Review Article

REVIEW ON SHELF STABLE CHICKEN PICKLE INCORPORATED WITH POUTRY BY PRODUCTS USING DIFFERENT ACIDULANTS

ABSTRACT

The present study was aimed to develop an acceptable quality chicken pickle with incorporation of poultry by products viz. Heart & gizzard (1:1) and different acidulants. Different level of heart and gizzard (5, 10 & 15%) were incorporated in chicken pickle formulations. Meat chunks prepared from broiler meat with inclusion of spices, acidulants and poultry by-products were used for preparation of chicken pickle. It was observed that incorporation of 10% heart and gizzard exhibited higher sensory and physico-chemical scores which were comparable to the control. These results revealed that 10% heart and gizzard can be used as poultry by-products in chicken pickle without any adverse effect on the quality and sensory properties of chicken pickle.

Chicken pickle prepared by using above selected levels of heart and gizzard were further incorporated with different acidulants viz. Citric acid, acetic acid & lactic acid for sensory and physico-chemical properties and evaluated at ambient temperature on every 15th day interval for 90 days. During storage chicken pickle incorporated with acetic acid maintained sensory and physico-chemical attributes for longer time as compared to the products incorporated with citric acid and lactic acid. During storage of chicken pickle the sensory scores for all the attributes declined significantly with the progress of storage period. Similarly, pH, TBA values and microbial count increased considerably at the later part of storage but were within spoilage limit.

It is concluded that chicken pickle prepared with incorporation of 10% heart & gizzard and acetic acid packed in PET bottles could be stored safely for 90 days at ambient temperature.

1. INTRODUCTION

India is passing through a phase of accelerated industrialization. Poultry sector has made considerable progress during last few decades and contributed significantly to the halt of protein hunger in the country. Remarkable progress that Indian poultry industry has made in recent years is because of increased poultry meat production coupled with ever increasing demand from

growing human population, rising income levels and rapid urbanization. Poultry industry thus plays a vital role in providing not only nutritional security but also income generation to large segment of Indian population. India ranks 5th in poultry meat production still its consumption is quite low i.e. 1.67 kg as compared to developing countries 49.8 kg in USA. [1].

There is increasing demand of processed, wholesome and nutritious ready to eat foods. Meat and meat products play an important role in human nutrition. Poultry meat being most widely consumed worldwide due to its desirable nutritional and organoleptic properties over red meat. Poultry meat is more acceptable because of its flavour, ease of digestion, low fat content and high ratio of unsaturated fatty acids. At the same time it is an excellent source of animal protein, B-complex vitamin & minerals etc. and thus can play a significant role in introduction of value added innovative processed poultry products. Poultry meat is more popular than other meat not only due to higher rate of returns to the producers but also it is an excellent source of animal protein, no religious taboo and acceptable to all non-vegetarian population.

India bestowed largest livestock resources in the world contributing 2.3 million tonnes of poultry meat annually and is available with reasonable price for development of various 'value added' processed products. India's total meat production is around 4.9 million tonnes to which poultry meat contributes 12% and only 1% of it is being used for product processing [2]. At present, only 1.7% of total meat produced in India is processed into value added products while in developing countries it is more than 60% [3].

Change in life style, increased per capita income, urbanization, consumer awareness and increasing number of women entering in job has created rising demand for ready to eat, meat products. There is growing quality consciousness among consumers for food with high nutritional value without any chemical preservatives and microbiological safety. Hence there is huge potential for development and processing of ready to eat poultry products like poultry pickle, chicken soup, chicken tandoori and variety of other meat products. High perishability of meat and meat products is one of the serious problem in countries like India due to climatic conditions & high protein content [4].Now a days there is need to develop the foods which are shelf stable so that can be contributed in various locations without aid of refrigeration. Pickling is one of the alternatives to develop such kind of products.

Traditional foods enrich our sensory perception by providing wide variety of flavours, colours and textures. Pickled products are common in Indian diets and are much relished by consumers. Meat pickles are traditional shelf stable ready to eat products. Presently more emphasis is given on developing shelf stable meat products which can be stored at ambient temperature. Besides upon various preservation techniques importance of shelf stable meat products like cured and canned meat products, snack type meat products, meat pickles and intermediate moisture meat products etc.has been reported [5].

Pickling of perishable foods in vinegar or edible oil with added salt, spices and condiments provide ready to use product with good shelf stability at ambient temperature. Vinegar and oil based spent chicken pickle was having good consumer acceptance [6]. Reduced water activity and pH are two major hurdles contributing to shelf stability of pickles. Along with preservative effect pickling also helps to improve desirable characteristics like colour, flavour& texture. Pickles generally acts as an appetizer and they stimulate the assimilation of gastric juices there by improving the digestion [7]. Along with preservative effect pickling also helps to improve desirable characteristics like taste and flavour.

Effective utilization of by-products for production of value added meat products is one way to realize maximum returns from poultry sector. It is estimated that during slaughtering of birds, about 10 to 13% live poultry weight is wasted in the form of skin, gizzard, heart and other by-products[8]. The nutritive value of these by-products in respect of protein and fat is as good as lean meat. It is more advisable to incorporate poultry by-products Viz. heart and gizzard in the preparation of processed meat products, if the consumer is looking for low calorie diet having high protein and polyunsaturated fatty acids.

Meat holds a special place in diet because of its high nutritional value. The rapid expansion of fast food market has increased the demand for different comminuted meat products. Use of chicken with by-products for preparation of traditional meat product such as pickle can offer an alternative avenue for proper utilization of chicken meat.Meat pickles are traditional, shelf stable ready-to-eat products and offer delicacy as well as convenience to consumers. Preservation of food in common salt, vinegar and common vegetable oil, seasoned with spices and condiments is called pickling [9]. Besides its preservative effect, pickling is also considered to be a means of imparting desirable characteristics such as flavour and taste to food [10].Pickling creates

unfavourable condition for growth and multiplication of microorganisms providing a long shelf life without refrigeration [11,9].

2. CHICKEN MEAT

Among the various classes of poultry birds, broilers are heavier in body weight and contain high fat which ranges from 10 to 15 percent [12] and poor in water binding capacity, thereby the prepared products shows high cooking losses [13,14]. Over last few years there is increasing demand for poultry meat because it is excellent and cheaper protein food of animal origin with low fat and low calorie food [15]. Broiler meat is more tender and juicy upto 6 weeks of age because of less collagen content [16].with minimum cross linkages [17]. Processing of poultry birds refers to conversion of raw carcass into value added, more convenient ready to use forms such as nuggets, patties, sausages etc. Further, processing reduces the preparation efforts of which is frequently used for such processed food products [18]. About 20-25% reduction in cost of production is possible when whole meat (deboned meat+skin,gizzard and heart) components were utilized compared to only deboned meat formulation [19]. Preservatives in the food are added to improve flavour and aroma and to increase microbial stability which include chemicals as well as natural preservatives

3. CHEMICAL PRESERVATIVES

3.1. Salt

Common salt an ingredient of spice mixture is added to impart characteristic taste and to increase the acceptability of any food product. It is capable of altering many functional characteristics when added in required proportion while preparing processed meat products. It stabilizes the muscle protein and acts as a preservative thus preventing microbial growth during storage. Salt is the key functional component of all curing mixture. It has diverse functions ranging from simple flavour to complex functional properties. It acts as a preservative by lowering the water activity and thus inhibiting the bacterial growth. Its antibotulinal activity, particularly in combination with nitrite [20] is most useful in cured meat [21,22]. Use of salt

alone resulted in harsh and dry product. Salt alone has been found to be pro-oxidant in meat system [23] that results in undesirable and unattractive dark coloured meat.

Salt is the most important and the only ingredient necessarily used in all curing mixture [24]. Salt contributed to meat particle binding, fat emulsification, increased water holding capacity and thus reduced cooking losses and improved the texture as well as cooking yield of restructured beef rolls [25,26].Sodium chloride is approved as a flavouring agent and a flavour enhancer thus contributing to sensory and functional properties in addition to preservative effect in processed meat products [27].

4. NATURAL PRESERVATIVES

Spices and condiments as natural preservatives impart flavour and colour to the meat products.These preservatives also have better antimicrobial and antioxidant properties. Effect of natural plants and spice extracts was investigated by many researchers to prevent rancidity in food products [28,29,30]. Spices are generally used in foods as flavouring and tenderizing agents [31]. The preservative action is due to presence of volatile oils and oleoresins [32]. Natural spices and condiments such as cinnamon leaves, red chilli, turmeric, black pepper, cloves, onion, garlic and ginger possess antioxidant properties [33].

Al-Jalay et al. [34] documented the antioxidant properties of various spices including clove and black pepper. All the spices exhibited antioxidant activity in meat emulsion products. Deans and Ritchie [35] reported that the spices like bay, cinnamon, clove, thyme (ajwain), marjoram and pimento had most rudely inhibitory activity. Uhl [36] observed that traditional foods are gaining popularity, which are mainly characterized by spicy flavour. Ingradients are the backbone of a product and spices contribute a major portion of flavour and also to some extent provide texture and appearance to product. Hwang [37] evaluated the extract / juices derived from garlic, onion, ginger and red pepper for their inhibitory activity towards Staphylococcus, Salmonella, Vibrio species and observed that amongst all garlic juice had higher antibacterial qualities. One per cent garlic juice completely inactivated Vibrio parahaemolyticus.

Naveena and Mendiratta [38] effectively utilized the ginger extract in cooking by which the shelf life of beef and pork was extended during storage, even without refrigeration. Ginger extract treatment caused two fold increase in shelf life of pre-cooked; saram wrapped lean beef at

4°C. They also reported increase in shelf life of mutton and chicken meat cuts treated with ginger, onion and sodium chloride by inhibiting the microbial growth.The secondary functions of spices include reducing the effect of salt and sugar and improving the textural properties of foods [39]. In addition, spices not only add micronutrients but also increase the palatability of foods [40]. Kondaiah et al. [41]. developed a spice mixture formulation for chicken products using most commonly available Indian spices. In addition to flavouring, many spices have antioxidant, antifungal and nutritional properties.

Rajkumar and Berwal [42]. documented antimycotic and antioxidant activity of clove and other spices for preservation of pastirma from boneless chevon where in the shelf life was increased upto 15 days. Spices and condiments are useful natural preservative in improving the oxidative stability as well as palatability of meat products [43].

5. EDIBLE ANIMAL BY PRODUCTS

Utilization of edible animal by-products in processed meat products is usually determined by consumer's judgement, regulatory requirements, hygiene, legislation, tradition and religion. In general, the by-products which are incorporated include chicken heart & gizzard as value added components. Comminuted meat products are widely consumed throughout the world, but unfortunately their cost especially in the developing countries is not within the reach of middle class non-vegetarian society. Efforts are being made to prepare value added meat based convenient products using low value meat components.Kondaiahet al.[44] indicated that acceptable quality economy type chicken nuggets could be produced using higher proportion of by-products with relatively lower quantity of lean meat.

Reddy and Vijayalakshami[45] reported that addition of skin, gizzard, and heart in the preparation of sausage significantly reduced fat separation value, percent moisture, crude protein, other extractive and juiciness.It is estimated that about 10 to 13 % live poultry weight is wasted in the form of skin, gizzard and heart etc. while slaughtering the birds. Effective utilization of these by-products for production of value added meat products is one way to realize maximum returns from poultry sector.Sharma[46].

5.1.Chicken heart and gizzard

Heart muscle is classified as involantary striated muscle and differs from rest of the skeletal muscle due to presence of intercalated disks, which connect the adjacent cardiac cells [47]. Generally, heart meat has lower solubility than skeletal muscle [48]. The weight of chicken heart is 10-20 g [49]. and the yield was found to be in the range 0.48 to 0.55% of live weight [50]. Gizzard meat is having the composition as 76.2% moisture, 4.2% fat, 18.2% protein with 118 calories per 100g. The meat is mostly utilised for flavourings in soup and stuffing mixes [51]. Blackshear et al. [52]. evaluated the organoleptic quality of frankfurters made from giblet meat with a view to utilize low value components of carcass in emulsion type sausage. A typical pronounced, undesirable flavour was reported in frankfurter when made from heart and slightly undesirable flavour from gizzard. However, the texture of gizzard meat frankfurter was very crumbly with distinct pieces of visible meat rather than a homogenous structure. Further more, addition of gizzard and heart was reported to improve the colour without adversely affecting the texture and flavour.Ahmad and Srivastava [53] reported that incorporation of different levels of heart did not have any significant effect on pH, moisture content and TBA number of sausage samples

6. ACIDULANTS

Acidulants are the acid which are artificially and deliberately added to lower the pH of food, thus extending shelf life. Addition of organic acids like Acetic acid and Lactic acid inhibits microbial growth, control spoilage, extend shelf life and tenderises the meat when used for marination [54,55,56]

6.1.Citric acid

Boylan et al. [57] reported that addition of citric acid for lowering pH of IMF Model system increase the effectiveness of several inhibitors.Erickson [58] documented that citric acid is added to flavouring extracts, soft drinks and also to fish to adjust the pH which aids in preservation and acts as antichoke to prevent discolouration and oxidation.Gould [59] reported that citric acid prevented the growth of various Cl.botulinum strains at higher pH values than normally reported from mineral acids.Berry [60] stated that citric acid is universally accepted as a safe food ingredient and it is approved by the joint FAO/WHO expert committee on food additives for use in foods without limitations.

6.2.Acetic acid

Acetic acid is widely used as acidifier, pH control agent, curing/pickling agent and flavouring agent. Its uses is limited by Good Manufacturing practice (GMP) in gravies, sauces, meat products etc.[61] Dilute acetic acid is approved as Generally Recognized As Safe (GRAS) material for food use. Food and Agricultural Organization (FAO) has set no limits on its acceptable daily intake (ADI) for humans [60]. Acetic acid is generally more effective against yeast and bacteria than molds [62]. However, overall, its action is weak compared to other preservatives. At pH 5, the growth of common yeasts is retarded by additions of as little as 1% acetic acid. Growth is inhibited entirely in the presence of 3.5 to 4% acetic acid [63]. Salt improves the action of acetic acid, mainly by lowering the water activity[64]. Acetic acid increases the heat sensitivity of bacteria but not that of yeasts or molds [65]. The effect of acetic acid against lactic acid bacteria is only slight [64].

6.3.Lactic acid

Dziezak[66]. reported lactic acid is used as acidifier, pH control agent, curing & pickling agent, flavour enhancer as well as inhibitor of microbes. It has mild taste, does not mask or over power the weaker aromatic foods, has distinct preservative action and regulates the microflora, hence it is acidulant of choice in many food products including meat products and pickles.Lactic acid which is generally recognized as safe (GRAS) is used primarily as acidulant, flavouring agents [67] and antimicrobial [68]. The lactate content with pH of tissue had a major role in flavouring growth of some fermentative gram negative bacteria over that of others and thus alter the flora and it was more effective against anaerobic organisms than aerobic at the ultimate pH (5.8) of beef [69].

Ravindranath[70]. reported that dipping of goat and buffalo meat in 10 % Lactic acid reduced the contamination, extends the keeping quality during storage.

7. MEAT PICKLES

Meat pickles are shelf stable, traditional and ready to eat product. Pickling is a method of preservation of food products with salt, vinegar, seasoned spices, condiments and some

vegetable oils. Flavour greatly influences acceptability of pickled products. Pickling imparts desirable characteristics such as flavour and taste to the food [10].

7.1.Chicken Pickles

Chicken pickle is prepared by using meaty portions of spent hens like breast, thigh and drumstick. After pressure cooking chicken parts for 15 min, cooked parts were pickled in pre-sterilized glass bottles. Pickled chicken parts were quite acceptable to the panelist even after 80 days of ambient storage [71]. Quality changes of chicken pickle during ambient storage (26 to 280C) were reported by [72]. Deboned skinned chicken meat pieces were processed for preparation of meat pickle and it was found to be safe for consumption upto 6 months with storage but decrease in sensory quality occurred while the product was microbiologically safe during storage [73].

7.2.Quail pickles

Quail meat pickle was prepared using four different pickling solutions. The pickles were stored in glass jar at room temperature and refrigeration storage. Both the pickles were organoleptically safe upto 60 days [10]. Whole quail carcasses after frying in refined mustard oil were pickled using 25% vinegar, table salt, spices and condiments. Pickle stored in pre-sterilized glass jars at room temperature was organoleptically acceptable up to 5 months [74].

7.3.Gizzard pickles

Chicken gizzard pickle containing 4% ground mustard (sarson) seed was compared with pickle prepared using modified traditional recipe containing 2% mango powder (amchoor). Use of ground mustard seed at 4% level for preparation of chicken gizzard pickle from spent hens contributed higher sensory scores and the values were comparable to those for traditional recipes varying from good to very good for all sensory attributes [75]. Gizzard pickle was found to be safe for consumption up to 45 to 75 days of storage in summer-rainy and winter season respectively its quality was comparable with refrigerated pickle. Proximate composition of the pickle was 50.2% moisture and 28.6% protein [76].

7.4.Chevon pickles

Using chevon and mutton in 10% vinegar indigenous recipe was developed for preparation of pickles. The shelf life of the product was attributed to high salt content, low pH, low moisture, cooking and frying [77]. Chevon pickle prepared using 1% acetic acid and 4% salt was acceptable up to 60 days at room temperature[78].

7.5.Pork pickles

Bone-in and bone-out pork pickles were prepared with 25% and 50% back fat cubes and 10% vinegar. Panelist rated both recipes between good to very good [79]. Pork pickles prepared using 10% vinegar and 0.5% citric acid were microbiologically safe up to 120 days at ambient temperature.

7.6.Buffalo meat pickles

Buffalo meat pickle using 4% salt and 1% acetic acid and specialty buffalo meat pickle of Nagaland using 2.4% salt and 0.2% acetic acid was prepared. Organoleptic evaluation indicated that the appearance of both products decreased gradually with increasing storage [80].

7.7.Rabbit pickles

Rabbit pickle was prepared using 1% acetic acid and 4% salt from deboned meat and liver of male rabbits. The process involved pre-salting of meat and liver pieces with 50% of the total salt required, cooking in pressure cooker for 10 minutes, separation of cookout broth, frying of meat till slight brown colouration, frying of spices and condiments, addition of fried meat and addition of required quantity of acetic acid. Significant reduction ($P<0.05$) in organoleptic score of pickle was reported. The products were acceptable upto 60 days [81].

8. QUALITY PARAMETERS

8.1.Proximate composition

Proximate composition of “bone-out” mutton and goat meat pickles viz., moisture, protein, fat and ash have been reported to be 39.69 and 43.37; 23.45 and 23.33; 26.58 and 24.47; and 4.11 and 4.40 respectively [79]. Kumar [82]reported a significant reduction in moisture content of the pickled pork compared to fresh pork and this was attributed to the effect of cooking and frying.The author concluded that keeping in view of moisture content of pork pickle it could be

treated as intermediate moisture food and the reduced moisture content was responsible for lowering the water activity. He also found no significant differences in the protein, ether extract and total ash contents during storage. Singh and Panda [74]observed a significant reduction in moisture content of pickled quail meat during storage. Crude Protein, ether extract, total ash and salt contents of pickles were not significantly affected by storage condition and periods.Khanna and Panda [83]reported that the protein, fat, moisture and ash content of pickled turkey meat were 22.10, 14.00, 59.93 and 3.97 respectively.

8.2.PHYSICO-CHEMICAL CHARACTERISTICS

A. pH

Padda and Sharma [77] reported that the pH of gravy in chevon and mutton pickles prepared from bone-in and bone-out were about 3.90, 3.80 and 3.60 respectively at zero hr which increased to 4.90, 4.20 and 4.80, 4.70 on maturation after 60 days.Singh and Panda [74] 1984) reported that pH of pickle solution of 50% and 75% vinegar increased rapidly from 3.05 and 2.70 at zero hr to 4.25 and 4.0 respectively after 6 hr immersion of quail carcasses. The equilibrium pH was observed on 4th day. Padda et al. [84] observed an average pH of 3.90 to 5.07 during a maturation period of 3 days in pork pickle prepared by using 10% vinegar. Stable pH in pork pickle was reported after maturation period of 9 days.Kumar [82] noted that the initial pH which varied from 4.27 to 4.42, increased to 4.88 and 4.87 respectively after a storage period of 120 days at ambient temperature.Sachdev et al.[76] reported that there is constant increase in pH in chicken gizzard pickle.The pH on zero day was 4.3 which increased to 4.8 at ambient storage and 4.3 to 4.6 at refrigerated storage after 45 days.

Sen and Karim [81] observed that pH of the boiled, boiled + fried rabbit meat pickle and boiled, boiled + fried rabbit liver pickle on zero day was 5.09, 4.85, 4.80, 4.94 which was increased to 5.29, 5.19, 5.02, 4.95 respectively on 60 days of ambient storage.Grover et al.[85] reported that pH of chicken gizzard pickle was significantly decreased to 4.26 after 15 days of attainment of equilibrium.Khanna et al.[86]observed that significant reduction in pH of chicken pickle from 4.9 to 4.3 in PET jar and 4.2 in laminated pouches was observed while titratable acidity was increased from 1 to 1.1% at the end of six months.Karle S.D. [87] noted that reduction of emulsion pH significantly ($P<0.05$) influenced the processing and quality

parameters of chicken sausages. Emulsion pH below 5.70 adjusted with lactic acid affected different sensory attributes as well as physicochemical properties adversely.

B. TBA value

Acousta et al.[88] reported that poultry meat is known to be higher in phospholipids as compared to red meat hence, more susceptible to oxidative rancidity during storage. Sato and Hegarty [89] observed that a major cause of muscle deterioration is oxidative rancidity. This oxidative deterioration of muscle involves the oxidation of unsaturated fatty acids catalysed by hemoproteins as well as by non-heme iron.Hamilton [90] noted that Rancid off flavors are concerned with the changes that results from reaction with atmospheric oxygen i.e. oxidative rancidity or by hydrolytic reactions catalyzed by lipases from food or from microorganisms.Rossel [91] reported that the TBA test is one of the empirical methods frequently used for detection of lipid oxidation. Thiobarbituric acid reacts specifically with malonaldehyde to give a red chromogen which may then be determined spectrophotometrically. Pal [92] reported that pork pickle kept at ambient temperature showed a progressive increase in TBA values with storage. Pickles with antioxidant at 200 ppm and packed in laminate had a lower TBA value (0.92 mg malonaldehyde/kg) after 150 days of ambient storage as compared to those samples in HDPE (1.42 mg malonaldehyde/kg).Brewer et al.[93] reported that TBA values increases with increased in aerobic storage of chevon sausage and low fat ground beef patties.

Reddy and Rao [71] reported that progressive increase in TBA value on storage in chicken parts. The initial values of 0.24 mg malon/kg reached 2.12 mg malon/kg after a storage period of 80 days at ambient temperature.Pangas et al[94] observed that TBA increased significantly in fried chicken gizzard from 0.04 mg malon/kg from zero day to 0.11 mg malon/kg on 7th day and 0.15 mg malon/kg at ambient and refrigerated temperature respectively.Karthikayan et al[95] noted that Caprine keema prepared by using preservative such as ascorbic acid 500 ppm, sorbic acid 500 ppm and nitrite 100 ppm on zero day had a TBA value of 1.48 mg malon/kg which increased to 2.73 mg malon/kg on the 7th day. Jayesh and Venkataramanujam[96] studied the effect of chilling and freezing on physico-chemical quality of mutton. They reported that TBA number increased with increase in length of storage.Sangtam et al. [97] observed that TBA values of mutton nuggets increased significantly on 20th day of refrigerated storage as compared to fresh product.Fernandez and Neill [98] reported that rabbit meat burger had higher TBA

during refrigerated storage than chicken meat which was more susceptible to oxidation. But the oxidative stability of both rabbit and chicken burgers was improved with vacuum-packaging.

8.3.SENSORY QUALITY

Chatterjee et al.[6] reported that there was no significant loss in the sensory quality of poultry meat pickle with respect to colour,flavour,juiciness and saltiness upto 120 days of storage at ambient temperature.Panda et al.[99] observed a consistent liking for the pickled quail meat by the panelist in respect of flavour,colour,tenderness,juiciness and overall acceptability of the product throughout the period of 45 days storage at ambient temperature.Whiting and Jenkins [100] demonstrated that sensory scores for flavor, texture and overall acceptability of frankfurters made from rabbit meat were almost equal to those made from beef and slightly superior to that of chicken.Padda and Sharma [77] evaluated the organoleptic quality of both bone-in and bone-out mutton and chevon pickle and reported a high overall acceptability for all the products. they also reported that mean scores of all attributes such as general appearance, flavour, texture and saltiness showed similar trend.

Singh and Panda [10] reported that Quail pickle in solution containing 50% vinegar with either 8 or 10% salt were more acceptable than those pickled in 75% solution, refrigerated stored pickle scored more than the pickle stored at room temperature. Along with the storage period the sensory scores declined significantly from 6.1–5.6 under both storage conditions. Singh and Panda [10] noted that no significant difference in overall acceptability scores of pickled quail meat stored either at room temperature or refrigeration storage was observed, but on 90th day of storage refrigerated stored pickle scored significantly higher than that stored at ambient temperature. The products were organoleptically acceptable upto 6 months under both the ambient and refrigerated storage.

Padda et al.[11] observed that organoleptic scores for pork pickle were between good to very good for all recipes. As the level of back fat cubes increased from 25 to 50% the sensory scores declined. There was reduction in sensory scores of pork pickle after 60 days. Overall acceptability reduced gradually but the extent of reduction was non-significant (Kumar and Bachhil) [101]. Sensory attributes of the chevon pickle did not alter (score ranged 7.09 - 8.24) and product remained acceptable throughout the 60 days of ambient storage (Pal and Agnihotri)

[78].Puttarajappa et al.[72] reported that the sensory evaluation of pickle was that the chicken pickle was acceptable even at the end of 6 months.

Reddy and Rao [71] noted that slight reduction in colour,flavour and overall acceptance scores was observed as storage progressed,but even after 80 days of ambient storage, the pickled chicken parts were quite acceptable to panelist.Shukla and Srivastava [102], demonstrated that Sensory attributes of the product such as general appearance, texture, sourness, saltiness did not alter (score ranged between 6.33–5.80) and the product remained acceptable throughout the storage period of 3 months,flavour of the pickle decreased significantly ($p<0.01$) but the product remained fairly acceptable up to 90 days.Shukla and Srivastava [103] demonstrated that Sensory attributes like general appearance,texture,saltiness or sourness scores of poultry pickles were not significantly ($p<0.01$) affected either by addition of BHT or with the increasing storage interval,addition of BHT showed significant impact on the flavour score of the chicken pickle.Rana and Shukla [104] observed that Sensory attributes of pickled guinea fowl meat were not affected by the packaging material and showed good to very good acceptability scores.

Significant reduction in organoleptic scores of rabbit pickle was observed. However, the scores always ranged from good to very good throughout the storage period and product was highly acceptable upto 2 months. There was significant decline in flavour score during storage (Sen and Karim,[81]. Khanna et al. [86] reported that during storage there was non-significant decrease in colour of chicken pickle up to 2 months in PET jars and 1 month in laminated pouches. Similarly nonsignificant decrease in flavour was observed up to 3 months in PET jar and 5 month in laminated pouchs. Thereafter,decrease in colour and flavour score was significant.

8.4.MICROBIAL QUALITY

Chatterjee et al.[6] reported that the microbiological count in chicken meat pickle was reported to remain within safety limit even after 120 days of storage at ambient temperature. The total plate count increased from 3.1×103/g on zero day to 2.3×104/g on 120th day, but no clostridia or mould were detected.Patterson [105] found that microbial contamination and physical constraints viz. moisture, pH, salt content, packaging system and storage temperature

etc. play a major role in multiplication of microorganisms in meat system. Spoilage becomes much evident when the total number of bacteria reached to 108 to 109/g of meat.

Acton and Johnson [106] found that low total viable count of the pickle solution i.e. 8.5×102/ml and 8.5×102/ml on 20th day and 50th day of storage respectively. Coliforms were not detected. Aerobic and anaerobic spore counts revealed that spore forming bacteria, probably introduced with spices, survived the harsh environment of the pickling medium but failed to increase in number. they concluded that pickled eggs were bacteriologically safe.Cremer and Chipley [107] noted that the microbial growth in meat system depends upon several factors like moisture,pH,salt content,availability of oxygen and storage temperature etc. The microbiological count of log 4.6 for psychrophiles and log 5.33 cfu/g for total plate count is considered to indicative of unacceptability of cooked meat products.Panda et al. [99] noted a very low total viable count and coliform count in the pickled quail meat and also reported that the quail pickle was free from anaerobic and fungal agents.Charoengpong and Chen [108] reported that canned pickled gizzard containing 50% cider vinegar stored at 24 to 250 C did not show any total aerobic or total anaerobic plate counts even after storage period for 1 week and 3 months respectively.

Padda and Sharma [77] reported that the high acidity,salt content,cooking,frying and low moisture reduces the microbial load of the product.Singh et al.[10] reported that quail meat pickle had total plate count of 1.68×102 on 8th day of storage at ambient temperatures which increased to 2.05×104 on 15th day of storage. However, microbes could not be detected after 30 day in pickle samples. Anaerobic, coliform and fungal counts were nil throughout the period of study.Singh and Panda [74] reported that the quail pickle held under refrigeration (5± 1oC) had lower count (21×103 org/g) than those kept at 290 C (40×103 org/g) up to a storage peroid of 150 days.Dziezak[109] noted that Meat products which remained well below pH value of 5.0 is considered critical for storage stability.

Kumar [82] found that pork pickles kept at room temperature were reported to be free from E.coli even after a storage period of 120 days. The initial total viable count, halophile, yeast and mold in fresh meat were 5.63×105, 3.84×104 and 7.76×103/g which was found to be reduced by 99.47%, 94.16% and 78.86% respectively on zero day after pickling.Judge et al. [110] reported that meat and meat products are highly perishable and spoil easily and soon

become unfit to eat and possibly hazardous to health through microbial growth, chemical changes and breakdown by endogenous enzyme.

Pal and Agnihotri [78] noted that standard plate count (log 4.14 cfu/g) and halophilic count (log 4.05 cfu/g) on zero day did not significantly differ even after storage period of 60 days though it decreased to log 3.75 and 3.80 cfu/g in chevon pickles stored at room temperature. Yeast and mold count also reported to have remained below log10/g throughout the storage period. Sachdev et al. [76] observed that total plate count was reported a comparatively slow rate of microbial multiplication in vinegar based gizzard pickle and the product remained microbiologically safe even after 75 days of storage during winter season. Reddy and Rao [76] observed that an increasing trend of total mesophilic count from log 1.43/ml on zero day to log 3.26/ml on 80th day of storage was observed in pickled chicken parts.Puttarajappa et al. [72] found that microbiological studies of shelf stable chicken pickle revealed that total plate count decreased from 5.8×104 /g to 4.8×104 /g at the end of 6 months. The product was free from coliforms, salmonella and s.aureus throughout the storage period.

Sen and Kareem [81] observed that the microbial counts of rabbit pickles remained in the range of 3 log cycle throughout the storage period. Standard plate count and halophilic counts did not vary significantly.Khanna et al. [86] reported that a gradual increase in bacterial counts of chicken pickle, regardless of packaging material was observed with increased storage time. The aerobic mesophilic counts increased from 3.4±0.41 to 3.9±0.31 and 3.9±0.42 in pickle stored in PET jars and laminated pouch respectively at the end of six months.Nychas et al. [111] reported that the microbiological quality of meat depends on the psycological status of the animal at slaughter, the spread of contamination during slaughter and processing,the temperature and other conditions of storage and distribution.Tidke A.P. [112] stated that pH, TBA value, tyrosine content and microbial counts increased considerably at later part of storage but were within the spoilage limit.

CONCLUSIONS

Acceptable quality chicken pickle can be prepared with incorporation of 10% heart and gizzard (1:1) by replacing proportionate quantity of meat. Chicken pickle prepared by using 10% heart & gizzard and 0.5% acetic acid was comparatively better over other organic acids with respect to

sensory quality as well as physico-chemical properties. Chicken pickle prepared by using 10% heart and gizzard and acetic acid packed in PET bottles were acceptable up to 90 days at ambient temperature storage (37±10C).

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