} \times 100$$

$$\text{Feather loss, (\%)} = \frac{\text{Weight of bird after bleeding} - \text{Weight of defeathered bird}}{\text{Live weight}} \times 100$$

$$\text{Inedible offal, (\%)} = \frac{\text{Live weight} - \text{Eviscerated weight + giblet}}{\text{Live weight}} \times 100$$

$$\text{Total loss, (\%)} = \text{Blood loss (\%)} + \text{feather loss (\%)} + \text{Inedible offal (\%)}$$

$$\text{Ready-to-cook yield, (\%)} = \frac{\text{Eviscerated weight + Giblet weight}}{\text{Live weight}} \times 100$$

Meat to bone ratio

Eviscerated birds were taken and 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 chicken meat balls

Deboned minced meat from the broilers was used for the preparation of chicken meat balls. Two recipes were developed for the chicken meat balls (Table 2) to suit Indian dietary tastes.

All the ingredients including the minced meat were added and mixed thoroughly and shaped into meat balls of approximately 2.5 cm diameter such that each ball weighed about 100 g. This constituted ready-to-cook chicken meat balls. The product thus prepared was stored under refrigeration (5°C) and frozen (-15°C) temperatures until further analysed for quality parameters or tested by panel for organoleptic evaluation after deep frying.

The chicken meat balls thus prepared as per the two recipes and stored were withdrawn from the refrigerator at zero, four and

Table 2. Chicken meat ball

Ingredients	Recipe I	Recipe II
Deboned minced chicken meat	1000 g	1000 g
Chopped and minced onion	60 g	60 g
Minced garlic	15 g	15 g
Egg white	50 ml	50 ml
Bread crumbs	100 g	100 g
Ground black pepper	10 g	10 g
Water	1/2 cup	1/2 cup
Salt	To taste	To taste
Red chilli powder	-	30 g
Minced ginger	-	10 g
Masala (Spices)	-	30 g
Monosodium glutamate	-	1 g

six days and from the freezer at zero, 15, 30, 45 and 60 days of storage. Representative samples in numbers of five each from each recipe for each storage temperature and withdrawal period were analysed for the quality parameters.

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 descibed by Dam et al. (1970) and were expressed as log count/g of sample.

Besides evaluating the product for the above parameters, organoleptic evaluations were also conducted after deep frying for eight minutes at 150°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 3.

Table 3. Score card for organoleptic evaluation

Name of the product :
Date of sampling :
Name of the panelist :
Score system used :

Point	Quality	Remarks
7	Excellent	Can think of no improvement
6	Very good	Enjoyed the product, very slight improvement may be made
5	Good	Enjoyed the product, minor improvements desirable
4	Fair	Improvements of important characters desirable
3	Poor	Moderately undesirable
2	Very poor	Highly undesirable
1	Undesirable	Cannot stand the product

Sample No.	Flavour	Juiciness	Tenderness	Overall acceptance

Any additional information desired to be recorded

The shelf-life of the product was studied in terms of oxidative rancidity, total bacterial counts, proximate analysis and organoleptic evaluations at each stage of storage period and storage temperature.

The total number of meat balls prepared from one kilogramme of meat was calculated and from this the yield per gramme of meat was also calculated.

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

Results obtained in the present study are briefly described in this section.

Meat yield and losses

The per cent ready-to-cook yield and total loss obtained during the processing of broilers used for the study are presented in table 4 and diagrammatically represented in Figure 1. The mean live weight was 1049.47 ± 17.29. The per cent ready-to-cook yield and total loss averaged 72.76 ± 0.71 and 27.24 ± 0.70 respectively. The components of total loss during processing of broilers were partitioned as loss of blood, feathers and inedible offal and the mean per cent contributions of the above were 3.42±0.40, 3.06±0.38 and 20.76±0.70 respectively (Fig.1).

Meat to bone ratio

The mean meat and bone yields in gramme were 321.97 and 245.78 respectively, resulting in a meat to bone ratio of 1.31 (Table 4). The per cent mean component yields of meat and bone of eviscerated broiler chicken are diagrammatically represented in Figure 2.

Table 4. Meat yield, losses and meat to bone ratio of chicken broilers of eight weeks of age

Mean live weight at the time of slaughter (g)	1049.47±17.29
Ready-to-cook yield (%)	72.76±0.71
Total loss (%)	27.24±0.70
Blood loss (%)	3.42±0.40
Feather loss (%)	3.06±0.38
Inedible offal (%)	20.76±0.70
Meat to bone ratio	1.31

FIG. 1. PERCENT MEAN COMPONENT YIELD AND LOSSES OF BROILER CHICKEN

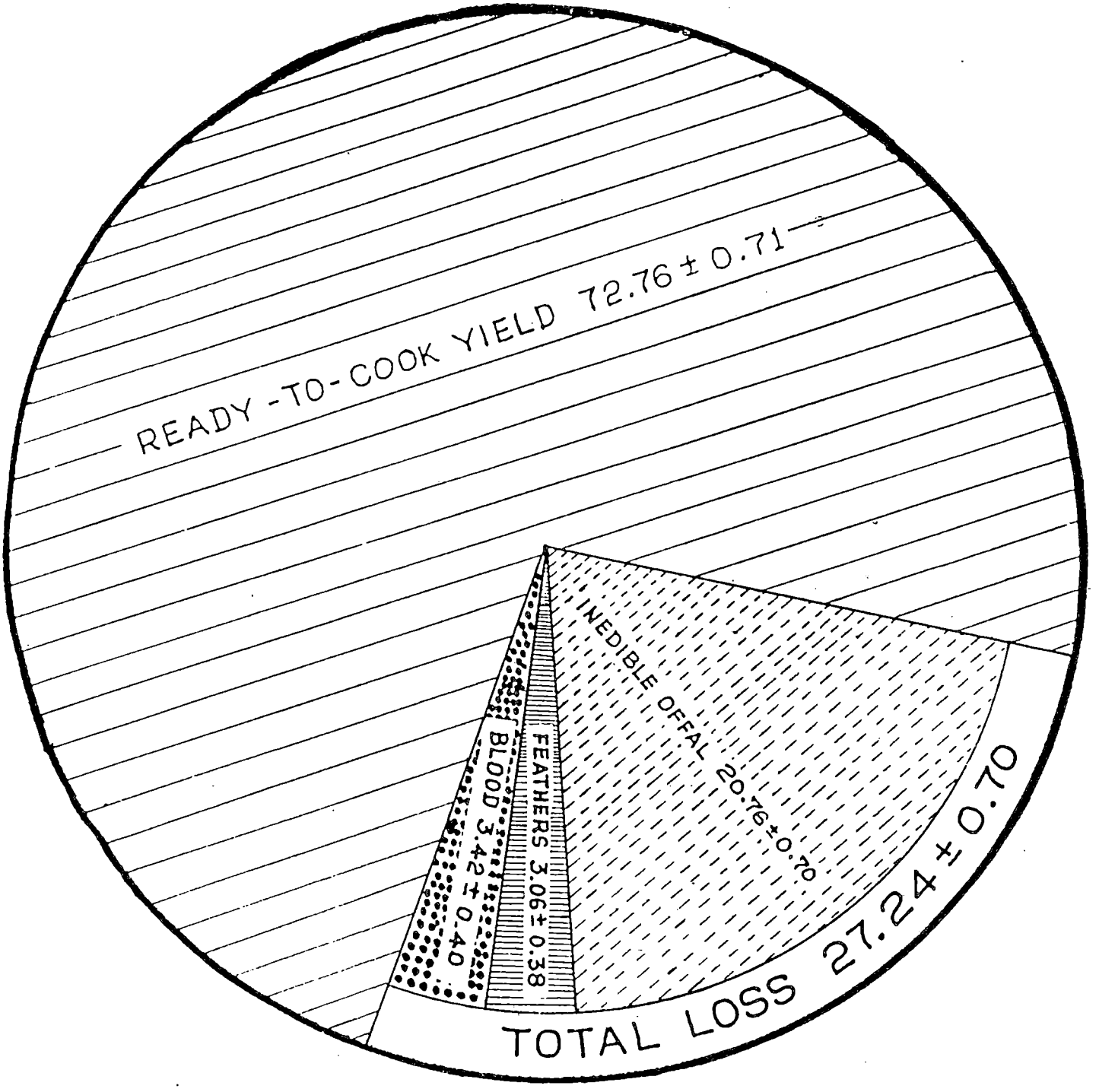
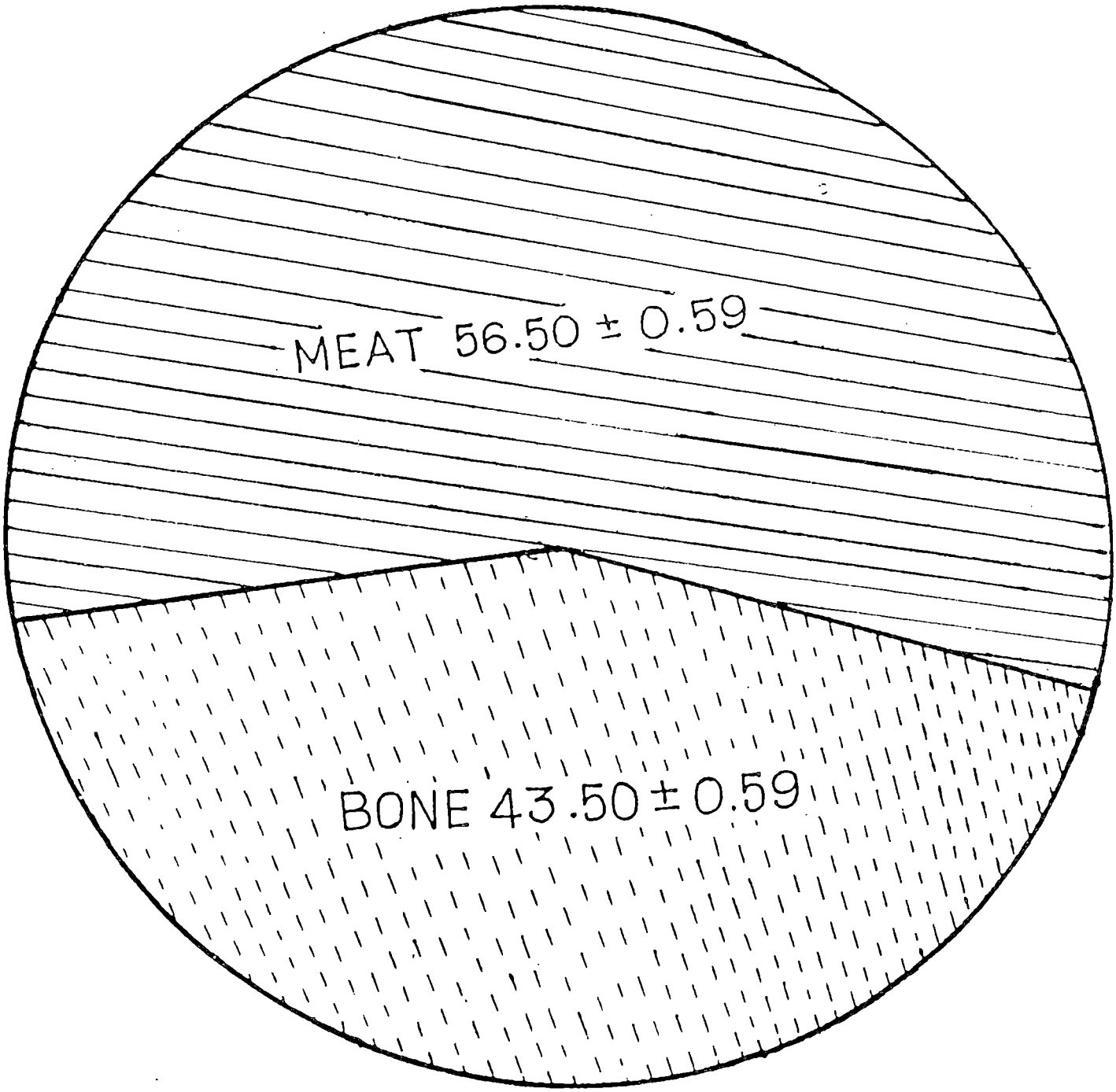


FIG. 2. PERCENT MEAN COMPONENT YIELD OF MEAT AND BONE OF EVISCERATED BROILER CHICKEN



Preparation and storage of chicken meat balls

Chicken meat balls were prepared from deboned minced chicken meat as per two recipes (Table 2). The product was kept at 5°C for zero, four and six days and at -15°C for zero to 60 days and samples were analysed qualitatively and organoleptically at different periods of storage at both the temperatures.

Quality Characteristics and Shelf-life of Chicken Meat Balls.

Proximate composition

The moisture, protein, fat and total ash contents of chicken meat balls prepared using two recipes and stored at 5°C for zero, four and six days and at -15°C for zero, 15, 30, 45 and 60 days were determined (Table 5). The proximate components of ready-to-cook chicken meat balls prepared as per the two recipes were not significantly affected either by storage time or temperature. Irrespective of the duration of storage, percent moisture ranged from 70.19 to 71.12 for the recipe I and for recipe II the values ranged from 68.65 to 69.56 at 5°C. At -15°C, the values ranged from 71.04 to 72.26 for recipe I and for recipe II, from 67.93 to 69.73 per cent .

Table 5. Influence of temperature and duration of storage on the proximate composition of ready-to-cook chicken meat balls

Storage temperature	Days of storage	Moisture (%)		Protein (%)		Fat (%)		Total ash (%)	
		Recipe I	Recipe II	Recipe I	Recipe II	Recipe I	Recipe II	Recipe I	Recipe II
	0	71.12±0.35	68.65±1.08	14.23±0.31	13.65±0.79	5.59±0.12	5.70±0.10	3.76±0.17	3.43±0.30
5°C	4	71.10±0.24	69.56±0.45	14.64±0.33	13.76±0.35	5.91±0.23	5.75±0.20	4.14±0.21	4.46±0.26
	6	70.19±0.53	69.53±0.45	15.12±0.34	14.33±0.39	5.95±0.54	5.37±0.18	4.20±0.38	4.07±0.21
	0	71.12±0.35	68.65±1.08	14.23±0.31	13.65±0.79	5.59±0.12	5.70±0.10	3.76±0.17	3.43±0.30
	15	71.04±1.21	67.93±1.18	15.21±0.53	14.46±0.24	5.90±0.16	5.93±0.16	3.91±0.14	4.16±0.20
-15°C	30	72.26±0.72	68.48±0.72	14.12±0.40	12.49±0.40	5.55±0.09	5.30±0.14	4.33±0.18	3.67±0.36
	45	72.12±0.30	69.10±1.03	14.04±0.12	13.21±0.40	5.79±0.06	5.47±0.10	3.64±0.43	4.09±0.16
	60	71.18±0.28	69.73±1.13	14.00±0.17	12.67±0.24	5.56±0.10	5.88±0.12	4.08±0.11	4.14±0.11

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

The per cent protein content of recipes I and II ranged from 14.23 to 15.12 and from 13.65 to 14.33 respectively, at 5°C irrespective of the duration of storage. At -15°C, the values ranged from 14.00 to 15.21 for recipe I and for recipe II, from 12.49 to 14.46, irrespective of the days of storage.

Under refrigeration storage (5°C) irrespective of the duration, percent fat content of recipes I and II ranged from 5.59 to 5.95 and from 5.37 to 5.75 respectively. Under frozen storage (-15°C) the values ranged from 5.55 to 5.90 and 5.30 to 5.93 for recipes I and II respectively.

Irrespective of the days of storage, total ash for recipes I and II ranged from 3.76 to 4.20 and from 3.43 to 4.46 percent respectively at 5°C, and at -15°C the values ranged from 3.64 to 4.33 and from 3.43 to 4.16 percent respectively.

Rancidity

The oxidative rancidity of fat in terms of mg malonaldehyde per kg of sample prepared as per the two recipes and stored at two different storage temperatures viz., 5°C and -15°C for varying periods was determined and is presented in Table 6.

Table 6. Influence of storage temperature and duration on oxidative rancidity of chicken meat balls

Storage temperature	Days of storage	TBA number (mg malonaldehyde /kg sample)	
		Recipe I	Recipe II
5°C	0	0.54 ± 0.01^{a}	0.58 ± 0.03^{a}
	4	0.80 ± 0.05^{b}	0.87 ± 0.04^{b}
	6	1.84 ± 0.09^{b}	1.58 ± 0.04^{b}
-15°C	0	0.54 ± 0.01^{a}	0.58 ± 0.03^{a}
	15	0.92 ± 0.01^{b}	0.89 ± 0.03^{b}
	30	0.93 ± 0.03^{b}	1.03 ± 0.03^{b}
	45	1.30 ± 0.02^{b}	1.01 ± 0.03^{b}
	60	1.21 ± 0.03^{b}	1.18 ± 0.03^{b}

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

The TBA numbers of chicken meat balls 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. Irrespective of the recipes, the TBA values were significantly higher ($P<0.05$) for those stored for four and six days at 5°C.

At -15°C, the TBA numbers of chicken meat balls prepared as per recipe I ranged from 0.54 to 1.30 and that for recipe II ranged from 0.58 to 1.18 during zero to 60 days of storage. Irrespective of the recipes, the differences in the TBA numbers between zero and any other days of storage were found to be significant ($P<0.05$).

The trend of changes in the TBA number during storage at two different temperatures is depicted in Fig. 3 and 4.

Total bacterial count

The total bacterial count of chicken meat balls prepared according to the two recipes and stored at different temperatures (5°C and -15°C) and periods is presented in Table 7.

The total bacterial load of the refrigerated products increased with the duration of storage and the increase in counts was significant statistically ($P<0.05$). On the other hand, when

OF CHICKEN MEAT BALLS STORED AT -5°C

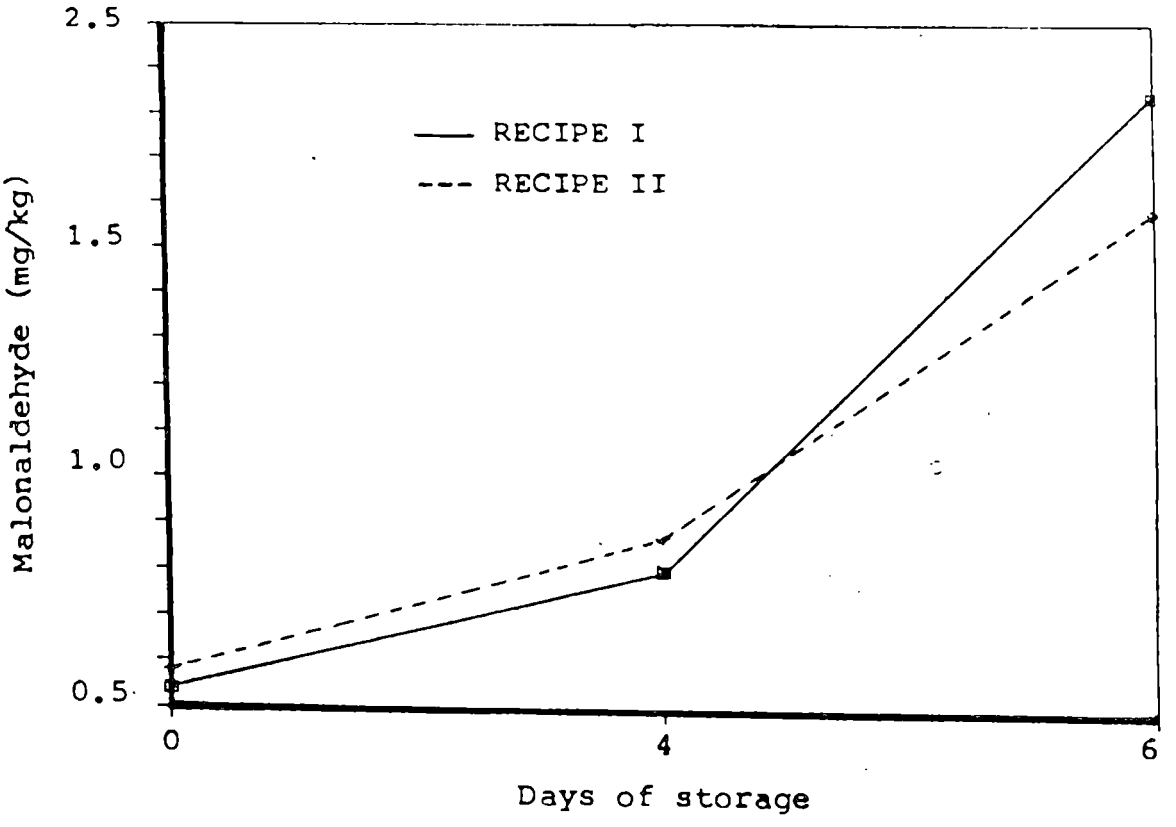


FIG.4 INFLUENCE OF DURATION OF STORAGE ON THE OXIDATIVE RANCIDITY OF CHICKEN MEAT BALLS STORED AT -15°C

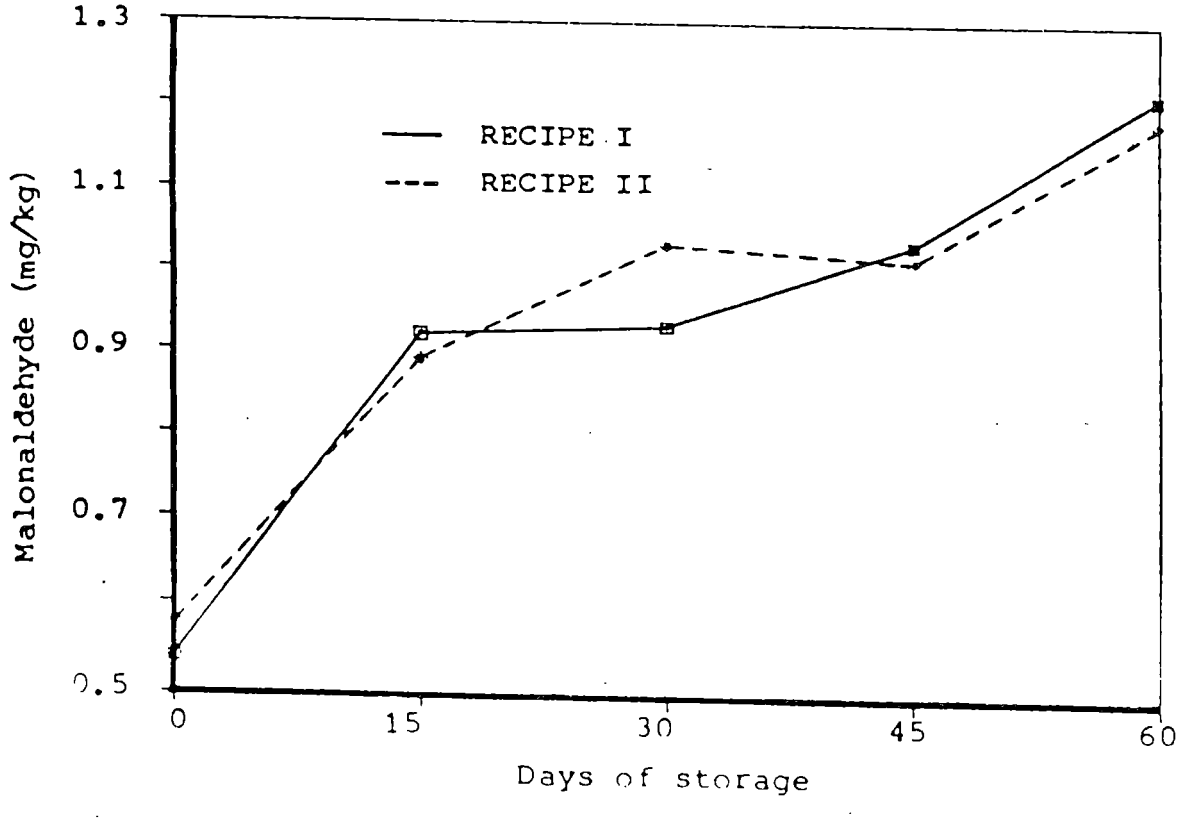


Table 7. Influence of temperature and duration of storage on the total bacterial counts of chicken meat balls

Storage temperature	Days of storage	Total bacterial count (log count/g sample)	
		Recipe I	Recipe II
5°C	0	7.52 ± 0.11^{a}	7.59 ± 0.05^{a}
	4	8.15 ± 0.05^{b}	7.98 ± 0.04^{b}
	6	10.12 ± 0.08^{b}	9.89 ± 0.04^{b}
-15°C	0	7.52 ± 0.11^{a}	7.59 ± 0.05^{a}
	15	6.47 ± 0.09^{b}	6.23 ± 0.06^{b}
	30	5.94 ± 0.04^{b}	6.13 ± 0.03^{b}
	45	5.54 ± 0.03^{b}	5.23 ± 0.06^{b}
	60	5.37 ± 0.02^{b}	5.05 ± 0.04^{b}

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

the product was deep frozen (-15°C) the counts reduced considerably and the reduction was found to be significant statistically ($P<0.05$).

The total bacterial counts (expressed as log count/g) of chicken meat balls stored at 5°C was 7.52 for the fresh sample in the case of recipe I which increased to 8.15 on fourth day and 10.12 on sixth day of storage. For recipe II, the total bacterial load was 7.59 log count/g on zero day which increased to 7.98 on fourth day and 9.89 on sixth day of storage at 5°C. Irrespective of recipes, 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 ($P<0.05$).

At -15°C, the total bacterial counts (log count/g) of chicken meat balls were 7.52 and 7.59 for recipes I and II respectively, for the fresh samples. The counts were found to be reduced when observed fortnightly upto 60 days of storage. On 60th day, the values were 5.37 and 5.05 respectively for recipes I and II.

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.

The trend of changes in the total bacterial counts during different storage periods and at different storage temperatures is represented graphically in Fig. 5 and 6.

Organoleptic evaluation of chicken meat balls

The organoleptic evaluation of ready-to-eat chicken meat balls prepared using the two recipes was conducted by a taste panel and the evaluation scores are shown in Tables 8 and 9.

The flavour scores of the chicken meat balls prepared as per recipe I were not found to be different significantly, irrespective of the days of storage at 5°C. With regard to recipe II, differences in the scores for flavour were found to be significant statistically ($P<0.05$) between zero and six days of storage at 5°C. The scores for the freshly prepared chicken meat balls were 5.00 and 5.80 for recipes I and II respectively. On fourth day the scores for flavour were 5.40 and 5.00 for the product prepared as per recipes I and II respectively.

The differences in the scores for juiciness of the product were found to be statistically significant ($P<0.05$) between zero and six days of storage at 5°C for both the recipes. Scores of 5.40 and 5.60 were given to chicken meat balls prepared as per recipes I and II respectively, for the freshly prepared samples and the values were 4.60 and 4.80 respectively, for the samples of recipes I and II stored for four days at 5°C.

OF CHICKEN MEAT BALLS STORED AT 5°C

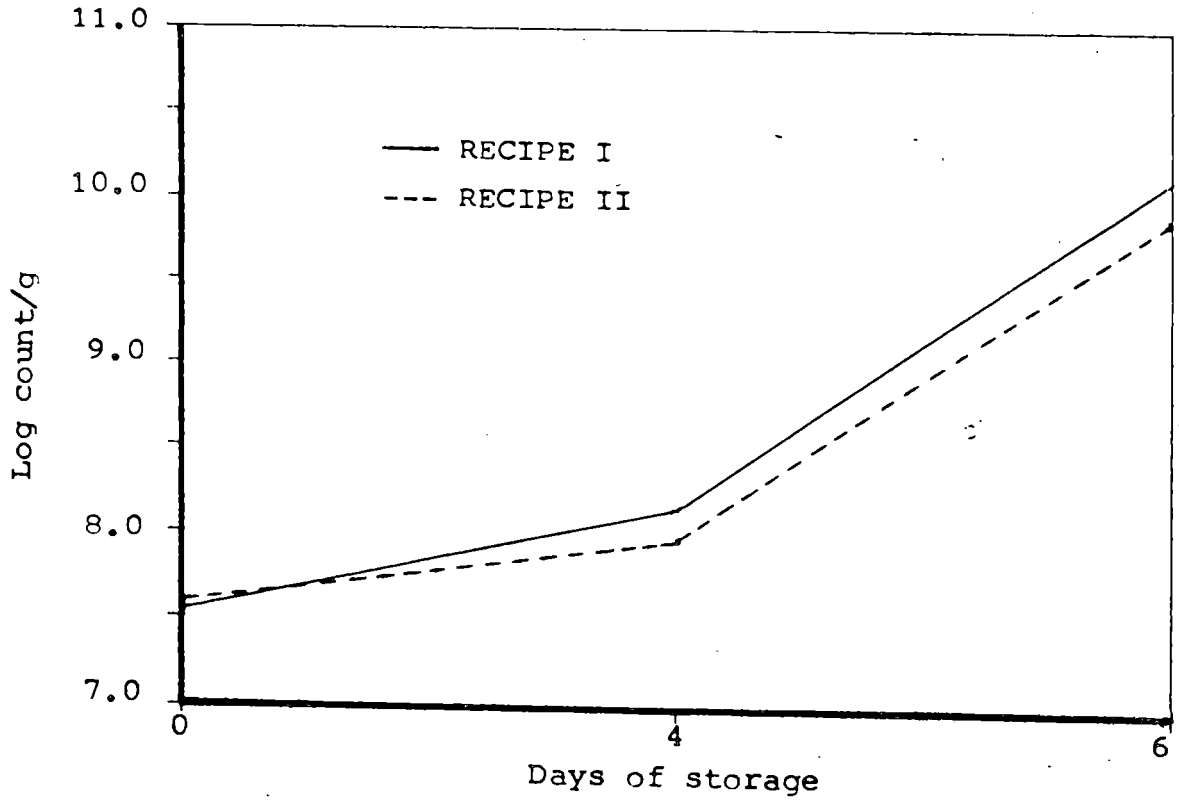


FIG.6 INFLUENCE OF DURATION OF STORAGE ON THE TOTAL BACTERIAL COUNT OF CHICKEN MEAT BALLS STORED AT ⁻15°C

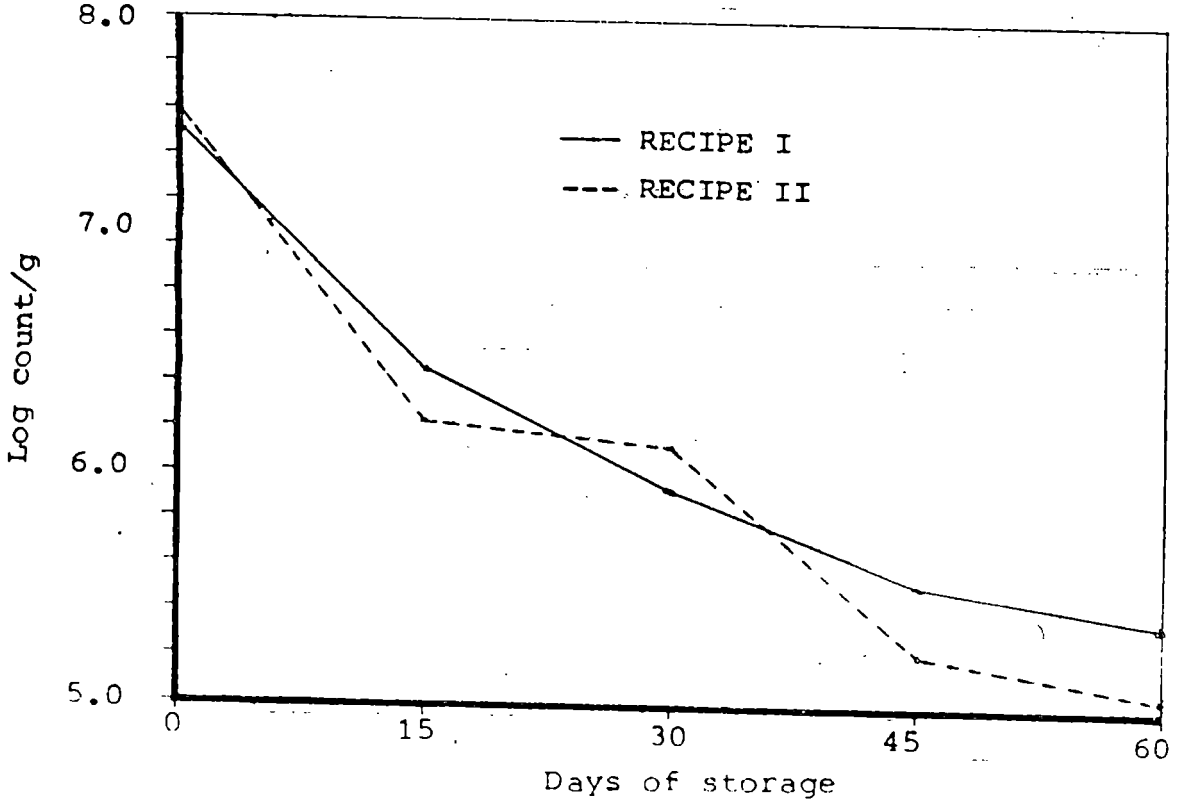


Table 8. Organoleptic scores of cooked chicken meat balls as influenced by period of storage

Storage temperature	Days of storage	Flavour		Juiciness		Tenderness		Overall acceptability	
		Recipe I	Recipe II	Recipe I	Recipe II	Recipe I	Recipe II	Recipe I	Recipe II
5°C	0	5.00±0.00^{a}	5.80±0.20^{a}	5.40±0.24^{a}	5.60±0.24^{a}	5.20±0.37^{a}	5.60±0.24^{a}	5.20±0.20^{a}	5.80±0.20^{a}
	4	5.40±0.24^{a}	5.00±0.00^{a}	4.60±0.24^{a}	4.80±0.37^{a}	5.20±0.58^{a}	5.00±0.63^{a}	5.00±0.32^{a}	4.60±0.24^{a}
	6	4.00±0.63^{a}	3.40±0.51^{b}	3.20±0.58^{b}	3.60±0.51^{b}	3.60±0.60^{a}	3.60±0.60^{b}	3.80±0.49^{b}	3.60±0.60^{b}
-15°C	0	5.00±0.00^{a}	5.80±0.20^{a}	5.40±0.24^{a}	5.60±0.24^{a}	5.20±0.37^{a}	5.60±0.24^{a}	5.20±0.20^{a}	5.80±0.20^{a}
	15	5.00±0.32^{a}	5.20±0.58^{a}	4.60±0.40^{a}	4.80±0.37^{a}	4.40±0.24^{a}	5.00±0.32^{a}	4.80±0.20^{a}	5.00±0.32^{a}
	30	5.80±0.20^{b}	5.40±0.40^{a}	5.20±0.20^{a}	5.60±0.24^{a}	5.40±0.24^{a}	5.20±0.37^{a}	5.20±0.20^{a}	5.20±0.37^{a}
	45	4.40±0.24^{a}	5.00±0.00^{a}	4.60±0.40^{a}	5.00±0.32^{a}	4.40±0.40^{a}	5.00±0.32^{a}	4.40±0.24^{b}	5.00±0.32^{a}
	60	5.00±0.32^{a}	5.00±0.32^{a}	5.00±0.00^{a}	4.80±0.37^{a}	5.40±0.24^{a}	5.20±0.37^{a}	5.20±0.20^{a}	5.00±0.32^{a}

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

Table 9. Organoleptic scores of cooked chicken meat balls as influenced by different recipes

Storage temperature	Days of storage	Flavour		Juiciness		Tenderness		Overall acceptability	
		Recipe I	Recipe II	Recipe I	Recipe II	Recipe I	Recipe II	Recipe I	Recipe II
5°C	0	5.00±0.00^{a}	5.80±0.20^{b}	5.40±0.24^{a}	5.60±0.24^{a}	5.20±0.37^{a}	5.60±0.24^{a}	5.20±0.20^{a}	5.80±0.20^{a}
	4	5.40±0.24^{a}	5.00±0.00^{b}	4.60±0.24^{a}	4.80±0.37^{a}	5.20±0.58^{a}	5.00±0.63^{a}	5.00±0.32^{a}	4.60±0.24^{a}
	6	4.00±0.63^{a}	3.40±0.51^{b}	3.20±0.58^{a}	3.60±0.51^{a}	3.60±0.60^{a}	3.60±0.60^{a}	3.80±0.41^{a}	3.60±0.60^{a}
-15°C	0	5.00±0.00^{a}	5.80±0.20^{b}	5.40±0.24^{a}	5.60±0.24^{a}	5.20±0.37^{a}	5.60±0.24^{a}	5.20±0.20^{a}	5.80±0.20^{a}
	15	5.00±0.32^{a}	5.20±0.58^{a}	4.60±0.40^{a}	4.80±0.37^{a}	4.40±0.24^{a}	5.00±0.32^{a}	4.80±0.20^{a}	5.00±0.32^{a}
	30	5.80±0.20^{a}	5.40±0.40^{a}	5.20±0.20^{a}	5.60±0.24^{a}	5.40±0.24^{a}	5.20±0.37^{a}	5.20±0.20^{a}	5.20±0.37^{a}
	45	4.40±0.24^{a}	5.00±0.00^{b}	4.60±0.40^{a}	5.00±0.32^{a}	4.40±0.40^{a}	5.00±0.32^{a}	4.40±0.24^{a}	5.00±0.32^{a}
	60	5.00±0.32^{a}	5.00±0.32^{a}	5.00±0.00^{a}	4.80±0.37^{a}	5.40±0.34^{a}	5.20±0.37^{a}	5.20±0.20^{a}	5.00±0.32^{a}

Note: Values bearing the same superscript within the row between recipes I and II for each character are not significantly different ($P<0.05$)

The differences in the scores for tenderness of the product prepared as per recipe I and stored at 5°C were not significant statistically, irrespective of the duration of storage. But in the case of recipe II, the differences in the scores were found to be significant statistically ($P<0.05$) between zero and six days of storage at 5°C. For freshly cooked samples, values for tenderness were 5.20 and 5.60 for recipes I and II respectively and the values were 5.20 and 5.00 respectively for the samples prepared by recipes I and II stored at 5°C for four days.

The overall acceptability of the chicken meat balls prepared by both the recipes was found to be different significantly ($P<0.05$) between zero and six days of storage at 5°C. The scores for overall acceptability for the freshly prepared samples were 5.20 and 5.80 respectively for recipes I and II. For the samples stored for four days at 5°C the scores were 5.00 and 4.60 respectively, for recipes I and II.

The scores for flavour, juiciness, tenderness and overall acceptability for both the recipes were found to be reduced after four days of storage at 5°C.

The differences in the organoleptic scores for flavour of the chicken meat balls prepared using recipe IIwere not found to be different significantly between zero and any other days of storage except for 30 days of storage ($P<0.05$) at -15°C. The

score for the product stored at -15°C for 30 days was 5.80 which was more than that given for the freshly prepared product (5.00).

In the case of recipe II, the differences in flavour scores were not found to be significant statistically between zero and any other days of storage at -15°C. The scores varied from 5.00 to 5.80, irrespective of the days of storage.

The differences in juiciness scores of the product stored at -15°C were not found to be significant statistically between zero and any other days of storage. The scores ranged from 4.60 to 5.40 for recipe I and from 4.80 to 5.60 for recipe II.

In the case of tenderness also there was no significant difference between the scores for fresh samples and that for stored samples for both the recipes. The scores varied from 3.60 to 5.40 and from 3.60 to 5.60 for recipes I and II, respectively.

The differences in the scores for overall acceptability of the product as per recipe I were found to be significant statistically ($P<0.05$) between zero and 45 days of storage at -15°C and the scores were 5.20 and 4.40 respectively. In the case of recipe I, the scores for zero and any other days of storage at -15°C were not found to be different and the values ranged from 5.00 to 5.80, irrespective of the days of storage.

The recipes were found to be different significantly ($P<0.05$) with regard to flavour at 5°C for zero, four and six days of storage. A score of 5.00 was given for recipe I as compared to 5.80 for recipe II with regard to flavour for the freshly prepared product. For the sample stored for four days at 5°C the scores were 5.40 and 5.00 respectively for recipes I and II. The values for the products stored for six days at 5°C were reduced considerably for both the recipes.

In the case of juiciness of the meat balls prepared by recipes I and II, the scores were not found to be different irrespective of the duration and temperature of storage and the scores ranged from 3.20 to 5.40 and from 3.60 to 5.60 for recipes I and II, respectively.

The tenderness of the product prepared by both the recipes was not found to be different statistically irrespective of the duration and temperature of storage and the scores varied from 3.60 to 5.20 and from 3.60 to 5.60 for recipes I and II, respectively.

Irrespective of the duration and temperature of storage the overall acceptability of chicken meat balls prepared by different recipes were not found to be different statistically and the scores ranged from 3.80 to 5.20 for recipe I and from 3.60 to 5.80 for recipe II.

The differences in flavour of the freshly prepared chicken meat balls was found to be significant statistically ($P<0.05$) between recipes I and II and the scores were 5.00 and 5.80 respectively. The scores for the product stored for 45 days at -15°C were also found to be significantly different ($P<0.05$) between recipes and the scores were 4.40 and 5.00 respectively.

Shelf-life of chicken meat balls

From the above observation it was found that chicken meat balls prepared as per two different recipes could be stored well for upto four days at 5°C and upto 60 days at -15°C without causing any quality deterioration.

Yield per gramme of meat

The number of chicken meat balls prepared from one kg or g of deboned chicken meat for recipes I and II is given in table 10. From each kg of deboned minced meat, 12.5 chicken meat balls of 100 g each could be prepared from recipe I and from recipe II, 13.2 chicken meat balls could be made.

Cost structure of ready-to-cook chicken meat balls

The cost structure for the preparation of ready-to-cook chicken meat balls by the two recipes was calculated and presented in table 11. The calculation was based on the costs of

Table 10. Yield per gramme of deboned chicken meat

Chicken meat ball	Yield/kg deboned meat (No.)	Yield/g deboned meat (No.)
Recipe I	12.50	0.0125
Recipe II	13.21	0.0132

Table 11. Calculation of cost structure of chicken meat balls prepared as per two recipes

Ingredients	Recipe I		Recipe II	
	Weight (g)	Cost (Rs)	Weight (g)	Cost (Rs)
Deboned chicken meat	1000	71.67	1000	71.67
Total additives	250	10.42	321	12.95
Total	1250	82.09	1321	84.62
One meat ball	100	6.57	100	6.41

deboned chicken meat and total additives. According to this, the cost of one chicken meat ball was Rs. 6.57 for recipe I and Rs.6.41 for recipe II.

Discussion

DISCUSSION

The results of the experiment conducted to study the feasibility of using deboned broiler chicken meat for the preparation of chicken meat balls, its various characteristics and shelf-life are discussed below.

Meat yield and losses

The mean per cent ready-to-cook yield of broilers used for the study was 72.76±0.71 (Table 4). The processing yields ranging from 64.18 to 71.10 per cent are reported in the literature. Jull (1951) observed that dressing per cent varied from 66 to 76. Mathur and Ahmed (1968) reported that the yield ranged from 71.08 to 71.13 per cent in broilers. Ready-to-cook yield of male broilers was 72.04 and that of females was 70.08 per cent (Hayse and Marion, 1973). Tan *et al.* (1975) reported that the dressing yield in per cent ranged from 69.80 to 70.80 for broilers of 10 weeks of age. The finding of the present study is in close agreement with that of the above authors.

The mean per cent losses of blood, feathers and inedible offal during the processing of birds were also determined (Table 4). The mean per cent losses due to blood (3.42±0.40) and feathers (3.06±0.38) obtained in this study are within the range reported in the literature. Jull (1951) and Mathur and Ahmed

(1968) reported that the per cent loss of blood amounted to 3.55 to 4.50 which is in agreement with that obtained in the study.

Jull (1951), Mathur and Ahmed (1968) and Souri et al. (1972) reported that the per cent loss of feathers amounted to 4.50 to 8.40 depending upon the breed, age and other body characteristics. The mean per cent feather loss of 3.06±0.38 obtained in the present study is slightly lower than those reported by the above authors. This difference could possibily be due to the type of commercial bird used in this study.

The per cent inedible offal averaged 20.76±0.70 which is in agreement with those reported by Mathur and Ahmed (1968). The total loss during the process of dressing averaged 27.24±0.70 per cent (Table 4) which is within the reported values (Mathur and Ahmed, 1968 and Souri et al., 1972).

Meat to bone ratio

The meat to bone ratio obtained in this study averaged 1.31 (Table 4) which is lower than that reported by Abhul Wahid et al. (1973), Hayse and Marion (1973) and Rao (1975). But the values obtained in the present study is fairly in agreement with that reported by Kutty et al. (1983). The low meat to bone ratio obtained in the present study might be due to the low live weight of broilers used for the experiment.

Quality Characteristics and Shelf-life of Chicken Meat Balls

Proximate composition

The proximate analysis of chicken meat balls prepared as per the two recipes revealed that per cent moisture ranged from 70.19 to 72.26 for recipe I and 67.93 to 69.73 for recipe II, protein from 14.00 to 15.21 for recipe I and 12.49 to 14.46 for recipe II, fat from 5.56 to 5.95 for recipe I and 5.30 to 5.93 for recipe II and total ash ranged from 3.64 to 4.33 for recipe I and 3.43 to 4.46 for recipe II (Table 5). These values are almost in agreement with those reported by Varadarajalu (1973) for poultry meat, Narayanankutty (1979) for deboned chicken meat, Narayanankutty *et al*. (1983) for chicken steak and Kondaiah *et al*. (1988) for chicken sausage.

It could be seen from Table 5 that the proximate composition of chicken meat ball prepared using the two recipes 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. Narayanankutty (1979) in his study with deboned chicken meat observed that no changes occurred in the proximate composition of minced chicken meat stored at 5°C for seven days and at -15°C for 90 days.

Rancidity

The TBA numbers of chicken meat balls ranged from 0.54 to 1.84 for recipe I and from 0.58 to 1.58 for recipe II at 5°C and at -15°C the values ranged from 0.54 to 1.30 for recipe I and from 0.58 to 1.18 for recipe II (Table 6). An increase in TBA number was observed with increase in duration of storage under refrigeration and frozen storage. The statistical analysis revealed that the TBA number of chicken meat ball was influenced by storage periods irrespective of storage temperature and the difference in TBA numbers between zero and any other days of storage was statistically significant. 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 indicated by increased TBA number.

Keskinel et al. (1964) observed a similar effect of storage on the fatty oxidation in minced meat. Baker et al. (1966) observed that chicken steaks stored frozen for one month retained their quality and, rancidity, if any, could not be detected by the taste panel although the TBA numbers were relatively high. Even at fairly low temperature (-29°C) of storage, Froning (1973) found increased oxidation of fat as the storage period was increased.

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.

In the context of the above, it appears that although the TBA number recorded a slight but significant increase at storage temperature of -15°C there might not be any deterioration in the quality of chicken meat balls upto 60 days so far as the organoleptic or nutritional aspects are concerned. This appears to be true in view of the fact that TBA number of only above two is considered to be associated with the development of rancidity in meat products (Hasiak and Baker, 1968 and Dawson et al., 1975).

The finding in the present study which indicate an increase in the TBA number during storage agrees with those reported by Keskinel et al. (1964), Baker et al. (1967), Hasiak and Baker (1968), Froning (1973), Narayanankutty et al. (1983) and Lyon et al. (1988).

Total bacterial count

Storage of chicken meat balls at 5°C influenced total bacterial count which differed from storage of the same at -15°C.

The counts increased at refrigeration temperature (5°C) with length of storage and 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), causing a deterioration in the quality of the product. Similarly it has been reported by many other workers {Baker et al., (1967); Hasiak and Baker (1968); Ostowar and MacNeil (1971); Maxcy (1973); Sahoo (1973); Froning (1976) and Narayanankutty et al. (1983)} that storage at -15°C or lower temperature helped to reduce significantly the bacterial counts in the product and thus to maintain its quality for longer periods.

The normal range of total bacterial counts of fresh deboned meat was reported to range from 10×10^4 to 10×10^5 per gramme of meat (Maxcy et al., 1973). A value of 7.52 to 7.59 log count per gramme of sample obtained in this study (Table 7) for total bacterial counts of freshly prepared chicken meat balls appears to be slightly higher than that reported in the literature.

Maxcy et al. (1973) reported an increase in total bacterial count of deboned chicken meat stored at 5°C. Froning (1976) has also reported increase in total bacterial load at 3°C upto 12 days. In the present study, at 5°C even for four days, high bacterial contamination was encountered which might be due to the high initial count.

The trend of the observations of this study is in agreement with those reported by Baker et al. (1967), Hasiak and Baker (1968), Ostowar and MacNeil (1971), Sahoo (1973), Varadarajulu et al. (1974), Froning (1976), Cunningham and Bowers (1977), Narayanankutty et al. (1983), Kondaiah et al. (1988) and Anand et al. (1990).

Organoleptic evaluation of cooked chicken meat balls

The taste panel preferences to the chicken meat balls prepared as per two recipes were evaluated in terms of flavour, juiciness, tenderness and overall acceptability (Table 8 and 9).

The overall acceptability of the chicken meat balls prepared by both the recipes was not found to be different statistically at different storage temperatures for varying periods. It was opined by the judges that chicken meat balls prepared as per recipes I and II were equally acceptable with regard to flavour, juiciness, tenderness and overall acceptability.

The present study revealed that a highly acceptable and nutritious chicken meat product viz., chicken meat ball could be prepared from deboned minced meat of broilers and stored upto four days at 5°C and upto 60 days at -15°C without any quality deterioration.

Summary

SUMMARY

An experiment was designed and conducted to examine the feasibility of preparing a ready-to-cook poultry product namely, chicken meat balls from deboned minced meat of broiler chicken by using two recipes, to suit the Indian Palate and to evaluate the commercial acceptability, nutritional characteristics, conditions of storage without deterioration of quality and its shelf-life.

Commercial broilers of eight weeks of age were used in the study. Data on meat yield, losses and meat to bone ratio were collected from all the broilers. Deboned minced meat from these broilers was used for the preparation of chicken meat balls. The product thus prepared was stored under refrigeration (5°C) and frozen (-15°C) temperatures until further analyses for quality parameters or tested by a panel for organoleptic evaluation. The chicken meat balls were withdrawn from refrigerator at zero, four and six days and from freezer at zero, 15, 30, 45 and 60 days. 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 yield of the product per kg deboned minced meat and its cost structure were also calculated.

The following observations were made in this investigation:-

1. It was found that the ready-to-cook yield, total loss and meat to bone ratio averaged 72.76 per cent, 27.24 per cent and 1.31 respectively.

2. Chemical composition of the product was found to agree with the reported values for the poultry meat and meat products.

3. Storage of the product at 5°C for zero, four and six days increased significantly the TBA numbers with each incremental storage period. The total bacterial count per gramme of the product also increased significantly per each period of storage under refrigeration condition. However, the proximate composition of chicken meat balls remained unaltered when stored at 5°C upto six days.

4. At -15°C the fatty oxidation (TBA number) increased with each incremental storage period. But, the total bacterial count declined significantly as the storage time was increased at fortnightly intervals upto 60 days of storage. There were also no changes in proximate composition of chicken meat balls stored at this temperature upto 60 days.

5. The organoleptic evaluation of cooked chicken meat balls prepared using the two recipes and stored at two different temperatures for different storage periods revealed that the product prepared by both the recipes were equally good and acceptable.

6. From each one kg deboned chicken meat, 12.5 chicken meat balls of 100 g each could be made as per recipe I and 13.2 chicken meat balls could be made from recipe II.

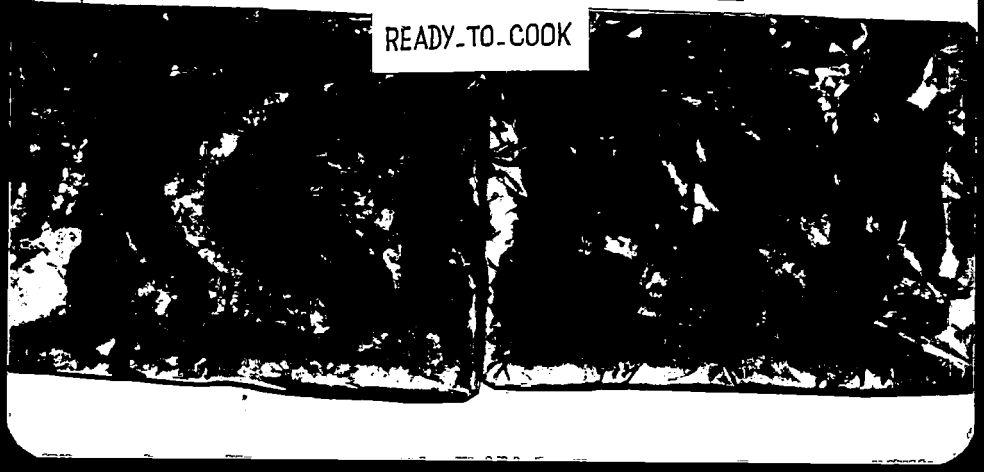
7. The cost structure revealed that cost of each chicken meat ball prepared as per recipes I and II was Rs. 6.57 and Rs.6.41 respectively.

On the basis of the above findings it was concluded that a highly acceptable chicken meat product in the form of chicken meat balls could be prepared from deboned minced broiler meat. The optimal condition for its long term storage was determined to be -15°C and at this temperature the product could be held upto two months without any appreciable quality deterioration. At 5°C, the product could be held upto four days without any loss of quality.

CHICKEN MEAT BALL CHICKEN MEAT BALL

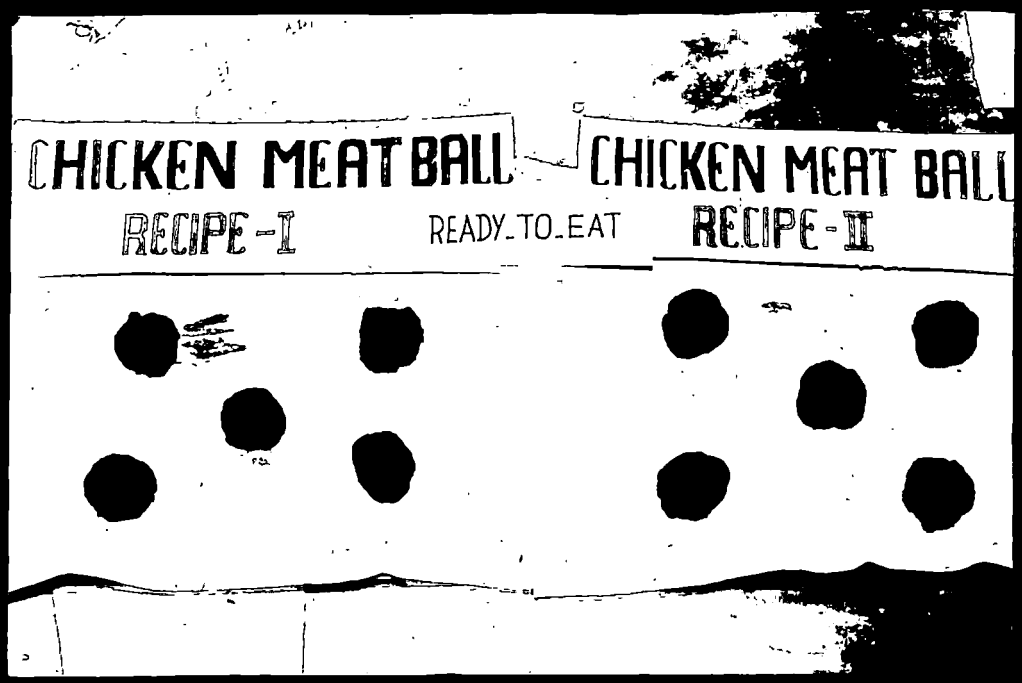
RECIPE-I RECIPE-II

READY_TO_COOK



CHICKEN MEAT BALL CHICKEN MEAT BALL

RECIPE-I READY_TO_EAT RECIPE-II



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FORMULATION AND QUALITY EVALUATION OF CHICKEN MEAT BALLS

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ABSTRACT OF A THESIS

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ABSTRACT

A study was undertaken to examine the feasibility of formulation of chicken meat balls from deboned minced meat of broilers and to evaluate its shelf-life.

The ready-to-cook yield, total loss and meat to bone ratio averaged 72.76 per cent, 27.24 per cent and 1.31 respectively for broilers used for the study.

The chicken meat balls prepared as per two recipes were kept under refrigeration (5°C) upto six days and under frozen (-15°C) storage upto 60 days. Representative samples were analysed qualitatively and evaluated organoleptically by a taste panel on zero, four and six days under refrigeration and zero, 15, 30, 45 and 60 days of storage under frozen conditions. It was observed that irrespective of different temperatures and duration of storage, the proximate components, viz., moisture, protein, fat and total ash of the product remained unaltered. At 5°C the thiobarbituric acid (TBA) number and total bacterial counts were increased significantly with increase in the duration of storage. At -15°C the TBA number was found to increase, whereas the total bacterial counts decreased significantly as the storage period increased. The chicken meat balls prepared by both the recipes

were found to be equally good and acceptable organoleptically. Twelve and thirteen chicken meat balls could be made from each 1000 g of deboned chicken meat of recipes I and II respectively. The cost of a chicken meat ball (100 g) prepared by recipe II was found to be less comparatively.

From the above findings it was concluded that a highly acceptable, nutritious, ready-to-cook meat product could be prepared from deboned minced chicken meat. The optimum storage temperatures for its short-term storage upto a period of four days and that for long-term storage upto 60 days were found to be 5°C and -15°C respectively, without any quality deterioration of the product.