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Full Length Research Paper

Quality and acceptability of duck patties stored at ambient and refrigeration temperature

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Effect of storage periods at ambient and refrigeration temperature on duck patties was studied. pH of duck patties significantly increased (P < 0.01) at ambient temperature and decreased (P < 0.01) at refrigeration temperature. TBA and Tyrosine values increased significantly (P < 0.01) with increased storage period at both temperatures. A higher rate of increase in TBA values occurred at ambient temperature than refrigeration temperature. There was no significant difference in proximate composition except moisture content on different storage periods at both temperatures. TVC and TPSC values increased significantly (P < 0.01) with increase in storage period at both temperatures. A significant decrease in scores of organoleptic evaluation occurred with increase in storage period at both temperatures. A higher rate of decrease in sensory scores occurred at ambient temperature than that of refrigeration temperature. A significant correlation of physico-chemical changes with acceptability of duck patties was noticed. So, duck patties were acceptable upto 7 days at refrigeration temperature.

Keywords: Ambient and refrigeration temperature, duck, patties, quality, storage.

INTRODUCTION

Ducks occupy second place to chicken for the production of eggs in India. They are mainly reared for laying purpose. Spent and culled ducks are presented in the market after 3 - 4 laying years. Such duck meat intended for human consumption has less juiciness, more toughness, less palatability which are the hidden reasons for unacceptability of the duck meat by the consumers, though there is no significant decline in its nutritive value with increase in age (De, 2001). Comminuted, emulsion type, value added meat products can be prepared from this desi duck meat to increase their acceptability.

Moreover, processing of duck meat is more important for providing variety of duck meat products to consumer so that demand and marketability can be increased. The changes of consumers' attitude towards the fast food are giving impetus to this field. It is more economical to utilize spent ducks for preparing value added meat products by adding non-meat ingredients, curing salts and seasonings. The present study was conducted with an objective to find out the quality changes and acceptability of duck patties stored at ambient and refrigeration temperature.

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MATERIALS AND METHODS

Indian *desi* ducks were purchased from local market (*Shyam Bazar Market*, Kolkata) and University Duck Farm for the study. Slaughter and dressing was done in the Poultry Processing Unit of Department of Animal Products Technology and Marketing, West Bengal University of Animal and Fishery Sciences, Kolkata as per the standard procedure. After dressing, the carcasses were manually deboned as per the method of Staff and Darrow (1983). The cut up parts were separated into prime and non- prime parts as per the procedure followed by Christine et al. (1982).

After deboning, meat was kept in the deep freezer (-20 ± 2°C) till the preparation of patties. The meat meant for patties preparation

Table 1. Ingredients used, emulsion characteristics and preparation parameters of duck patties.

InIn ingredients	Percentage
Meat (prime and non prime cut)	68.5
Fat (skin + visceral organ)	5.5
Salt	1.5
Preservatives	0.07
Sugar	1.0
Spice	3.3
Condiments	8.0
Soy protein	3.3
Whole egg	1.3
Baking powder	0.03
Ice cubes	5.5
Curd	2.0
Total	100
Emulsion properties#	
Emulsion pH	6.09 ± 0.01
Emulsion stability %	12.0 ± 1.03
Emulsion moisture %	63.1 ± 2.35
Emulsion total protein %	22.0 ± 1.14
Emulsion ether extract %	10.9 ± 1.03
Emulsion total ash %	2.63 ± 0.11
Moisture protein ratio	3.02:1
Preparation parameters#	
Cooking loss %	16.4 ± 0.55
Product yield %	83.6 ± 0.55
Diameter shrinkage %	2.94 ± 0.37

Mean ± Standard error.

was thoroughly screened for removing excess fat, tendon, etc. After adequate thawing in ambient temperature, meat was weighed, cut into small chunks and placed in the meat mincer (Stadler Ltd, Mumbai.) . Mincing was done by 10 mm diameter plate and 5 mm diameter plates subsequently. The minced meat was then chopped in a bowl chopper (Stadler Ltd, Mumbai.) and the following recipe was added for preparing duck meat emulsion. The ingredients used for emulsion formulation, emulsion characteristics and preparation parameters of duck patties are tabulated in Table 1.

The molded raw patties were cooked by dry heat cooking in cooking range (Faber Ltd.) . Patties were first cooked at 210°C for 15 min. After 15 min, the patties were turned upside down and cooked at 200°C for 10 more minutes so as to attain the internal temperature of 75 ± 1°C.

The cooked duck patties were cooled at ambient temperature and subjected to analysis study. The pH of comminuted emulsion and patties were measured as per Trout et al. (1992). Emulsion stability (%) of meat emulsion and cooking loss (%) of duck patties were determined as per the method of Baliga and Madaiah (1971). Diameter of patties was measured at six different places both before and after cooking using electronic digital vernier caliper (Biswas, 2002) . Product yield (per cent) of patties was calculated and expressed as percentage by the following formula (Baliga and Madaiah, 1970).

Product yield (%) = Weight of patties after cooking / Weight of product before cooking × 100

Proximate composition

Moisture, fat, protein and ash content were determined using the technique of the association of official analytical chemists (AOAC, 1995).

Microbial analysis

Total viable count (TVC) and total psychrophilic count (TPSC) in the sample was determined as per the method described by APHA (1984).

Sensory evaluation

The samples were cut into small pieces, oil fried in shallow pan (Pal and Agnihotri, 1996) and served warm to six semi trained taste panelists for sensory evaluation. Experienced panelists evaluated the sensory attributes viz. colour, appearance, odour, juiciness, texture, tenderness, flavour and overall acceptability of various duck products using a nine point hedonic scale (9 is extremely desirable and 1 is extremely poor) score card as per the method of Keeton (1983).

Statistical analyses

Data were analyzed by statistical method of one way ANOVA using SPSS$^{@}$ software package developed as per the procedure of Snedecor and Cochran (1968) and means were compared by using Duncan's multiple range test (Duncan, 1955). Correlation coefficients were used to determine relationships among quality parameters and the previously reported (Brady and Penfield, 1981) objective measurement of quality.

RESULTS AND DISCUSSION

Physico-chemical properties

A significant ($P < 0.01$) increase in pH of duck patties was noticed on 2nd day at ambient temperature (Table 2). The rise in pH of sausages stored at ambient temperature might be because of mesophilic bacterial action on the protein molecules due to more alkaline metabolite formation (Bachhil, 1982).

The pH values of duck patties did not reveal any significant difference ($P > 0.05$) between 3 and 7 days at refrigeration storage. Similarly, Sunki et al. (1978) reported that there was no significant change in pH of ground meat and meat products at refrigeration storage upto 7 days. There was a highly significant ($P < 0.01$) decrease in the pH after 7th day at refrigeration storage. The reduction in meat products was due to the growth of psychrophilic gram-positive bacteria especially lactic acid bacteria (Shelef, 1975).

The results revealed that the TBA values of duck rate when compared to that of refrigeration temperature. Cross and Overby (1988) also reported that elevated

Table 2. Mean ± Se values of physico-chemical properties, proximate analysis and microbial parameters of duck patties stored at ambient and refrigeration temperature for different storage periods.

Parameters	0 Day	2 Am	3 Re	7 Re	14 Re	21 Re	S /NS
pH	6.20 ± 0.06^{b}	6.73 ± 0.08^{a}	6.28 ± 0.06^{b}	6.32 ± 0.04^{b}	6.08 ± 0.04^{c}	6.02 ± 0.14^{c}	**
TBA value	0.144 ± 0.02^{c}	0.304 ± 0.02^{a}	0.152 ± 0.01^{c}	0.153 ± 0.01^{c}	0.204 ± 0.02^{b}	0.279 ± 0.05^{a}	**
Tyrosine value (mg/g)	0.362 ± 0.002 ^{e}	0.389 ± 0.003 ^{de}	0.419 ± 0.002 ^{d}	0.505 ± 0.004 ^{c}	0.618 ± 0.007 ^{b}	0.799 ± 0.04 ^{a}	**
Moisture%	57.6 ± 0.86^{a}	53.2 ± 0.81^{cd}	56.6 ± 0.78^{ab}	54.9 ± 0.52^{bc}	53.7 ± 0.61^{c}	51.1 ± 1.06^{d}	**
Total Protein%	23.1 ± 0.52	22.6 ± 0.77	22.9 ± 0.63	22.7 ± 0.41	22.5 ± 0.81	22.1 ± 1.27	NS
Ether extract%	13.5 ± 0.30	12.6 ± 0.65	13.5 ± 0.48	13.6 ± 0.80	13.2 ± 1.28	11.3 ± 1.17	NS
Total Ash%	1.96 ± 0.23	2.50 ± 0.16	2.15 ± 0.21	2.58 ± 0.14	2.34 ± 0.14	2.42 ± 0.32	NS
TVC (log cfu /g)	2.94 ± 0.24 ^{e}	5.39 ± 0.41 ^{a}	3.27 ± 0.17 ^{de}	4.02 ± 0.16 ^{cd}	4.51 ± 0.32 ^{bc}	4.91 ± 0.31^{ab}	**
TPSC (log cfu/g)	2.68 ± 0.14 ^{d}	4.98 ± 0.32 ^{a}	2.71 ± 0.14 ^{d}	3.63 ± 0.05 ^{c}	4.3 ± 0.18 ^{b}	5.16 ± 0.33 ^{a}	**

Am – Samples stored at ambient temperature on respective days, Re - samples stored at refrigeration temperature on respective days, data having same superscriptions are not varying significantly, NA-not acceptable **-highly significant, TVC – total viable count, TPSC – total psychrophilic count.

temperatures will speed the chain propagation reactions of rancidity and accelerate the decomposition of peroxides that lead to higher rate of lipid oxidation. There was no significant difference in the TBA values of duck patties stored at refrigeration temperature on 0 day, 3rd and 7th day. Libby (1975) stated that lowering of the temperature might retard fat rancidity. Price and Schweigert (1970) indicated that rancidity is due to the formation of hydroperoxides (-OOH) during the early stages of autoxidation. They further reported that the hydroperoxides were quite stable at low temperature.

TBA values increased significantly (P < 0.01) with increase in storage period. This observation is in agreement with Brewer et al. (1998) that TBA value increased with increase in storage time. The TBA values increased slightly with increase in refrigerated storage period; however, there was a significant (P < 0.01) increase in TBA values of duck patties only after 7 days of refrigeration storage, which was similar to the findings of Witte et al. (1970). The results revealed a highly significant (P < 0.01) increase in tyrosine value with increase in storage period after 3 days at refrigeration temperature. Eyas (2001) reported that tyrosine value is an indicator of proteolysis and protein degradation and have some degree of correlation with the pH and standard plate count of the product. Tyrosine value of meat increased with storage period until deamination of amino acid limits the formation of free amino acid (Pearson, 1968).

Proximate analysis

There was a significant (P < 0.01) gradual decrease in moisture content of duck patties with increase of storage period at ambient temperature on 2nd day and in refrigeration temperature after 7 days. Arief et al. (1989) stated that loss of moisture was due to evaporation of moisture from meat in chiller. The total protein, ether extract and total ash percent did not show any significant difference in duck patties stored at different temperature and periods. Bhoyar et al. (1997) also reported that there was no significant difference in crude protein of restructured chicken steaks due to refrigerated storage in diffe-rent packaging groups.

Microbial profile

Mean ± S.E values of total viable count (TVC) and total psychrophilic count (TPSC) of duck patties stored at ambient and refrigeration temperature for different storage periods are tabulated in Table 2.

A significant (P < 0.01) increase in TVC values was noticed on 2nd day at ambient temperature. Frazier and Westhoft (1978) stated that at ordinary at ordinary atmospheric temperature, mesophiles would grow well.

The TVC values of duck patties on 2nd day at ambient temperature was significantly (P < 0.01) higher than that of 3.7 and 14 days at refrigeration temperature. Weiser et al. (1978) stated that optimum temperature (30 - 40°C) might cause a rapid multiplication of mesophilic organisms when

Table 3. Mean ± Se values of organoleptic evaluation of duck patties stored at ambient and refrigeration temperature for different storage periods.

Parameters	0 day	2 Am	3 Re	7 Re	14 Re	21 Re	S /NS
Colour	7.33 ± 0.49^{a}	4.67 ± 0.42^{c}	6.67 ± 0.33^{ab}	6.17 ± 0.31^{ab}	5.5 ± 0.43^{bc}	4.67 ± 0.49^{c}	**
Odour	7.67 ± 0.49^{a}	4.83 ± 0.31^{c}	7.17 ± 0.31^{ab}	6.17 ± 0.31^{b}	4.83 ± 0.40^{c}	3.83 ± 0.31^{c}	**
Juiciness	7.67 ± 0.42^{a}	4.67 ± 0.33^{c}	6.17 ± 0.48^{b}	5.83 ± 0.40^{b}	NA	NA	**
Texture	7.33 ± 0.33^{a}	4.5 ± 0.22^{c}	6.83 ± 0.31^{a}	5.83 ± 0.31^{b}	NA	NA	**
Tenderness	7.33 ± 0.33^{a}	4.67 ± 0.33^{c}	6.83 ± 0.31^{a}	5.67 ± 0.33^{b}	NA	NA	**
Flavour	7.67 ± 0.42^{a}	4.67 ± 0.33^{c}	5.83 ± 0.31^{b}	6.50 ± 0.22^{b}	NA	NA	**
Overall acceptability	7.33 ± 0.33^{a}	4.67 ± 0.33^{c}	6.83 ± 0.31^{ab}	6.33 ± 0.33^{b}	NA	NA	**

Am– Samples stored at ambient temperature on respective days, Re - samples stored at refrigeration temperature on respective days data having same superscripts do not differ significantly, NA-not acceptable, ** indicates P< 0.01

compared to lower temperature. Pangas et al. (1998) observed that refrigerated fried chicken gizzard had lower TVC (log 4.30 cfu) than the TVC (log 6.11 cfu) of ambient storage on 7th day. The TVC of duck patties stored in refrigeration temperature did not show significant difference between 0 day and 3rd day. Rao et al. (1999) found that there was no significant change in TVC of smoked duck sausages upto 1 week of refrigeration storage. The results revealed the gradual increase in TVC of duck patties with increase in storage period. This increase in TVC of duck patties with increase in storage periods might be due to multiplication of micro-organisms during storage (Bawa et al., 1988). Similar results have been reported by Mahapatra et al. (1984) [for chicken patties], Kondaiah et al. (1988); Padda (1989) [for goat meat products], Sahoo and Anjaneyulu (1997). In the present study, high TVC values in duck patties were noticed on 2nd day at ambient temperature and 21st day at refrigeration temperature (log 5.39 ± 0.41 cfu/g and log 4.91 ± 0.31 cfu/g) respectively. According to Bureau of Indian standards (1992), aerobic plate count should not be beyond log 4/g in ready-to-eat sausage products. However, the level of total viable counts to the extent of log 5.0/g was considered as the maximum limit for acceptability of the product (Bauemann, 1979) and log 7.0/g was considered as indicative of starting of spoilage (Panda, 1971).

A significant (P < 0.01) increase in TPSC of duck patties was noticed on 2nd day at ambient temperature, which may be due to growth of psychrophilic organisms. Weiser et al. (1978) stated that the higher temperature limit for growth of psychrophilic organisms as 30°C and they also reported that the optimum temperature range for growth of psychrophilic organisms is 15 - 20°C. There was no significant change in TPSC of duck patties on 0 day and 3rd day at refrigeration storage. Pati et al. (1993) reported that there was no significant difference in psychrophilic count of precooked patties upto 5 days at refrigeration storage. The results revealed a significant (P < 0.01) increase in TPSC of duck patties with increase in storage period at refrigeration temperature from 7th day onwards. This similar trend was observed by Bhoyar et al. (1997).

Organoleptic evaluation

Mean ± S.E values of colour, odour, tenderness, juiciness, flavour and overall acceptability of duck patties stored at ambient and refrigeration temperature for different storage periods are tabulated in Table 3.

There was significant (P < 0.01) decrease in colour scores of duck patties on 14th day as compared to 0 day and 21 day as compared to 0, 3 and 7 days at refrigeration temperature. Reddy and Rao (1997) reported that the colour of duck patties decreased significantly with increase in storage period. Biswas (2002) noted that the gradual decrease in colour scores of ground pork patties stored at refrigeration storage might be due to pigment and lipid oxidation resulting in non-enzymatic browning. There was significant (P < 0.01) decrease in odour, juiciness, texture, tenderness, flavour and overall acceptability score of duck patties on 2nd day at ambient temperature and 7th, 14th and 21st days at refrigeration temperature. Eyas (2001) in-dicated that the decreased juiciness might be due to loss of moisture from the product during storage as low density polyethylene packages were permeable to water vapour. The gradual decrease in textural scores might be due to release of moisture (Wu et al., 2000) and depletion of fat during storage (Biswas, 2002).

The lower flavour score might be related to increased malonaldehyde formation due to oxidation of fat, which has detrimental effect on the flavour and firmness of the product (Miller et al., 1980). They also observed a significant decrease on 3rd and 6th day's refrigeration storage and found no significant difference between 3rd and 6th day of refrigeration storage. Deterioration of flavour during storage might be due to microbial growth and oxidative rancidity (Suresh et al., 2003). Biswas (2002) stated that the decrease in overall acceptability scores of pork patties might be due to decrease in the value of other sensory attributes. The results are in congruent with Reddy and Rao (1997) who reported that duck patties could be acceptable

Table 4. Correlation of quality parameters of duck patties stored at ambient and refrigeration temperature for different storage periods (N = 36).

Parameters	PH	TBA	TYR	TPC	TPSC	Colour	Juiciness	Texture	Flavour	Overall
PH	1.000	0.166	-0.394*	0.211	0.213	-0.126	0.479**	0.470**	0.475**	0.485**
TBA	0.166	1.000	0.296	0.746**	0.720**	-0.478**	-0.424*	-0.477**	-0.478**	-0.475**
TYR	-0.394*	0.296	1.000	0.379*	0.567**	-0.413*	-0.829**	-0.835**	-0.822**	-0.822**
TVC	0.211	0.746**	0.379*	1.000	0.735**	-0.709**	-0.519**	-0.526**	-0.538**	-0.508**
TPSC	0.213	0.720**	0.567**	0.735**	1.000	-0.635**	-0.644**	-0.681**	-0.690**	-0.692**
Colour	-0.126	-0.478**	-0.413*	-0.709**	-0.635**	1.000	0.565**	0.464**	0.485**	0.524**
Juiciness	0.479**	-0.424*	-0.829**	-0.519**	-0.644**	0.565**	1.000	0.940**	0.944**	0.962**
Texture	0.470**	-0.477**	-0.835**	-0.526**	-0.681**	0.464**	0.940**	1.000	0.968**	0.963**
Flavour	0.475**	-0.478**	-0.822**	-0.538**	-0.690**	0.485**	0.944**	0.968**	1.000	0.963**
Overall	0.485**	-0.475**	-0.822**	-0.508**	-0.692**	0.524**	0.962**	0.963**	0.963**	1.000

* indicates $P < 0.05$; ** indicates $P < 0.01$.

up to 6 days under refrigeration storage. Pangas et al. (1998) found that overall acceptability of fried chicken gizzard stored under refrigeration was significantly low as com-pared to fresh samples. The results of this study are in agreement with Nath (1992) in chicken patties.

Correlation of quality parameters of duck patties stored at ambient and refrigeration temperature

The statistical analysis of results revealed a significant ($P < 0.05$) negative correlation of pH with tyrosine values and a highly significant ($P < 0.01$) positive correlation with sensory properties like juiciness, texture, flavour and overall acceptability of duck patties (Table 4). Eyas (2001) also noticed a correlation of pH with tyrosine value in the enrobed buffalo meat cutlet. TBA and Tyrosine values of duck patties were positively ($p < 0.01$) correlated with TVC and TPSC values and negatively correlated with colour, juiciness, texture, flavour and overall acceptability of duck patties. The quantitative production of malonaldehyde during oxidation of fat in food is responsible for TBA values correlated with off-flavour, rancidity and flavour deterioration of food and food products (Klose et al., 1959). Several other workers also reported a similar negative correlation between TBA values and sensory flavour score. Several other workers also reported a similar negative correlation between TBA value and sensory panel flavour score (Greene and Cumuze, 1982). A highly significant ($P < 0.01$) negative correlation of TVC values of duck patties with TPSC values and highly significant ($P < 0.01$) positive correlation of TVC values with sensory properties like juiciness, texture, flavour and overall acceptability of duck patties was noticed. The statistical analysis showed a highly significant ($P < 0.01$) correlation between colour, juiciness, texture, flavour and overall acceptability of duck patties. These results are congruent with Arafa and Chen (1976) in chicken products. Shiota et al. (1995) also reported that the flavour of frankfurters is highly correlated with overall acceptability.

Conclusion

The findings revealed a higher rate of decrease in sensory scores of duck patties at ambient temperature than that of refrigeration temperature. During the storage periods, physico- chemical changes and microbial profile of duck patties stored at ambient and refrigeration temperature affect the quality and acceptability of duck patties. It may be concluded that patties prepared from spent duck meat were acceptable up to 7 days at refrigeration temperature.

REFERENCES

AOAC (1995). Official methods of Analysis, 16th Ed. Assoc. of Official Analytical Chemists, Washington, D.C.

APHA (1984). Compendium of Methods for the microbiological examination of foods, 2nd Ed. M.L. Speck, American Public Health Association, Washington, D.C.

Arafa AS, Chen TC (1976). Quality characteristics of convenience chicken products as related to packaging and storage. J. Food Sci., 41: 18-22.

Arief MA, Reddy KP, Reddy VR (1989). Influence of packaging materials and storage periods on certain organoleptic characteristics of broiler cut up parts. Kerala J. Vety. Sci., 20: 107-114.

Bachhil VN (1982). Influence of lower storage temperature on keeping quality of fresh goat meat. Indian Vety. J., 6: 105-106.

Baliga BR, Madaiah N (1970). Quality of sausage emulsion prepared from mutton. J. Food Sci., 35: 607-610.

Baliga BR, Madaiah N (1971). Preparation of Mutton Sausages. J. Food Sci., 36: 607-610.

Bauemann JF (1979). Processing of poultry products with and without sodium nitrite. Food Technol., 33: 42-43.

Bawa AS, Vineet J, Thind SS (1988). Effect of packaging and storage on the quality of chicken sausages containing soy flour. Indian J. Meat Sci. Technol., 1: 79-83.

Bhoyar AM, Pandey NK, Anand SK, Verma SS (1997). Effect of packaging on refrigerated storage stability of restructured chicken steaks. Indian J. Poult. Sci., 32: 259-265.

Biswas AK (2002). Studies on enrobing of pork patties. M. V. Sc. thesis,

Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh, India.
Brady PL, Penfield MP (1981). Textural characteristics of beef: Effects of the heating system. J. Food Sci., 46: 216.
Brewer MS, Mckeith FK, Britt K (1998). Fat, soy and cariageenan effect on sensory and physical characteristics of ground beef patties. Indian J. Food Sci., 57: 1051-1055.
Bureau of Indian Standards(BIS) (1992). Year Book, Bureau of Indian Standards, Manak Bhawan, Bahadur Shah Zafar Marg, New Delhi, India.
Christine M, Crews MG, Ritchey SJ (1982). J. American Dietician Association. 81: 435. Sahoo J (1983). Influence of sex on meaty cut up parts of desi duck carcasses in Kashmir. Indian J. Meat Sci. Technol., 3: 87-91.
Cross HR, Overby AJ (1988). Meat Science, Milk Science and Technology, 1st Ed., Elsevier Science Publishers, B.V. Oxford, New York.
De PN (2001). A study on the quality of spent duck meat with special reference to physico-chemical characters. MVSc thesis, Department of Animal Products Technology and Marketing, West Bengal University of Animal and Fishery Sciences, Kolkata, West Bengal, India.
Duncan DB (1955). Multiple range and multiple F tests. Biometrics, 1: 1-8.
Eyas AM (2001). Studies on development of enrobed buffalo meat cutlets. MVSc thesis, Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh, India.
Frazier WC, Westhoff DC (1978). Food Microbiology, 3rd Ed., Tata McGraw Hill Pub. Co. Ltd., New Delhi, India.
Greene BA, Cumuze TH (1982). Relationship between TBA numbers and in experienced panelists' assessment of oxidized flavour in cooked beef. J. Food Sci., 4: 52-58.
Keeton JT (1983). Effect of fat and NaCl/ phosphate levels on the chemical and sensory properties of pork patties. J. Food Sci., 48: 878-885.
Klose AA, Pool MF, Campbell AA, Hanson HL (1959). Time temperature tolerance of frozen food. Food Technol., 13: 477.
Kondaiah N, Panda B, Anjaneyulu ASR, Singh RP (1988). Utilization of whole meat components from spent Hens for chicken sausage production. Indian J. Poult. Sci., 23: 135-141.
Libby JA (1975). Chemistry of muscle and major organs. In Meat Hygiene, 4th Ed., pp. 239 ,Lea and Febiger, Philadelphia.
Mahapatra CM, Pandey NK, Goyal RC, Verma SS (1984). Use of different binders on the acceptability and composition of chicken patties. Indian J. Poult. Sci., 19: 187-289.
Miller AJ, Ockerman SA, Palumbe SA (1980). Effect of frozen storage on functionality of meat for processing. J. Food Sci., 50: 531-534.
Nath RL (1992). Effects of addition of chicken fat and cooking methods on the quality of chicken patties. MVSc thesis, Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh, India.
Padda GS (1989). Studies on low temperature storage of goat meat and in physiochemical quality for convenience meat products. PhD thesis, Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh, India.
Pal UK, Agnihotri MK (1996). Effect of vegetable oil on the quality of fresh chevon sausages. J. Appl. Anim. Res., 9: 187-191.
Panda PC (1971). Bacteriological condition of dressed chicken during the process of retailing. Indian Vet. J., 48: 927-931.
Pangas TK, Souhdev AK, Ram G, Verma SS (1998). Studies on storage stability of fried chicken gizzard. J. Food Sci. Tech., 35: 419-421.
Pati PK, Anjaneyulu ASR, Kondaiah N (1993). Influence of buffalo fat premix on the refrigerated storage stability of patties. Int. J. Anim. Sci., 8: 249-253.
Pearson D (1968). Application of chemical methods for the assessment of beef quality and methods related to protein breakdown. J. Sci. Food Agric., 19: 357-363.
Price JF, Schweigert BS (1970). By-products. In: The science of meat and meat products, 2nd Ed., p. 559-561, Chapter -13, W.H. Freeman and Company, Sanfransisco.
Rao KH, Anjaneyulu ASR, Singh RRB, Yadav PL (1999). Quality and storage stability of smoked chicken sausages incorporated with milk proteins. Indian J. Poult. Sci., 34: 373-377.
Reddy P, Rao S (1997). Influence of binders and refrigerated storage on certain quality characteristics of chicken and duck meat patties. J. Food Sci. Tech. 34: 446-449.
Sahoo J, Anjaneyulu ASR (1997). Quality improvement of ground buffalo meat by preblending with sodium ascorbate. Meat Sci., 46: 237-247.
Shelef LA (1975). Microbial spoilage of fresh refrigerated beef liver. J. Appl. Bacteriol., 39: 273-280.
Shiota K, Kawahara S, Tajima A, Ogata T, Kawano T, Ito T (1995). Sensory evaluation of beef patties and sausages containing lipids with various component fatty acids. Meat Sci., 40: 363-371.
Snedecor GW, Cochran WG (1968). Statistical methods. 6th Ed., Oxford and IBH Publishing Co. Calcutta.
Staff CE, Darrow MI (1983). Poult. Sci.32,145. Cited by: Sahoo J. Influence of sex on meaty cut up parts of desi duck carcasses in Kashmir. Ind. J. Meat Sci. Technol., 3: 87-91.
Sunki GR, Annapureddy R, Rao DR (1978). Microbial, biochemical and organoleptic changes in ground rabbit meat stored at 5 to 7°C. J. Anim. Sci. 46: 584-588.
Suresh D, Mendiratta SK, Anjaneyulu ASR (2003). Effect of calcium lactate on the quality and shelf life of restructured pork rolls. J. Meat Sci., 1: 1-6.
Trout ES, Hunt NC, Johnson DE, Claus JR, Kastner CL, Kropf DH (1992). Chemical, physical and sensory characterization of ground beef containing 5 to 30 % fat. J. Food Sci., 57: 25-29.
Weiser HH, Mountney GJ, Gould WA (1978). Practical food micro-biology and Technology, 1st Ed., p. 69-78, Chapter- 5, The AVI publishing company, INC, Westport.
Witte VC, Krause GF, Bailey ME (1970). A new extraction method for determining 2-Thiobarbituric acid values of pork and beef during storage. J. Food Sci., 35: 582- 585.
Wu Y, Rhim JW, Wellu CL, Hamouz F, Cuppett S, Schnepe M (2000). Moisture loss and lipid oxidation for precooked beef patties stored in edible coatings and films. J. Food Sci., 65: 300-304.